December 18, 2017

Ms. Kirsten Walli
Ontario Energy Board
2300 Yonge Street, 27th Floor
Toronto, ON
M4P 1E4

Dear Ms. Walli:

Re: EB-2017-0323 - Union Gas Limited - 2015 Disposition of Demand Side Management Deferral and Variance Accounts

Enclosed is the application and evidence submitted by Union Gas Limited ("Union") concerning the final disposition and recovery of certain 2015 year-end deferral and variance account balances.

Union proposes that the impacts which result from the disposition of the deferral and variance account balances be implemented on April 1, 2018 to align with other rate changes implemented through the Quarterly Rate Adjustment Mechanism ("QRAM").

If you have any questions concerning this application and evidence please contact me at (519) 436-4558.

Yours truly,

[*Original Signed by*]

Adam Stiers
Manager, Regulatory Initiatives

cc: Myriam Seers (Torys)
EB-2015-0276 Intervenors

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c.15 (Schedule. B);

AND IN THE MATTER OF an Application by Union Gas Limited for an order or orders clearing certain non-commodity related deferral accounts;

APPLICATION

1. Union Gas Limited ("Union") is a business corporation, incorporated under the laws of Ontario, with its head office in the Municipality of Chatham-Kent.

2. Union conducts an integrated natural gas utility business that combines the operations of selling, distributing, transmitting, and storing gas within the meaning of the *Ontario Energy Board Act, 1998* (the "Act").

3. In EB-2013-0202, Union applied to the Ontario Energy Board (the "OEB") for an order approving or fixing just and reasonable rates and other charges for the sale, distribution, storage and transmission of gas by Union effective January 1, 2014. The OEB approved Union's request. In doing so, the OEB approved the continuation of certain deferral accounts.

4. Union applies to the OEB for the approval of final balances for all 2015 DSM deferral accounts as listed in Exhibit A, Tab 3, Appendix A, Schedule 1 and an order for final disposition of those balances.

5. Union also applies to the OEB for such interim order or orders approving interim rates or other charges and accounting orders as may, from time to time, appear appropriate or necessary.

6. Union further applies to the OEB for all necessary orders and directions concerning pre-hearing and hearing procedures for the determination of this application.

7. This application is supported by written evidence. This evidence may be amended, from time to time, as required by the OEB or as circumstances may require.

8. The persons affected by this application are the customers resident or located in the municipalities, police villages, and First Nations reserves served by Union, together with those to whom Union sells gas, or on whose behalf Union distributes, transmits or stores gas. It is impractical to set out in this application the names and addresses of such persons because they are too numerous.

9. The address of service for Union is:

Union Gas Limited

P.O. Box 2001
50 Keil Drive North
Chatham, Ontario
N7M 5M1

Attention: Adam Stiers
Manager, Regulatory Initiatives

Telephone: (519) 436-4558

Fax: (519) 436-4641

- and -

Torys LLP

Suite 3000, Maritime Life Tower
P.O. Box 270
Toronto Dominion Centre
Toronto, Ontario
M5K 1N2

Attention: Myriam Seers

Telephone: (416) 865-7535

Fax: (416) 886-7154

DATED: December 18, 2017

UNION GAS LIMITED

[Original signed by]

Adam Stiers
Manager, Regulatory Initiatives

2015 DSM DEFERRAL AND VARIANCE ACCOUNT DISPOSITION

REQUESTED APPROVALS

Union Gas Limited ("Union") is applying to the Ontario Energy Board (the "Board" or "OEB") for approval to dispose of the 2015 balances in its Demand Side Management ("DSM") deferral and variance accounts. Please see Table 1 below for the DSM deferral accounts and corresponding balances. Union proposes to dispose of the "audit adjusted" balances (as provided in Table 1). The audit adjusted balances reflect the final audited DSM amounts, adjusted to remove the incomplete and ongoing commercial and industrial Custom Project Net to Gross ("NTG") study (the "NTG Study") results from 2015 DSM results.[1] The term audit adjusted in this evidence refers to the fact that Union supports the application of the OEB Staff-coordinated 2015 DSM audit or evaluation, measurement and verification ("EM&V") results with the exception of the incomplete and ongoing NTG Study results. Union's 2015 DSM Final Annual Report reflects the audit adjusted balances and can be found at Exhibit B, Tab 1.

Union believes it is inappropriate to retroactively apply the incomplete and ongoing NTG Study results to 2015 DSM program results, it is also contrary to what the OEB stated in its Decision and Order on the 2015-2020 DSM Plan. Detailed justification for Union's position on the 2015 DSM program EM&V results is provided in Exhibit A, Tab 2. For comparative purposes, and in accordance with Section 11.0 of the OEB's 2015-2020 Demand Side Management Filing

[1] The NTG Study results are reflected in the 2015 DSM Annual Verification Report at Exhibit B, Tab 2, p. 7, Table 1-1.

Guidelines (the “Guidelines”), Union has also provided the 2015 DSM Annual Verification Report at Exhibit B, Tab 2,[2,3] audited DSM balances at Exhibit A, Tab 3, Appendix B, and the allocation of the audited DSM balances at Exhibit A, Tab 4, Appendix B.

Table 1

2015 Audit Adjusted DSM Deferral Accounts and Balances

Account No. and Name	**Balance ($000s)**
179-75 Lost Revenue Adjustment Mechanism (“LRAM”)	$0.617
179-111 Demand Side Management Variance Account (“DSMVA”)	($0.195)
179-126 Demand Side Management Incentive Deferral Account (“DSMIDA”)	$7.472
Total 2015 DSM Deferral Account Balances	$7.895

The net balance in these accounts is a debit of $7.895 million for collection from ratepayers. The deferral and variance account balances relate primarily to DSM activities in 2015.[4] Although the current DSM Framework covers 2015-2020, 2015 was considered a transition year (see Tab 2, pp. 8-11).

[2] Section 11.0, p. 37 of the Guidelines states *the natural gas utilities should apply annually for the disposition of any balances in their LRAMVA and DSMVA and, if applicable, apply for a shareholder incentive amount associated with the previous DSM program year and disposition of any resulting DSMIDA balance. This application should include the final results as outlined in the Final Evaluation and Audit Reports, and information setting out the allocation across rate classes of the balances in the LRAMVA, DSMVA and DSMIDA.*
[3] Union understands that a revised version of the 2015 DSM Annual Verification Report will be issued to reflect corrections to errors discovered in the original version issued October 16, 2017.
[4] The LRAM account balance includes volume variances related to 2014 audited results at 2015 rates. This is discussed in further detail in Exhibit A, Tab 3, pp. 2-4.

1. THE 2015 DSM EVALUATION AND AUDIT PROCESS

Union's concerns with the 2015 DSM EM&V process and results are detailed in Exhibit A, Tab 2 and are summarized below:

The 2015 DSM EM&V process and results inappropriately apply the results of the Evaluation Contractor's incomplete and ongoing commercial and industrial Custom Project NTG Study to Union's 2015 DSM program results retroactively - Union argues that applying new NTG adjustment factors resulting from an incomplete and ongoing NTG Study retroactively to Union's 2015 DSM program results creates regulatory instability and unpredictability. Union received support from the OEB that 2015 DSM program results should be evaluated based on the same input assumptions and NTG adjustment factors used for setting its OEB-approved 2015 targets (2014 assumptions and factors) in order to determine the 2015 DSM incentive.[5] Directing the EC to apply NTG Study adjustment factors retroactively: is incongruent with the logic of the DSM incentive formula which is meant to compare targets to actuals using consistent input assumptions and NTG adjustment factors; is inconsistent with the scope of the NTG Study Request for Proposal ("RFP");[6] and, it relies upon an incomplete and ongoing NTG Study. These actions run counter to regulatory efficiency and stability. Union's position on this was well established in its submission on this subject as part of the consultation process for the 2015-2020 DSM Framework, and remains relevant today:[7]

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[5] EB-2015-0029 Decision and Order, January 20, 2016, pp. 74-75.
[6] See Exhibit A, Tab 2, Appendix B.
[7] EB-2014-0134 – Developing a New Demand Side Management Framework for Natural Gas Distributors – Union Gas Limited Submission, October 15, 2014, p. 38.

> *"The Board has outlined changes to the evaluation and audit process based on what it believes will provide the required confidence to ensure regulatory efficiency and provide for a stable and predictable regulatory process for all stakeholders. Ensuring credibility in the evaluation, verification and audit is critical to instill confidence and stability, and remove uncertainty for the Board, stakeholders and the utilities. Clarity and predictability will further ensure DSM results, and any associated DSM incentive, can factor into the company's value on energy efficiency against competing priorities in a meaningful way.*
> *If the Board determines that a greater level of involvement in the evaluation and audit process is required to meet these objectives, the role of the Board, the Auditor, the utilities and stakeholders must be clearly defined to ensure transparency and clarity in accountabilities. In establishing the process, the Board should provide for clear and enforceable roles and responsibilities."*

The 2015 DSM EM&V process lacks the collaboration, transparency, and predictability claimed by the OEB as justification for assuming control of the process – Collaboration and transparency are lacking in the 2015 EM&V process in part due to the absence of a clearly defined role for OEB Staff which has resulted in EM&V process shortfalls. Examples of such shortfalls in the EM&V process began at the outset when the independent third-party consultant DNV GL was hired to be the EC without any Evaluation Advisory Committee ("EAC") member consultation or consideration. Shortfalls in the EM&V process continued when the EC withheld the sample of projects being used as the basis for its conclusions, and again when OEB Staff comments on the savings verification reports were provided to the EC but not the EAC. At the deemed conclusion of the 2015 EM&V process more shortfalls were apparent when OEB Staff directed the EC to apply the results of the incomplete and ongoing NTG Study retroactively and to adopt a proxy 3.4% Spillover value. Shortfalls persist beyond the 2015 EM&V process with the utilities not being supplied the supporting information required to accurately forecast, accrue and track EM&V related costs.

The 2015 DSM EM&V process is delayed and not aligned with the Scope of Work – The approximate one year delay of the EM&V results is excessive and is in part due to the prolonged time taken to finalize the EM&V Plan, and excessive project sampling relative to prior audits for the 2015 Custom Project Savings Verification ("CPSV") Process. As a result of this lack of EM&V process efficiency, Union's customers will bear the burden of disposition of 2015 deferral balances no sooner than in 2018. Further, the EC deviated from the NTG Study scope of work dated December 14, 2016 ("Scope of Work") and work plan by not incorporating its findings on Secondary Attribution, and by neglecting to conduct interviews of utility Account Managers prior to launching the NTG survey (in-field).[8] These actions erode confidence in the EM&V process and results as currently managed.

To address these concerns, and in the interest of continuous improvement, Union requests that the OEB make the following determinations as detailed in Exhibit A, Tab 2, Section 3:

- Approve the deferral balances as outlined in Table 1;

[8] See Exhibit A, Tab 2, Appendix D.

- Direct the EC to update the NTG Study findings to include Secondary Attribution and Participant Spillover results;
- Direct the EAC to develop a formal EAC Charter; and,
- Facilitate a more expeditious EM&V process beginning with the 2016 EM&V process.

2. 2015 DSM PROGRAM RESULTS

In accordance with Union's recommendations above, Union's 2015 audit adjusted DSM results include OEB-approved 2014 NTG adjustment factors. These results are presented at Exhibit A, Tab 3, Appendix A, Schedule 1. Union requests that the OEB approve the 2015 audit adjusted results as presented on the basis of the arguments summarized above and described in further detail herein. Table 2 below provides Union's 2015 pre-audit, audited, and audit adjusted amounts for comparison. Union's 2015 audited DSM results are presented at Exhibit A, Tab 3, Appendix B, Schedule 1.

Table 2

2015 DSM Results ($ Millions)

	2015 Pre-Audit Results[9]	2015 Audited Results[10]	2015 Audit Adjusted Results[11]
LRAM	$0.613	$0.602	$0.617
DSMVA	($0.195)	($0.195)	($0.195)
DSMIDA	$7.548	$7.040	$7.472
TOTAL	$7.966	$7.447	$7.895

The allocation to rate classes and unit rates for disposition of the audit adjusted DSM deferral and variance account balances is provided at Exhibit A, Tab 4, Appendix A, Schedule 1 and Schedule 2. Union proposes to dispose of the account balances with the first available Quarterly Rate Adjustment Mechanism ("QRAM") following OEB approval. For purposes of calculating bill impacts, Union assumes implementation with the April 2018 QRAM.

The evidence supporting the requested approvals is organized as follows:

Exhibit A

Tab 1 Requested Approvals

Appendix A – Glossary of Terms

[9] 2015 Demand Side Management Draft Annual Report, April 22, 2016.
[10] 2015 Natural Gas Demand Side Management Annual Verification, October 12, 2017. – *Includes revised Free Ridership and Spillover findings from incomplete and ongoing NTG Study.*
[11] 2015 Natural Gas Demand Side Management Annual Verification, October 12, 2017. – *Excludes revised Free Ridership findings and proxy Spillover value from incomplete and ongoing NTG Study. These are the basis for Union's deferral account application and evidence.*

Tab 2	2015 Evaluation, Measurement and Verification		
	Appendix A – Evaluation Advisory Committee Charter		
	Appendix B – Technical Evaluation Committee NTG Study Request for Proposal		
	Appendix C – Technical Evaluation Committee NTG Study Scope of Work		
	Appendix D – OEB NTG Study and CPSV Scope of Work		
	Appendix E – Net-to-Gross Policies Jurisdictional Review		
Tab 3	2015 DSM Deferral and Variance Account Balances		
	Appendix A –	Schedule 1 – 2015 Audit Adjusted Deferral Account Balances	
		Schedule 2 – 2015 Audit Adjusted LRAM	
		Schedule 3 – 2015 Audit Adjusted DSMVA	
		Schedule 4 – 2015 Audit Adjusted DSMIDA	
	Appendix B –	Schedule 1 – 2015 Audited Deferral Account Balances	
		Schedule 2 – 2015 Audited LRAM	
		Schedule 3 – 2015 Audited DSMVA	
	`	Schedule 4 – 2015 Audited DSMIDA	
Tab 4	Allocation and Disposition of 2015 DSM Balances		
	Appendix A –	Schedule 1 – 2015 Audit Adjusted Allocation	
		Schedule 2 – 2015 Audit Adjusted Unit Rates	
		Schedule 3 – 2015 Audit Adjusted Bill Impacts	
	Appendix B –	Schedule 1 – 2015 Audited Allocation	
		Schedule 2 – 2015 Audited Unit Rates	
		Schedule 3 – 2015 Audited Bill Impacts	

Exhibit B

Tab 1 2015 DSM Final Annual Report

Tab 2 2015 Natural Gas DSM Annual Verification

Tab 3 2015 Audit Summary Report

GLOSSARY OF TERMS

The glossary serves as a reference for the benefit of stakeholders in their overall understanding of the DSM terminology in Union's evidence. It is intended to provide guidance to a broad audience, recognizing that more detailed definitions may apply to specific terms when used by DSM practitioners.

Audit The audit is an annual Evaluation, Measurement and Verification ("EM&V") process to assess the results of Union's DSM results. OEB Staff is responsible for retaining the auditor, also known as the Evaluation Contractor ("EC"), whom ultimately serves to protect the interests of ratepayers with respect to Union's DSM claims.

Audit Committee ("AC") In the previous framework, the AC ensured an effective and thorough audit of the utilities' DSM results each year. Each utility had a respective AC that consisted of three intervenor members and one utility representative. The ACs have been replaced by the Evaluation Advisory Committee ("EAC") as part of the 2015-2020 evaluation governance structure.

Custom DSM Project A custom DSM project is a natural gas savings project that is based on customer-specific information and considerations, and includes new capital equipment and O&M energy savings measures.

Custom Project Savings Verification ("CPSV") The annual process by which the gross savings estimates of Union's custom DSM projects are verified. A statistically significant sample of low-income, commercial/industrial, and large volume custom projects are verified by a third party consultant.

Demand Side Management ("DSM") DSM is the modification in end-use customer demand for natural gas through conservation programs. While the focus of Union's DSM is natural gas savings and the reduction in greenhouse gases emissions, it may also result in the saving of a number of other resources such as electricity, water, propane, and heating fuel oil.

Demand Side Management Incentive Deferral Account ("DSMIDA") The account to record the DSM shareholder incentive amount earned by Union as a result of its DSM programs.

Demand Side Management Variance Account ("DSMVA") The account used to track the variance between actual DSM spending by rate class versus the budgeted amount included in rates by rate class. Union may record in the DSMVA in any one year, a variance amount of no more than 15% above its DSM budget for that year.

DSM Shareholder Incentive The incentive available to Union for achieving OEB-approved performance targets.

Evaluation Advisory Committee ("EAC") As part of the new 2015-2020 evaluation governance structure, the EAC provides input and advice to OEB Staff on the evaluation and audit of DSM results. The EAC consists of representatives from Union, Enbridge, non-utility stakeholders, independent experts, staff from the Independent Electricity System Operator ("IESO"), and observers from the Environmental Commissioner of Ontario and the Ministry of Energy ("MOE"), all working with OEB Staff. The EAC replaces the ACs and TEC from the previous framework.

Evaluation Contractor ("EC") As part of the new 2015-2020 evaluation governance structure, the EC is a third party who carries out the evaluation and audit processes of Union's DSM programs. The EC, also known as the auditor, is retained by OEB Staff.

Evaluation, Measurement & Verification ("EM&V") EM&V is the collection of methods and processes used to assess the implementation and performance of energy efficiency activities. The main objective of EM&V is to assess the performance of a program and to measure (through data collection, analysis, and reporting of data) and verify program impacts to ensure the expected level of savings are being achieved. EM&V data, in addition to various evaluation studies, such as Net-to-Gross ("NTG")or persistence studies, inform recommendations for improvements in program performance.

Free Ridership Free Riders are program participants who would have installed the energy efficient measure without the influence of Union's DSM programs. Free Ridership is not a binary concept and consequently, different levels of Free Ridership exist.
Free Rider rates are estimated based on research, market penetration studies, through negotiations in prior evaluation processes or by surveying participants. The Free Rider rates are applied to the gross program savings results to derive savings generated by the program.

Input Assumptions Assumptions such as operating characteristics and associated units of resource savings for DSM technologies and measures. These cover a range of typical DSM activities, measures and technologies with residential, commercial and industrial applications.

Lifetime Cumulative cubic meters ("cumulative m3") Total natural gas savings over the effective useful life of a DSM measure. Frequently used at the measure or program level and can also summarize the benefits of an entire portfolio.

Lost Revenue Adjustment Mechanism ("LRAM") The LRAM is the OEB's approved method by which utilities recover the lost distribution revenues associated with DSM activity.

Measure A measure is any particular energy efficient technology (e.g. a low-flow showerhead, an energy recovery ventilator, condensing boiler, etc.).

Net-to-Gross ("NTG") Ratio Gross impacts are the program impacts prior to accounting for program attribution effects. These effects include Free Ridership and Spillover. Net impacts are the program impacts once program attribution effects have been accounted for. The NTG Ratio is defined as [(1 – Free Riders) x (1 – Spillover Effects)].

Offering A DSM offering exists where there are either bundles of energy efficiency measures or performance/maintenance based enhancements to existing measures marketed together (e.g. energy savings kits, home retrofit measures, custom equipment/process/O&M) or where support is delivered through a suite of services (e.g. customer engagement, site energy assessments, etc.).

Participants The units used by Union to measure participation in its DSM programs. Participant units of measurement may include customers, projects and measures or technologies installed depending on the metric. Not all participants result in energy savings.

Prescriptive Offering A prescriptive DSM offering includes natural gas savings from various measures/technologies that are based on previously substantiated and pre-approved inputs. Prescriptive DSM measures apply to all of Union's customer market segments including residential, low-income, commercial and industrial.

Program A program is the utility specific approach to providing one or more DSM offerings to customers.

Realization Rate A realization rate compares verified audited results for a sample of custom projects with the original savings claimed. This rate is then used to adjust the savings for the full population of custom projects to reflect the sample.

Resource Acquisition Programs that seek to achieve direct, measurable savings customer-by-customer through the incenting/promotion of specific energy efficiency upgrades.

Spillover Spillover effects refer to customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program.

Technical Evaluation Committee ("TEC") In the previous framework, the TEC established DSM technical and evaluation standards for the natural gas utilities in Ontario. The TEC consisted of seven individuals: three intervenors members, a representative from Union, a representative from Enbridge, and two independent members with technical and other relevant expertise. The TEC has been replaced by the EAC as part of the 2015-2020 evaluation governance structure.

2015 DSM DEFERRAL AND VARIANCE ACCOUNT DISPOSITION

2015 EVALUATION, MEASUREMENT AND VERIFICATION

The purpose of this evidence is to outline Union's concerns with the 2015 DSM EM&V process. As a result of Union's concerns, this application and evidence reflects all 2015 EM&V results with the exception of incomplete and ongoing NTG Study findings. Based on these concerns, Union has also provided recommendations for continuous improvement of the EM&V process going forward for the 2016 DSM program and beyond. Union's three primary concerns with the OEB Staff-coordinated 2015 DSM EM&V process and results are:

1. The retroactive application of the results of the EC's incomplete and ongoing commercial and industrial Custom Project NTG study ("NTG Study") to Union's 2015 DSM program results;
2. The lack of efficiency, collaboration, transparency, stability and predictability in the coordination of the 2015 EM&V process; and,
3. EC work deliverables deviated from the Scope of Work, led to delays, and contributed to customer complaints.

This exhibit of evidence is organized as follows:

1. 2015 DSM Evaluation, Measurement and Verification Process Background
    - 1.1 August 21, 2015 OEB Letter of Direction
    - 1.2 March 4, 2016 OEB Letter of Direction
2. 2015 OEB Staff-Coordinated EM&V Process
    - 2.1 Retroactive Application of the Incomplete and Ongoing NTG Study to 2015 DSM Program Results
    - 2.2 Lack of Efficiency, Collaboration, Transparency, Stability, and Predictability in the 2015 EM&V Process
    - 2.3 EC Work Deliverables Deviated From the Scope of Work, Led to Delays, Contributed to Customer Complaints, and Did Not Follow NTG Best Practices
3. Conclusions and Recommendations for Continuous Improvement

This evidence supports the arguments outlined above, identifies opportunities for continuous improvement of the OEB Staff-coordinated EM&V processes as it transitions from Union and Enbridge Gas Distribution Inc. (“EGD”) to OEB Staff, and provides recommendations for the OEB’s consideration as OEB Staff coordinates future EM&V processes for the 2016 DSM program and beyond.

1. 2015 DSM Evaluation, Measurement and Verification Process Background

In the OEB's Guidelines, the OEB stated that:[1]

> "*the Board will take on the coordination function of the EM&V process*."

In the Demand Side Management Framework for Natural Gas Distributors (2015-2020) (the "Framework"), the OEB added that the OEB:[2]

> "*is in the best position to coordinate the evaluation process throughout the DSM framework period (i.e., 2015 to 2020). A process coordinated by the Board, in collaboration with the gas utilities, and supported by stakeholders with technical expertise, will be one that results in a thorough evaluation of DSM programs in an efficient manner*. *By taking on a larger role in the EM&V process, the Board will consult and seek expert opinion from both the gas utilities and stakeholders as appropriate. In addition, the Board expects to provide input on evaluation methodologies and help ensure that the operational characteristics of the programs will generate the data required to undertake robust and accurate evaluations. The Board will contribute in the annual evaluation process to confirm that the program impacts have been appropriately identified and to verify that programs have resulted in the intended benefits and to inform future program design and delivery.*"

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[1] EB-2014-0134, Filing Guidelines to the Demand Side Management Framework for Natural Gas Distributors (2015-2020), p. 15.
[2] EB-2014-0134, Report of the Board, DSM Framework for Natural Gas Distributors (2015-2020), Section 7.2.

Following the issuance of the Framework and Guidelines, the OEB issued the following two letters of direction related to the EM&V guidance noted above, the first was issued in August 2015 and the second was issued in March 2016. These letters are explained in detail below.

1.1 AUGUST 21, 2015 OEB LETTER OF DIRECTION[3]

This letter established the OEB's governance structure to evaluate the results of DSM programs from 2015 to 2020. It defined the roles of OEB Staff (acting on behalf of the OEB), the EC, the natural gas utilities and the EAC, and explained the formation of the EAC. The letter also explains the transition of EM&V accountabilities from the Technical Evaluation Committee ("TEC") and respective utility Audit Committees to the EAC. The letter laid out the OEB's evaluation governance structure and the EC's responsibilities. The letter noted that the EC was expected to draft an EM&V Plan for the utilities' DSM programs for approval by OEB Staff. The EM&V Plan was to take into consideration advice and input provided by the EAC. The letter further noted that the EC will be responsible for: auditing the utilities' annual DSM results based on the three-year OEB Staff-approved EM&V plan, reviewing and proposing updates to OEB Staff related to data within the Technical Reference Manual ("TRM") on an annual basis, and conducting multi-year impact assessments and targeted evaluations of selected natural gas DSM programs throughout the 2015 to 2020 DSM period.

[3] EB-2015-0245 OEB Letter, 2015-2020 DSM Evaluation Process of Program Results, August 21, 2015.

In the letter, the OEB stated that the EAC was established to provide input and advice as required throughout the DSM EM&V process noted above and explained that the EAC would be comprised of:[4]

- Experts representing non-utility stakeholders, with demonstrated experience and expertise in the evaluation of DSM technologies and programs, natural gas energy efficiency technologies, multi-year impact assessments, net-to-gross studies, Free Ridership analysis and natural gas energy efficiency persistence analysis;
- Expert(s) retained by the Board;
- Representatives from the Independent Electricity System Operator;
- Representatives from each natural gas utility;
- Representatives from the Ministry of Energy and the Environmental Commissioner of Ontario, who will participate as observers; and,
- Intervenor representatives on behalf of School Energy Coalition, Green Energy Coalition, and Building Owners and Managers Association.

In the letter the OEB recognized that there was a utility-coordinated evaluation process underway that was supported by three committees: the TEC and two Audit Committees (one for each utility). The OEB letter clarified that once an EC was retained, OEB Staff would work with the

[4] EB-2015-0245 OEB Letter, 2015-2020 DSM Evaluation Process of Program Results, August 21, 2015, p.5.

TEC on an appropriate plan to transition to the new framework on a go-forward basis. With the formation of the EAC, separate utility Audit Committees would no longer be required.

1.2 MARCH 4, 2016 OEB LETTER OF DIRECTION[5]

This letter clarified the transition of DSM evaluation activities into the new Framework. Prior to the creation of the EAC, there were a number of evaluation projects already underway including the completion of a Commercial and Industrial Custom Project Net-to-Gross Study that needed to be transitioned from the TEC to the EAC. The letter explained that the EC (who had been hired as the consultant conducting the NTG Study prior to becoming the EC) was in the process of developing a detailed scope of work. The OEB explained that going forward the utilities should continue to manage the contractual obligations and costs associated with the NTG Study while OEB Staff assumed responsibility for its oversight. Transition plans were also provided for TRM Development, a Boiler Baseline Study, and a Persistence Study. These transitions have occurred and the TEC has been discontinued.

2. 2015 OEB STAFF-COORDINATED EM&V PROCESS

In April 2016, the EC was selected, with no EAC or utility collaboration, to audit the utilities' respective 2015 portfolios of DSM programs. The 2015 EM&V process took 19 months to complete. This is approximately nine months longer than the duration of historical utility-

[5] EB-2015-0245 OEB Letter. 2015-2020 Transition of Technical Evaluation Committee Activities to the OEB, March 4, 2016.

coordinated audits, despite the fact that historical processes were subjected to the scrutiny of consensus-based Audit Committees on all aspects of the audit, including selection of the auditor. The EC's Final 2015 Natural Gas Demand Side Management Annual Verification Report ("Final Audit Report") was released to the utilities on October 16, 2017, 22 months after the close of the utilities' 2015 program year (see Exhibit B, Tab 2).

The application of incomplete and ongoing NTG Study results within the EC's Final Audit Report is inconsistent with the original and revised OEB Decision and Order on Union's 2015-2020 DSM Plan. The 2015 EM&V process lacked the collaboration, transparency, and predictability intended by the OEB and the regulatory efficiency and stability expected by Union. Lastly, the EC work deliverables deviated from the Scope of Work, led to delays, and contributed to customer complaints. Each of these issues and associated recommendations are discussed below.

2.1 RETROACTIVE APPLICATION OF THE INCOMPLETE AND ONGOING NTG STUDY TO 2015 DSM PROGRAM RESULTS

The audit adjusted $7.472 million DSM incentive claimed in this Application uses a 46% custom program NTG adjustment factor (please see Exhibit A, Tab 3, Appendix A, Schedule 4). Use of this factor to calculate DSM incentive amounts is appropriate and consistent with the original and revised OEB Decision and Order on Union's 2015-2020 DSM Plan. In contrast, the audited DSM incentive amount is inconsistent, because it:

a) Does not reflect the original and revised OEB Decision and Order;

b) Calculates 2015 audited DSM program results using different NTG factors than those used to calculate the OEB-approved 2015 targets;

c) Is inconsistent with the scope of the original NTG Study Request for Proposal; and

d) Uses results from the incomplete and ongoing NTG Study.

a) Inconsistency with OEB Decision and Order

Inconsistency in the interpretation of the Framework and the OEB's Decision and Order regarding application of the results of the NTG Study arose in a number of instances as explained below.

The principal example of Union's understanding of the appropriate manner to apply NTG results is explained in the OEB's revised Decision and Order in response to Union's written comments:[6]

> *"Union interpreted the OEB's Decision to mean that input assumptions and net-to-gross adjustment factors are finalized for a given year based on the previous year's final DSM audit.*
>
> *Decision*
>
> *The OEB confirms that Union's interpretation is correct."*

[6] EB-2015-0029 Decision and Order, February 24, 2016, p.3.

It is logical to conclude from the example above that the appropriate NTG assumptions to be applied to the 2015 DSM program year are those that were drawn from the 2014 EM&V results. However, while the OEB held that it does not expect the gas utilities to rely on predetermined NTG adjustment factors, it directed the NTG Study result to be updated in 2016 and effective for the 2017-2020 DSM program years.[7]

> *"The OEB does not expect the gas utilities to rely on a predetermined free ridership rate for the duration of the 2017 to 2020 term. In 2016, the free rider rates will be updated based on the results of the net-to-gross study and the annual evaluation process. Annually, the evaluation process will continue to inform the free rider rates for custom programs."*

The treatment of the 2015 DSM program year separately from 2017-2020 is consistent with 2015 being a transition year of the 2012-2014 Framework. As per the 2015-2020 Framework:[8]

> *"The gas utilities should roll-forward their 2014 DSM plans, including all programs and parameters (i.e., budget, targets, incentive structure) into 2015. Both Enbridge and Union requested that their 2014 activities be rolled forward into 2015 to help facilitate a smooth evolution into the new DSM framework."*

> *"The Board agrees this is appropriate and will allow the gas utilities to fully consider the new DSM framework and appropriately develop their DSM portfolio and suite of*

[7] EB-2015-0029 Decision and Order, January 20, 2016, p. 21.
[8] EB-2014-0134, DSM Framework, p.34.

> *programs that will make up their new multi-year plans…The Board expects the gas utilities' new multi-year DSM plans will fully address the guiding principles and key priorities outlined in the framework."*

Considering the timeline of the 2015-2020 DSM proceeding, Union reiterates that it is appropriate to consider 2015 separately as a transition year, since the OEB's Decision with respect to the 2015-2020 DSM Plans was not received until after the 2015 DSM program year was complete.

- **December 2014 –** The 2015-2020 Framework and Guidelines were released.
- **April 2015 –** The 2015-2020 DSM Plan was filed.
- **January 20, 2016 –** The original OEB Decision and Order on the 2015-2020 Plan was released.
- **February 24, 2016 –** The revised OEB Decision and Order on the 2015-2020 Plan was released.

The 2015-2020 DSM Plan proceeding extended well beyond the point where Union could be reasonably expected to incorporate guidance arising from the resulting OEB Decision and Order into its 2015 DSM program design and delivery. The timing of these items supports the decision to treat 2015 separately from 2016 and by extension supports the application of the NTG Study in 2016 for 2017-2020 DSM program results rather than to 2015 DSM program results.

b) <u>2015 Input Assumptions for Program Results and Targets Should Align</u>

When establishing its new multi-year DSM plan (2015-2020), Union endeavoured to balance and consider: meeting the needs of its ratepayers, fulfilling the OEB's request to enable and to incorporate the priorities and guiding principles outlined in the Framework, responding to input received from stakeholders, and adherence to a reasonable total cost impact for its customers.[9] Union sought clarification regarding target setting in the 2015-2020 DSM plan proceeding. In its Decision and Order, the OEB offered the following clarification:[10]

> *"To calculate next year's targets, the OEB directs the utilities to use the new, updated input assumptions and net-to-gross factors that are the result of the annual evaluation process. The OEB finds it appropriate to use the best available information to determine subsequent targets for prescriptive programs."*

Union's approach to setting its 2015 targets was consistent with this direction as it used input assumptions that were the result of the 2014 program EM&V. Specifically, Union used 2014 post-audit results, including the 46% NTG adjustment factor for Union's Commercial Industrial ("CI") and Large Volume custom programs, to establish its 2015 targets.

Union asserts that it was reasonable and consistent with the OEB Decision and Order on the 2015–2020 DSM Plans for Union to apply a 46% custom program NTG adjustment rate when setting its 2015 targets. Similarly, it is reasonable and consistent for Union to apply a 46% NTG adjustment rate when calculating its 2015 DSM program results and DSM incentive amounts as

[9] EB-2015-0029 Cover Letter, p.1.
[10] EB-2015-0029 Decision and Order, January 20, 2016, p. 74.

presented in Exhibit A, Tab 3, Appendix A, Schedule 4. This was supported in the revised OEB Decision and Order on the 2015–2020 DSM Plans in response to Union's written comments on the original OEB Decision and Order. Union's written comments stated:[11]

> *"Consistent with the Board's previous EB-2006-0021 Decision, Union interprets the above to mean that input assumptions and net-to-gross adjustment factors are finalized for a given year based on the previous year's final DSM audit. By way of example, upon the completion of the 2016 audit in June 2017, the best available input assumptions and net-to-gross adjustment factors used to determine the 2016 LRAM results will be used to determine the 2017 scorecard targets and the final 2017 savings results for the purpose of determining the 2017 DSM Incentive. This process ensures that targets and achievements are based on the same set of input assumptions and net-to-gross adjustment factors."*
>
> *"Given that the Board's Decision is effective for 2015 and based on the process outlined above, Union's 2015 results for the purpose of determining the 2015 DSM Incentive will be based on the same input assumptions and net-to-gross adjustment factors used for setting Union's 2015 targets. These inputs were finalized in Union's 2014 DSM audit."*

In response to Union's written comments, the OEB's revised Decision and Order stated:[12]

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[11] EB-2015-0029, Union Gas Limited 2015-2020 DSM Plan Written Comments, February 3, 2016.
[12] EB-2015-0029 Decision and Order, February 24, 2016, p.3.

"Union interpreted the OEB's Decision to mean that input assumptions and net-to-gross adjustment factors are finalized for a given year based on the previous year's final DSM audit.

Decision

The OEB confirms that Union's interpretation is correct."

c) Inconsistency with the Scope of the NTG Study Request For Proposal

When setting its 2015 DSM program targets, Union referred to the TEC's original NTG Study RFP which stated that the NTG Study was meant to inform program design on a go-forward basis once completed. As per the original NTG Study RFP: [13]

"The primary objective for this study is to assist the TEC in developing NTG factors to be applied to each utility's custom commercial and industrial programs. This includes:

- *Estimating program free ridership factors by market sectors and precision targets for both the Enbridge and Union Gas' custom Commercial and Industrial programs. A 90/10 precision target is preferred for both the aggregate and sub segment level.*
- *Estimating participant inside and outside spillover as per market sectors and precision target for both the Enbridge and Union Gas' custom Commercial and Industrial programs.*

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[13] Exhibit A, Tab 2, Appendix B, p.10. *Note this Appendix includes part of the original NTG Study RFP. The full RFP document can be provided upon request.*

- *Provide guidance on the development of a strategy for applying free ridership and spillover data collected on previous program participation to forward looking DSM program activity."*

This is further evidence that it is not appropriate to apply the findings from the incomplete and ongoing NTG Study retroactively to 2015 DSM program results. Rather, the results of the NTG Study should inform future program design and be reflected in the targets for subsequent DSM program years.

d) The 2017 NTG Study is Incomplete and Ongoing

The scope of the NTG Study clearly indicates that both Free Rider and Spillover components are to be included. Further, as per the Scope of Work, Secondary Attribution was also supposed to be included.[14] To date, only results of the Free Rider component of the NTG Study are available, the Spillover component remains in-field,[15] and Secondary Attribution findings were not applied to utility results by the EC.[16] Applying incomplete and ongoing NTG Study findings in order to expedite completion of the 2015 DSM program results is inappropriate. Such actions ignore the relevance of the unique Spillover and Secondary Attribution components that are meant to act as a counter-balance to and are necessary to the development of Free Ridership respectively.

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[14] Exhibit A, Tab 2, Appendix D, pp. 90-92.
[15]OEB Staff has directed the EC to apply a deemed Spillover value from another jurisdiction as a proxy that can be used for the purposes of closing off the 2015 audit as discussed in section 2.2.
[16] See section 2.3, the EC quantified Secondary Attribution but did not apply these findings to final NTG Study results.

Furthermore, application of any NTG results to the 2015 DSM program year contradicts the OEB's Decision as noted at Exhibit A, Tab 2, Section 2.1. part a). Instead any NTG Study results should only be adopted once completed, they should be consistent with the NTG Study RFP, and they should be applied on a go-forward basis to DSM program targets and results.

Conclusion and Recommendations for Continuous Improvement

The OEB's Decision and Order on the 2015 – 2020 DSM Plans confirm that:

- The findings of NTG Study are not applicable to the 2015 program year;
- DSM plan targets and EM&V results should be based on the same set of input assumptions and NTG adjustment factors; and,
- For the purpose of calculating 2015 targets and DSM incentives, the correct NTG adjustment factors are those resulting from 2014 EM&V activities.

Further, the original scope of the incomplete and ongoing NTG Study as submitted to the TEC states that its findings should be applied once the Study is completed on a go-forward basis rather than retroactively.[17] Therefore, Union's audit adjusted DSM incentive claim of $7.472 million is consistent with the OEB's original and revised Decision and Order on Union's 2015 – 2020 DSM Plan as well as the scope of the NTG Study.

[17] See Exhibit A, Tab 2, Appendix C, p. 4 and p. 7.

2.2 Lack of Efficiency, Collaboration, Transparency, Stability, and Predictability in the 2015 EM&V Process

The EM&V process has lacked the collaboration, transparency, and predictability outlined by the OEB in its justification for coordinating the process, and the regulatory efficiency and stability expected by Union. While the OEB's Guidelines state that OEB Staff will *"take on the coordination function of the EM&V process"*[18] there is no clear definition of OEB Staff's role as coordinator. As such, Union has advocated for the creation of an EAC Charter or Terms of Reference for the past two years, with the premise that clear roles and accountabilities will improve the EM&V process. Union is encouraged to see OEB Staff have recently indicated support of this concept and welcome the opportunity to work collaboratively with the EAC to develop a meaningful document engendering a more structured and transparent process.

The EC was hired by OEB Staff to act as an independent third party auditor of the utilities' 2015 DSM programs. As described in the Guidelines, at a minimum, the OEB expects that the independent EC will be asked to:[19]

- *Review the draft evaluation reports prepared by the gas utilities and verify the components of the draft program results;*
- *Conduct audits of DSM programs to ensure that the results proposed by the gas utilities are accurate;*

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[18] EB-2014-0134, Filing Guidelines to the Demand Side Management Framework for Natural Gas Distributors (2015-2020), p. 15.
[19] EB-2014-0134 2015-2020 DSM Guidelines, p. 24.

- *Confirm the calculations of savings and the draft evaluations conducted by the gas utilities are consistent with the evaluation plans approved by the Board;*
- *Provide an audit opinion on the DSMVA, lost revenues and shareholder incentive amounts proposed by the natural gas utilities and any subsequent amendments;*
- *Confirm any target adjustments have been correctly calculated and applied;*
- *Identify any input assumptions that either warrant further research or that should be updated with new best available information;*
- *Review the reasonableness of any verification work that has been undertaken by the gas utilities and included in the Draft Evaluation Reports;*
- *Recommend any forward-looking evaluation work to be considered; and,*
- *Prepare a Final Audit & Evaluation Report.*

While the EC is expected to render its opinion on the items defined above, its opinion should consider all information provided and be independent from OEB Staff (acting as coordinators) and members of the EAC. As per the Board's August 21, 2015 letter, the EAC should "*provide input and advice into the evaluation and audit of DSM results*."[20] Despite this clarification with regard to the role of the EAC, the role of OEB Staff acting as EM&V coordinator remains inadequately defined.

[20] EB-2015-0245 OEB Letter, 2015-2020 DSM Evaluation Process of Program Results, August 21, 2015, p. 2.

The Role of OEB Staff

Union has serious concerns with directions provided to the EC with regard to the Final Audit Report in two notable cases described below. In Union's submission the EM&V process would benefit from a clearer definition of OEB Staff's role as the EM&V coordinator.

Directing the EC to apply the incomplete and ongoing NTG Study to 2015 DSM Program results – As per evidence provided in section 2.1, the results of the ongoing and incomplete NTG Study should not be used for the purposes of calculating Union's 2015 DSM incentive. Throughout the 2015 DSM program EM&V process, Union sought to understand OEB Staff's position on the application of the NTG Study to 2015 DSM program results. The issue was raised formally during an October 2016 EAC meeting during which OEB Staff committed to consider the matter and respond. The EAC was advised, the day prior to the EC releasing the Free Rider portion of the NTG Study results and without prior consultation, that the EC was directed to apply the incomplete and ongoing NTG Study results to the 2015 DSM program results. The EC distributed the resulting Free Rider adjustment the following day having applied only the Free Rider adjustment to Union's 2015 DSM programs.[21] OEB Staff explained that they directed the EC to apply the NTG Study results to the 2015 DSM program results in order to follow the DSM Framework and Filing Guidelines as OEB Staff understands it.

[21] NTG includes adjustments that both increase and decrease attributable savings. The equation is typically expressed as NTG = 1 – Free Riders + Spillover. Free Riders decrease attributable savings. Spillover represents a potential increase. The Spillover component of the NTG Study is incomplete and ongoing.

Directing the EC to apply incomplete and ongoing NTG Study adjustment factors to the 2015 DSM program EM&V process and results is inappropriate. It is also inconsistent with the OEB's original and revised Decision and Order on Union's 2015–2020 DSM Plan as outlined in section 2.1. Union recommends as part of an EAC Charter, that OEB Staff's role and responsibilities be clearly defined.

Directing the EC to apply a deemed Spillover rate to Union's Commercial Industrial and Large Volume custom programs without EAC consultation – Union is concerned with OEB Staff's direction to the EC to adopt a deemed Spillover rate from a Massachusetts study to Union's CI and Large Volume custom programs instead of developing the rate through the incomplete and ongoing NTG Study, without prior notice or consultation with the EAC. Providing this direction is an overextension of OEB Staff's role as coordinator of the EM&V process.

On October 16, 2017 OEB Staff issued a letter officially declaring that the 2015 EM&V process was closed. Within this letter, OEB Staff noted its decision to direct the EC to apply a deemed Spillover rate to expedite a component of the EM&V process that was already well over a year behind schedule:[22]

> *"The 2015-2020 DSM Decision and DSM Framework provide that net-to-gross adjustment factors are expected to include spillover effects. The OEB is currently studying*

[22] EB-2015-0245 OEB Letter. 2015 DSM Results Reports (EB-2015-0245), October 16, 2017.

> *spillover effects in the gas utilities' custom programs and the results are expected to be available in early 2018 for inclusion in future assessments. In order to approximate spillover effects for custom DSM programs in 2015, the OEB has applied, as a proxy, an assumed spillover rate to calculate final custom program results for 2015, based on spillover values of similar programs in another jurisdiction. The basis for this assumption is documented in Appendix N of the 2015 Natural Gas Demand Side Management Annual Verification report."*

Appendix N of the EC's 2015 Natural Gas Demand Side Management Annual Verification report provides little basis for how the decision to use a deemed Spillover rate as proxy was reached. The appendix notes only that *"the OEB asked the EC to conduct secondary source research to identify an estimate that might reasonably be applied to the Ontario DSM programs as an estimate for the 2015 clearance of accounts. The EC selected a 3.4% spillover rate based on a study in Massachusetts."*[23] OEB Staff's direction to apply this value circumvented the completion of the EC's current evaluation work to quantify Spillover for Union's custom programs as part of the NTG Study, and completely bypassed the advisory role the EAC is meant to play. As a result, the EC's opinion as presented in its 2015 Natural Gas Demand Side Management Annual Verification report, is *"based on the information available at the time that this report was*

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[23] Final 2015 Natural Gas Demand Side Management Annual Verification Report, page N-1.

published"[24]. Since this report was published prior to the completion of the Spillover component of the NTG study it is based on incomplete conclusions.

Union is concerned with the lack of EAC consultation on the approach to apply a deemed Spillover rate. Further, this action is incongruent with the NTG Study Scope of Work and the methodology that was presented to the EAC. This further supports the need to establish an EAC Charter that clearly defines the roles and accountabilities of all EAC members as well as OEB Staff.

The EC was Hired Without Input from EAC Members

In April 2016, the EC was hired without input from EAC members to audit the utilities' full 2015 DSM program portfolio without any EAC consultation. Prospective bidder proposals, the EC contract, and total proposed budgets were not provided to members of the EAC.

The EAC is intended to provide input and advice into the EM&V of DSM results. The selection of an EC is a critical component of the EM&V process and should fall within the activities for which the EAC can provide input. The EAC is comprised of members who collectively have knowledge and experience with:

- The Ontario natural gas DSM environment/framework;

[24] Final 2015 Natural Gas Demand Side Management Annual Verification Report, page i.

- OEB proceedings related to DSM audits;
- Impact evaluation of DSM technologies and programs, natural gas energy efficiency technologies, multi-year impact assessments, NTG studies, and Free Ridership analysis; and,
- Detailed understanding of the utilities' DSM programs.

Notwithstanding OEB Staff's experience in these areas, the EAC's experience is extensive and should have been leveraged during the vendor selection process. This would have enabled a more complete review of prospective bidders and could have contributed to the process of aligning the winning bid with the robust EM&V process in Ontario. It could also have helped alleviate Union's concerns with the approach taken by the EC when conducting the EM&V process as discussed in section 2.3.

Excluding the EAC from the EC selection process is a step backward compared to the level of collaboration and transparency seen in the 2012-2014 DSM Framework. Throughout the 2012-2014 DSM Plan period, the Audit Committee had the overarching objective of reaching consensus in advising the EM&V process: [25]

> "*Where consensus on an audit firm selection from the proposals submitted is not*

[25] EB-2011-0327 Attachment A, Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc. and Union Gas Limited, Section 6.v. Audit Committee Terms of Reference, p. 14.

achieved, the intervenors will decide the firm from among the proposals submitted by pre-approved bidders."

The auditor (now known as the EC) selection process has historically been a collaborative effort where all members of the utilities' respective Audit Committees endeavoured to reach consensus. This process acknowledged the benefits of leveraging the experiences and expertise of the Audit Committee. It also helped ensure that Audit Committee members supported the evaluation approach proposed by the auditor prior to the initiation of EM&V activities rather than later in the process.

During the EC selection process for the 2016 program year, OEB Staff did enlist one member of the EAC to provide input into the process; however the EAC member included in the selection process was not a member of either utility and was chosen without any input from the EAC. While inclusion of one EAC member in the selection process represents a very modest improvement over the 2015 experience, it is not sufficient to ensure efficiency, collaboration, transparency, stability and predictability relative to consultation with the full EAC. Inclusion of all members of the EAC in the selection process would ensure a robust proposal evaluation that is open and transparent. Further, bidder confidentiality should not be a concern given that all EAC members have signed non-disclosure agreements. Union recommends that an EAC Charter reinstate a provision similar to the 2012-2014 auditor selection process that provides for more transparent and collaborative vendor selection among members of the EAC, and enables all parties to view the proposals and understand the scope of work and budget implications associated with the selection process. This will help ensure stakeholders are engaged and support the audit early in the process, and can lead to more constructive EAC activities and a more efficient EM&V process.

Lack of Transparency in Cost Accounting

Union is concerned with the lack of transparency regarding budgets and costs for the EC's 2015 EM&V activities. The EC was hired through a multi-year contract with the OEB but the details of this contract (including budgets) has not been shared with the utilities. However, the utilities are expected to pay for this work using their respective EM&V budgets, which are approved by the OEB and ultimately paid for by customers. Withholding proposals and related budgets from the utilities is not a reasonable approach to EM&V coordination since the utilities are dependent upon budget information for contract payment, completion of program planning, and financial reporting. Under the current process Union has lost the ability to track and accurately accrue related costs. This has created an environment of uncertainty and made management of evaluation budgets, which can be used for other evaluation activities, needlessly difficult.

The challenge of managing evaluation budgets without an understanding of a forecasted total amount is further exacerbated by an unclear invoicing process. Invoices for work completed by the EC are channelled from the EC through OEB Staff to the utilities. Invoices have been provided to the utilities in piecemeal fashion, without related work-product details, and with no indication of what amounts remain outstanding. Invoices have also been delayed by up to a year without explanation. Union has had difficulty reconciling 2016 accrual amounts provided by OEB

Staff with 2016 actual costs. In general, there has been a lack of structure and stability regarding invoicing.

Union requests that any Charter or Terms of Reference developed for the EAC clearly define OEB Staff, EC, and utility accountabilities related to budget and invoice management, and that it provides greater transparency on evaluation budgets and costs.

The EM&V Process has been Subject to Substantial Delays that have been Prejudicial to Union

As per OEB Staff's 2015 EC RFP, the 2015 Final Audit Report was due October 2016. However, there were delays in the 2015 EM&V process from the outset and the EC's Final Audit Report was released following an EM&V process that was approximately 12 months longer than the utility-coordinated 2012-2014 annual EM&V processes.

The Guidelines specify that OEB Staff are expected to hire the EC by October 1 of the year to be audited. In the case of the 2015 DSM program year, the EC should have been selected by October 1, 2015. However, the EC was not hired until April 2016, approximately seven months after the deadline. The delays continued beyond EC selection to the issuance of the EM&V Plan. According to the EC RFP, the EC was expected to deliver an EM&V Plan 30 days after initiation of the project (May 2016). A draft EM&V Plan was not circulated to the EAC until September

2016 with a final version released February 2017 (nine months delayed).[26] The EC's final CPSV and NTG Scope of Work were provided to the EAC in December 2016.[27] As a result of these delays, EC requests for Union to provide data on its custom programs did not occur until fall 2016 and CPSV fielding was not initiated until January 2017. This is approximately one year later than the historical EM&V timelines. A request from the EC for Union to provide a complete tracking database for all of its 2015 programs (including calculation of DSM incentive and LRAM amounts) did not occur until January 2017, also nearly one year later than historical EM&V timelines. This one year delay persisted throughout the course of the 2015 EM&V process. The EC released its draft 2015 audit report to the utilities on July 26, 2017 and its Final Audit Report on October 16, 2017 (22 months after the close of the 2015 program year). Union expects a revised Final Audit Report to be issued by the end of December 2017 to correct errors. In total, the duration of the 2015 EM&V process from the time the EC was hired to the time the Final Audit Report was issued was more than 19 months. In comparison, during the last year of the utility-coordinated process, the final 2014 auditor's report was released October 29, 2015 which is 10 months after the close of the 2014 program year.

Union understands that an adjustment period is expected in the first year of a process change. However, a year-long delay in obtaining Final Audit Report results as well as an annual EM&V process that spans longer than a year is excessive and has led to rate and regulatory instability and

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[26] While the EC report was dated December 2016, it was not provided to the EAC until February 2017.
[27] See Exhibit A, Tab 2, Appendix D.

inefficiency for utilities and customers. Additionally, the annual EM&V process needs to be conducted as soon as practical after a program year in order to collect the best information possible from customers and to avoid confusion related to customer human resource changes, not to mention to reinforce the value of DSM program participation with customers.

These delays have also effectively created a new barrier to lowering Free Ridership as the utilities have not received actionable Free Ridership mitigation recommendations from the EC in a timely manner. One method by which Union can reduce Free Ridership within its custom offerings is by enhancing program design and implementation practices to include new Free Ridership mitigation efforts. One source of new Free Ridership mitigation efforts comes from feedback provided through the EM&V process. As part of this process, the EC and/or CPSV consultant provides an in-depth review of Union's custom offerings, integrates knowledge and expertise from other jurisdictions, and provides feedback that can be incorporated into program design.[28]

During these delays (particularly between the hiring of the EC and the release of the draft EM&V plan 6 months later), there was little explanation communicated to the EAC. As a consequence, the utilities, and subsequently ratepayers, were left unaware of the impending delay that would have implications on their respective operations and financials. This delay also means that

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[28] The CPSV consultant is responsible for the annual savings verification for custom projects within Union's custom offerings. The EC is responsible for the annual evaluation and audit of Union's entire DSM portfolio. In 2015, the EC and CPSV consultant roles were performed by the same firm.

evaluation findings from the 2015 EM&V process cannot be considered for implementation before the 2018 program year at the earliest. This regulatory instability and inefficiency negatively impacts Union's customers and discredits the EM&V process.

Union submits that going forward, the annual DSM EM&V process should conclude in a timely manner. Union recommends that going forward the EAC be allowed to provide an advisory role to ensure timelines are kept on track and to help keep the entire process transparent in order to inform the utilities and its customers. The anticipated outcome of this advisory role (as well as the proposed EAC Charter) is to help improve upon the time required to complete the 2016 EM&V process and, starting with the 2017 EM&V process, attempt to achieve alignment with the nine-month audit timeline presented in the EC RFP.

The Relationship Between OEB Staff and the EC

It came to the EAC's attention over the course of the 2015 EM&V process that OEB Staff reviewed and provided comments on EC deliverables (including EM&V plan, CPSV/NTG Scope of Work, CPSV findings and draft auditor report) prior to the EC sharing these deliverables with the EAC. Despite multiple requests from members of the EAC, these comments were not shared with the committee. Since the EC's work deliverables were provided to the EAC after the OEB Staff comments were incorporated, the impacts of the comments on the EC's deliverables, methodologies, and Scope of Work are unknown.

OEB Staff's ability to preview and provide comments on the EC's work without oversight from other parties was not afforded to the members of the EAC. Rather, comments provided by the EAC were shared and discussed collectively in a transparent manner and are publically available. Any decision by the EC to incorporate EAC comments into its work was communicated to the committee and OEB Staff. OEB Staff's comments should be held to this same standard.

Union recommends that as part of any EAC Charter or Terms of Reference, rules on communication transparency should be established. This should include clear direction that EAC and OEB Staff feedback and comments on EC deliverables should be made available to all members of the EAC and exist within the public domain.

Conclusion and Recommendations for Continuous Improvement

For the reasons set out above, Union is concerned with the lack of a clear definition of OEB Staff's role as coordinator of the EM&V process. As a result, Union makes the following recommendations for continuous improvement in order to ensure that the EM&V process proceeds in an efficient, collaborative, transparent, stable and predictable manner for the 2016 program year and beyond.

To begin to address the challenges experienced during the 2015 EM&V process, Union recommends that going forward the EAC be allowed to provide an advisory role. The anticipated outcome of this advisory role is to improve upon the time required to complete the 2016 audit process and, starting with the 2017 audit, to attempt to achieve alignment with the nine-month audit timeline presented in the EC RFP.

Union recommends that a formal Charter or Terms of Reference be established for the EAC and OEB Staff, with clear objectives, conflict resolution processes, and accountabilities for OEB Staff's role as coordinator, along with the expected advisory functions of the utilities and other members of the EAC. This Charter should be developed in collaboration with the EAC, and include consideration of the following components:

- Consensus as an overarching objective;
- Definition of OEB Staff's role as coordinator;
- Guidance on how differences of opinions will be resolved when consensus is not achievable;
- Clarity on the EAC's role in guiding the EM&V process;
- Reintroduction of a provision similar to the 2012-2014 auditor selection process that makes vendor selection more transparent and collaborative among members of the EAC;
- Definition of OEB Staff and utility accountabilities related to budget and invoice management;
- Greater transparency between OEB Staff, EC and the EAC on evaluation budgets and costs;
- A process to manage delays for EM&V work;

- Consistent with the principle of transparency, all communication should be shared with all EAC members, excluding anything with specific customer information; and,
- A requirement for official meeting minutes prepared by an independent scribe for EAC meetings held both in-person and via teleconference. Minutes should be publicly posted quarterly on the OEB website similar to TEC meeting minutes.

2.3 EC Work Deliverables Deviated From the Scope of Work, Led to Delays, Contributed to Customer Complaints, and Did Not Follow NTG Best Practices

During the 2015 EM&V process, Union provided extensive comments highlighting concerns it had with the approach and scope of the EC's proposed activities. In Union's opinion, many of these comments were not fully addressed and related issues were not resolved. Examples include:

a) Secondary Attribution was quantified but not applied to NTG Study results;
b) There was an oversampling of projects selected for 2015 CPSV and NTG activities;
c) The EAC was not provided with full documentation, calculations or other detail sufficient to reproduce the 2015 EM&V findings; and,
d) NTG best practices were not followed when conducting the NTG Study

a) Secondary Attribution was quantified but not applied to final NTG Study results

Primary Attribution refers to project-specific influence that a utility has had on a participant's decision to participate in a DSM program. Secondary Attribution refers to the longer-term effect that a utility relationship with a participant has had on the participant's decision to participate. If the utility is found to have influenced a project in either a primary or secondary manner, the utility program is credited as having influenced the project. If not, the project is considered a Free Rider. As such, if Secondary Attribution is not measured, a program's Free Rider rate might increase, leading to incorrect and understated program results.

The EC and the TEC (prior to its transition to the EAC) considered the issue of attribution while finalizing the original NTG Study contract and decided that the effects of Secondary Attribution on the current project were to be captured in a secondary, less rigorous question sequence.[29]

Following these discussions, the EC's CPSV/NTG Scope of Work indicated that Secondary Attribution would be determined less rigorously but would be measured for all measure types.[30] The EC's calculation of cumulative net gas savings would be based on the greater of Primary and Secondary Attribution.[31] When the EC revealed the results of the Free Rider component of the NTG Study, the EC had measured Secondary Attribution but did not incorporate these results into its Free Rider rate findings. This approach is neither equitable nor consistent with the original approach discussed at the TEC and presented more recently to the EAC.

Excluding Secondary Attribution results has a notable impact on the EC's NTG Study findings. Its exclusion decreased the NTG rate from 45% to 39% for Union's custom CI program and from 12% to 8% for Union's custom Large Volume Direct Access program. As per section 2.1 of this

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[29] Exhibit A, Tab 2, Appendix D, p. 129.
[30] Exhibit A, Tab 2, Appendix D, p. 45.
[31] Exhibit A, Tab 2, Appendix D, pp. 90-91.

evidence, the Free Rider rates resulting from the NTG Study should not be applied to 2015 program results. However, the EC should remain consistent with TEC discussions and the CPSV/NTG Scope of Work that it presented to the EAC, and incorporate Secondary Attribution results into its Free Rider rate findings going forward. Union urges the OEB to direct the EC to apply Secondary Attribution results to its Free Rider findings in accordance with TEC recommendations and the EC's own CPSV/NTG Scope of Work.

b) <u>There was an oversampling of projects selected for 2015 CPSV and NTG activities</u>

The EC conducted CPSV on a quantity of projects that was more than double the target sample size proposed in its CPSV/NTG Scope of Work.[32] The EC's oversampling approach resulted in the verification of every project completed at each sampled site. Customers were burdened by this approach which was reflected in increased customer complaints related to the extensive duration of site visits.

The EC took this approach without providing evidence to the EAC that the benefits of the approach outweigh its additional time and resource drawbacks. The decision to oversample was questioned by EAC members throughout the EM&V process. The utilities requested that the EC

[32] The CPSV target sample size in the EC's CPSV Scope of Work was 75 Union custom projects as noted in Exhibit A, Tab 2, Appendix D, p.28, Table 16. The actual number of Union projects sampled by the EC for CPSV was 192 projects. This is 237% the size of the proposed sample. See Final Audit Report, Appendix P Tables 3-1 and 4-1.

compare CPSV results with and without oversampled projects to determine if study results would appreciably change if the EC did not oversample. This request was refused.

The approach to oversample projects is inconsistent with the sampling methodology established by the TEC with consensus and used to complete verification in the previous 2012-2014 DSM Framework period. The TEC sampling methodology is designed to achieve a 90/10 standard,[33] which remains the goal of CPSV in the current Framework.

Union is concerned that the EC will continue with this approach during the 2016 EM&V process, negatively impacting Union's customer relationships, causing delays similar to those in 2015, and adding an unnecessary cost to customers. In the interest of continuous improvement, Union urges the OEB to direct the EC to abandon the oversampling approach and return to the sampling methodology that was developed for, and that gained the consensus of, the TEC.

c) The EAC was not provided with full documentation, calculations or other detail sufficient to reproduce 2015 EM&V findings

A principal requirement of any audit is the ability to reproduce its results. This is important for a number of reasons. It holds an auditor accountable to its findings and ensures that any adjustments made to the data being audited are consistent with the methodology, assumptions,

[33] 90/10 precision is a statistical standard for which there is 90% confidence that sample results are within +/- 10% of population results.

and approach that the auditor has reported to have taken. Ultimately, having reproducible audit results adds to the level of transparency needed to facilitate a critical review of audit conclusions and helps identify possible material errors.

In a number of instances,[34] the EC did not provide the EAC with documentation, calculations or other detail sufficient to reproduce its EM&V findings. Despite requests from members of the EAC for more transparency, the EC provided insufficient information to reproduce EM&V findings. This lack of supporting information limits a critical review of EM&V findings, requires the EAC to rely upon an assumption that the EC "did it right", and reduces the ability of the EAC to provide effective input and advice into the EM&V process. In areas for which Union was able to verify the EC's calculations, errors were found. One such example of this is the calculation of Union's LRAM amount, which increased by 40% as a result of Union checking the EC's calculations. While the EC corrected the error found by Union, it later uncovered another error in its calculation of Union's LRAM amount. This error was not communicated to the EAC until December 13, 2017, nearly two months after the Final Audit Report was released.[35] Union contends that had it been granted a more robust review of the auditor's adjustments, via access to review the auditor's live calculations, such errors could have been caught and confidence in and

[34] Examples include not releasing details on how CPSV sample strata and weighting were derived, not providing the EAC with CPSV project-specific calculations, and not providing sufficient information to connect CPSV project-specific findings discussed with the EAC to the CPSV adjustment factors applied to Union's program results.
[35] As a result, Union expects the EC to issue a revised 2015 Annual Verification Report to reflect corrections to errors discovered in the original version issued October 16, 2017.

transparency of the audit improved. Lack of supporting information also represents a decrease in transparency compared to the formerly utility-coordinated EM&V process. In past EM&V processes auditors and verifiers provided the Audit Committees (now EAC) with fully transparent calculations and supporting documentation.

Union urges the OEB to consider adopting the proposed EAC Charter (Exhibit A, Tab 2, Appendix A), developed in collaboration with EGD, or a similar Terms of Reference, that will enable the EAC to provide oversight to the EC and which requests that going forward, the EC and any subcontractors provide complete and full calculations for all EM&V findings to the EAC for review.

d) <u>NTG best practices were not followed when conducting the NTG Study</u>

EGD and Union engaged Navigant Consulting, Inc. to conduct a jurisdictional review of NTG policies (the "Navigant Study") that considers DSM attribution policy trends and best practices for estimation, assessment, and application of net savings (see at Exhibit A, Tab 2, Appendix E). From a policy standpoint, the Navigant Study demonstrates that jurisdictions with comparable DSM frameworks and carbon reduction programming (such as California, Illinois and Massachusetts) have developed considerations that either reduce or remove the impact of after-the-fact NTG studies to utility incentives. Additionally, the EM&V processes in these jurisdictions provide stakeholders the opportunity to suggest modifications to the initial NTG estimates, with the objective of arriving at an agreed upon NTG value that takes the experience of stakeholders into consideration.

Given the information contained in the Navigant Study, it is apparent that the EC's NTG Study did not meet best practice standards. Instances where the EC's 2015 NTG Study failed to meet best practices predominantly relate to mitigating issues with self-report survey methods, such as:

- *Fast Feedback* – Industry best practice for establishing Free Ridership when a self-report survey is used, is to conduct the survey as soon after project completion as possible. This helps to reduce recall bias and ensure that interviews reach a person that was actively involved in the original project. In the case of the 2015 NTG Study, customers were contacted over two years after projects had been completed. This delayed survey approach risks significantly exacerbating recall bias of survey participants, leading to inaccurate Free Rider findings. Additionally, the 2015 NTG Study survey instrument assumed no staff turnover within the two year delay, and survey respondents were not asked if they were actively involved in the original project. Union is also concerned that recall bias is particularly pronounced for business partners who, having likely worked on numerous projects over the two year delay since the sampled project was implemented, might not recall the details of the specific project that is the subject of the survey.
- *Survey instrument reflects the program design and level of maturity* – Industry best practice designs the survey instrument considering, *"multiple factors in the NTG scoring (program influence and other non-program influences), ensuring the questions and weighting are fully vetted, consistency checking, and gaining insight into the project story*

by spending additional time with the participant to understand the project and possibly meeting with implementation staff knowledgeable about the project."[36] The survey instrument used by the EC focused largely on the payment of incentives rather than on the entire suite of services and value provided to customers. Influence can come from a number of customer interactions ranging from offering incentives to conducting feasibility studies, communication, education, and long standing customer support prior to the current program year. Overlooking these additional points of influence limits the accuracy of the NTG Study.

Furthermore, it is Union's contention that the unique design of Union's Large Volume Direct Access program is incompatible with the concept of a NTG Study. The amount of funds available to Direct Access program participants is fully transparent and customers access their own pool of funds for eligible projects. If Large Volume customers do not use their funds, they become accessible to other Large Volume customers. While Union can attempt to influence Large Volume customers by providing incentives, identifying opportunities to save energy, and quantifying savings estimates, customers prioritize project investment based on their own needs and with consideration for the amount of DSM funding available to them. If a project meets the eligibility criteria of the program, Union will not refuse a customer access to its own money regardless of whether the

[36] Exhibit A, Tab 2, Appendix E, p. 4.

program has influenced the customer. Despite Union raising these concerns over the course of the NTG Study, a separate survey instrument for the Large Volume custom project participants was not developed.

- *Triangulation* – Industry best practice for establishing NTG includes surveying trade allies who work with the utilities in support of program delivery. The EC's research conducted to ascertain utility influence via business partners was limited in scope. Business partner interview questions did not appear to adequately cover the full range of ways in which a business partner can influence customer program participation.
- *Sensitivity Analysis* – Conducting a sensitivity analysis to test NTG survey instruments at the design phase and periodically thereafter is a leading practice that engenders a more equitable NTG evaluation. The sensitivity analysis would include a review of the scoring methodology in order to better understand the implications of assumptions used in translating survey responses into impacts on the NTG values. Union is not aware of any such sensitivity analysis conducted for the 2015 NTG Study, and has not been privy to the data that is used to derive the resulting values. Union posits that testing the sensitivity of the scoring methodology and related assumptions on the NTG survey design is a practice that should be adopted going forward. Transparency with regard to the weighting of results is also important to ensure that they are based on accurate calculations and correct underlying assumptions. If the utilities cannot view this level of data due to confidentiality concerns, then a third-party review of sensitivity and accuracy of results should be considered in order to enhance overall confidence in any NTG EM&V activity.

The above examples contributed to Union's concern that the EC's NTG Study does not follow best practices, and as such, does not instill confidence in the results. Union submits that the results of the NTG Study not be applied retroactively. Union further requests OEB direction that any future NTG Study should exclude the Large Volume program from its scope. Union will continue to use the historical NTG values for the purpose of establishing the utility DSM targets and incentives until 2017 as referenced in section 2.1. Union will consider any insights gained through the NTG Study as a continuous improvement opportunity to refine the CI Custom offering to reduce Free Riders going forward.

3. CONCLUSIONS AND RECOMMENDATIONS FOR CONTINUOUS IMPROVEMENT

Union's three principle concerns with the 2015 DSM EM&V process and results are:

1. The retroactive application of the results of the NTG Study to Union's 2015 DSM program results;
2. The lack of efficiency, collaboration, transparency, stability and predictability in the 2015 EM&V process; and,
3. EC work deliverables deviated from the Scope of Work, led to delays, contributed to customer complaints, and did not follow NTG best practices.

To address these concerns, Union requests that the OEB make the following determinations:

- Approve the deferral balances as outlined in Exhibit A, Tab 3, Appendix A, Schedule 1, and as summarized in Exhibit A, Tab 1, Table 1. As outlined in section 2.1 herein, these values do not include the findings of the incomplete and ongoing NTG Study;
- Direct the EC to update the NTG Study findings to include Secondary Attribution and Participant Spillover based on Union's customer responses as per the details of its NTG Scope of Work;
- Direct the EC to exclude Union's Large Volume program from the NTG Study on the basis that measurement of whether decision making was influenced by the program incentives is incompatible with this program since the incentives accessible to customers are their own DSM contributions;
- Direct the EAC to develop a formal EAC Charter or Terms of Reference to clarify roles and responsibilities for committee oversight of all EM&V work. Union submits a draft EAC Charter for OEB consideration (see Exhibit A, Tab 2, Appendix A); and,
- Facilitate a more expeditious EM&V process, by providing direction to avoid oversampling and adopt the original TEC sampling methodology.

Evaluation Advisory Committee Charter

I. Background

As noted in Section 14.0 of the Framework, the role of Ontario Energy Board Staff ("OEB Staff") will be increased in the 2015 – 2020 Plan period, primarily with respect to coordinating the evaluation and audit process and the annual update of input assumptions. The OEB continues to see the direct involvement of all key stakeholders, notably the gas utilities and intervenors with the required expertise. Union has developed this Evaluation Advisory Committee ("EAC") Charter and is submitting it to the OEB as part of its DSM Deferral Evidence in the spirit of continuous improvement. Adherence to this EAC Charter will engender greater efficacy, transparency and efficiency in the evaluation processes.

II. Purpose

The EAC Charter provides insights into the Evaluation, Measurement & Verification ("EM&V") activities conducted on Enbridge Gas Distribution Ltd. and Union Gas Limited (collectively the "Utilities") DSM programs. It describes the means by which intervenors that represent ratepayer and environmental groups, the Utilities, their customers, and OEB Staff can provide input and participate in the direction of EM&V activities. This is meant to instill confidence in the EM&V process, including the accuracy of reporting and the calculation of the DSM Variance Account ("DSMVA"), Lost Revenue Adjustment Mechanism ("LRAM"), and Demand Side Management Incentive Deferral Account ("DSMIDA"). It also provides confidence that program results are calculated using reasonable assumptions. The benefits of the EM&V process include the development and enhancement of utility DSM programs, the reduction of regulatory burden, and reassurance that the Utilities continue to deliver successful and cost effective DSM programs.

III. Charter Objective

The purpose of this EAC Charter is to clarify and define the roles and responsibilities of intervenors, the Utilities, OEB Staff, and other stakeholders with respect to participating in the EAC. Roles and responsibilities will cover processes relating to annual evaluation & audit, updating input assumptions, and multi-year DSM program impact assessments and evaluations. The Charter outlined herein is expected to lead to greater objectivity within these three areas for the remainder of the current DSM 2015 - 2020 Framework.

IV. EAC Role Designation

The EAC is composed of active and observer members and an EAC coordinator. Roles and responsibilities of each designation will differ as per the Charter. Any roles involved in the EAC's EM&V work outlined in this Charter are expected to adhere to it.

Active members:

- Experts representing non-utility stakeholders, with demonstrated experience and expertise in the evaluation of DSM technologies and programs, natural gas energy efficiency technologies, multi-year impact assessments, net-to-gross studies, free ridership analysis and natural gas energy efficiency persistence analysis
- Experts retained by the OEB
- Representatives from the Independent Electricity System Operator
- Representatives from each natural gas utility

Observer members:

- Representatives from the Ministry of Energy
- Representatives from the Environmental Commissioners Office

EAC coordinator:

- Representative(s) from OEB Staff

V. Guiding Principles

The following principles will guide EAC activities.

Confidentiality

- Non-disclosure agreements must be signed by all EAC members when dealing with evaluation draft reports and study working documents and all other confidential documents referenced in the evaluation activities.
- Observer members would have access to Utility or customer-sensitive information at the sole discretion of the Utilities.
- If any confidential information could potentially give the recipient an unfair business advantage in competing for work from the Utilities, the Utilities will identify such concerns in advance of providing the information and the potential recipient will have to choose to either: (1) not review the confidential information and remove himself / herself from the portion of the engagement process related to the confidential item; or (2) accept and review the confidential information but commit to not pursuing the work opportunity.

Conflict of Interest

In the case of a conflict of interest arising, it is the member's responsibility to declare the conflict to the EAC as early as possible. The selected candidates are expected to provide input and advice based on their experience and technical expertise and not to advocate position of parties they have represented before the OEB in various proceedings.

Transparency

- All deliverables, including RPFs, proposals and/or draft work products, will be provided to all EAC members without comment or review by any party or parties in advance of the full committee.
- Any backup documentation and calculations undertaken to adjust Utility savings or financial values will be provided to the Utilities to enable the Utilities to confirm the application of the math.
- Members of the EAC may, at EAC meetings or via email, provide comments on any EM&V deliverable and/or activity, but no decisions pertaining to EM&V work will be made unilaterally by any EAC member or the EAC coordinator.

VI. EAC Charter Scope

EAC members will adhere to the guiding principles of the Charter and will provide input and advice on:
- Annual evaluation and audit of DSM results
- Annual update of input assumptions to the Technical Reference Manual ("TRM")[1]
- DSM program impact assessments and evaluation studies

VII. EAC Charter Accountabilities

Within the Charter Scope areas, EAC member accountabilities include providing input, guidance and advice into:
- Establishing priorities and considering potential future studies or research studies specific to the Charter Scope with consideration for resource constraints (such as funding, personnel resources, time limitations);
- Any scope of work, EM&V activity and/or other RFPs used to engage a third party;[2]
- Any scope of work, EM&V activity and/or other proposals related to activities within the Charter Scope;
- Selection of any third party commissioned to undertake work;
- Any scope of work, EM&V activity and/or other draft and final deliverables
  - Consistent with the principle of transparency, all verification reports, evaluation reports, summary spreadsheets, calculations and other materials used and/or generated for the

[1] The TRM is a document that is filed with the OEB to provide essential information and source materials underpinning prescribed energy savings assumptions and/or calculations for a number of energy efficient technologies that are or may be in the future promoted by the Ontario gas utilities' energy efficiency. The TRM will be common to both Union and Enbridge.
[2] For clarity, "third party" referenced in this document includes the Evaluation Contractor, its subcontractors and/or any third party commissioned to undertake EM&V work specific to the Charter Scope.

purpose of EM&V activities will be available on request, for review by all EAC members (with Utility defined redaction of information to maintain privacy considerations) and on signing the Declaration and Undertaking, and;

- Specific project management details, such as:
  - Budgets and invoicing
  - Timelines
  - Maintaining scope of work with no allowance for “scope creep”
  - Meeting minutes and action items.

EAC members may make recommendations on all Charter Scope areas, which will be reflected in meeting minutes and action items as appropriate.

The EAC Coordinator/OEB Staff will adhere to the guiding principles of the Charter and has accountability for:

- Facilitating EAC meetings;
- Sharing the full cost of contracts and any budget overspend incurred, with the EAC;
- Undertaking procurement necessary for third parties based on the EAC’s recommendations;
- Administering all third party contracts and holding these parties accountable to the terms of the contract(s);
- Coordinating all EM&V work;
- Providing the Utilities with invoices for all EM&V work in a timely manner and include pertinent details sufficient for the Utilities’ financial accounting responsibilities, and;
- Taking minutes, including action items and agreements, and sharing these with EAC members for review and approval. This task can be shared with the Utilities.

Notwithstanding the accountabilities outlined above, neither EAC members nor the EAC coordinator/OEB Staff will instruct any third parties on how to execute their work. This includes selection of tools, methodology, processes used in EM&V activities, and how third parties conduct their work and form their opinions with consideration for OEB policies. Any situation where interpretation of OEB policy is required, it is the role of the Board itself to adjudicate and offer a decision. It is important to ensure that third party reports and efforts will be independent. Though EAC members may provide comments to third parties on drafts of the report, third parties will ultimately provide their independent opinions. All EM&V deliverables must represent the independent professional opinion of the applicable third party.

Ontario Natural Gas Technical Evaluation Committee (TEC)

Request for Proposal

Measurement of Net-to-Gross (NTG) Factors for Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs

RFP-002-2013 (2)

Date of Issue:
November 1, 2013

Proposal Due Date:
December 23, 2013

Table of Contents

Section 1 – Background Information

1.1 Ontario's Natural Gas Demand Side Management and Technical Evaluation Committee Background

Enbridge Gas Distribution (Enbridge) and Union Gas Limited (Union) (together, "utilities") have been delivering Demand Side Management (DSM) initiatives since 1995 and 1997 respectively. These initiatives include program activities across all customer segments including residential, low income, commercial, and industrial. Combined, both utilities serve the vast majority of small and large volume natural gas customers across Ontario[1].

On June 30th 2011, the Ontario Energy Board (the Board) issued new DSM Guidelines for Natural Gas Utilities which takes into account the experience gained by the two utilities along with current market conditions. The operating objectives for this new framework include the maximization of cost effective savings, prevention of lost opportunities and the pursuit of deep savings. To encourage the natural gas utilities to aggressively pursue DSM savings, the Guidelines also outline a DSM financial incentive based on performance. This incentive uses a series of scorecard metrics which are largely weighted on cumulative (lifetime) natural gas savings (m^3).

In keeping with the new Guidelines, Enbridge and Union developed a three year portfolio (2012 to 2014) of programs[2] based on three generic program types: resource acquisition, market transformation, and low income.

A summary of the approved 2012 budget and target natural gas savings put forward by Enbridge and Union are highlighted in the tables below.

Table 1.1 Enbridge Gas Distribution Board Approved 2012 DSM m3 Targets and Budgets

Enbridge Gas Distribution[3]		
Program Type	**2012 Lifetime Savings (m^3)**	**2012 Program Budget[4]**
Resource Acquisition	820,453,481	$15,125,000
Low Income	62,463,070	$6,120,650
Market Transformation	n/a[5]	$3,920,000
Total	**882,916,551**	**$25,165,650**

[1] http://www.ontarioenergyboard.ca/OEB/_Documents/RRR/2011_naturalgas_yearbook.pdf
[2] See section 2.3 – Sources of information.
[3] http://www.ontarioenergyboard.ca/OEB/_Documents/Documents/EGDI_appl_DSM%20plan%202012-2014_20111104.PDF
[4] Overheads not included.
[5] Performance metrics for Market Transformation programs are not based on savings but on other indicators or market change

Table 1.2 Union Gas Board Approved 2012 DSM m3 Targets and Budgets

Union Gas Limited[6]		
Program Type	**2012 Lifetime Savings (m^3)**	**2012 Program Budget[7]**
Resource Acquisition	826,000,000	$14,022,000
Large Industrial[8]	1,000,000,000	$4,534,000
Low Income	43,000,000	$6,839,000
Market Transformation	n/a[9]	$829,000
Total	**1,869,000,000**	**$26,223,000**

Resource acquisition programs which contribute to the majority of the proposed savings are designed to achieve direct measureable savings and include both prescriptive and custom based programs. Custom programs targeting commercial and industrial customers, particularly larger customers, represent more than half of the portfolio savings for both Enbridge and Union.

The Board has identified free ridership and spillover as the two adjustment factors which may be taken into consideration when considering the net lifetime natural gas savings attributable to programming efforts.[10] The natural gas utilities are required to consider free ridership for all their applicable programs. They are also free to propose inclusion of spillover where it can be supported by comprehensive and convincing empirical data.

The following tables summarize the 2012 results of Enbridge[11] and Union's Commercial and Industrial custom based Resource Acquisition programs.[12] The adjustment factors used to generate the net lifetime savings shown in the tables below, are based on the free ridership findings from the 2008 Custom Attribution Study[13] and do not account for spillover.

[6] http://www.rds.ontarioenergyboard.ca/webdrawer/webdrawer.dll/webdrawer/rec/322654/view/UNION_SettlementP_20120131.PDF
[7] Overhead and Inflation factors not included.
[8] For Union Gas, Large Industrial is another permutation of a Resource Acquisition program with its own shareholder performance scorecard.
[9] Supra see note 6
[10] Page 22, Ontario Energy Board, Demand Side Management Guidelines for Natural Gas Utilities EB-2008-0346, June 30 2011.
[11] Subject to clearance of accounts application with the Ontario Energy Board.
[12] These are the audited results, but they have not yet been approved by the Ontario Energy Board.
[13] See Appendix B

Table 1.3 Enbridge Gas Distribution 2012 Claimed m^3 Savings for Commercial and Industrial Custom Programs[14]

Enbridge Gas Distribution			
Sector	**Gross Lifetime Savings (m^3)**	**Net Lifetime Savings (m^3)**	**Number of Projects**
Commercial	286,039,013	251,714,332	490
Large New Construction	181,676,611	134,925,548	70
Multi-Residential	275,160,544	220,128,435	275
Industrial	610,001,350	305,915,406	91
Total	**1,352,877,698**	**912,683,721**	**926**

Table 1.4 Union Gas 2012 Claimed m^3 Savings for Commercial and Industrial Custom Programs[15]

Union Gas			
Sector	**Gross Lifetime Savings (m^3)**	**Net Lifetime Savings (m^3)**	**Number of Projects**
Commercial Existing	160,929,048	74,161,791	160
Commercial New Construction	40,381,144	18,575,326	8
Industrial Agriculture	250,881,301	115,405,399	78
Industrial Non-Agriculture	1,000,892,847	460,410,710	229
Large Volume Industrial	3,165,754,522	1,456,247,081	180
Total	**4,618,838,862**	**2,124,800,307**	**655**

Additional 2012 program details can be found in Appendix D and E.

In addition to developing multi-year plans, the natural gas utilities were required to establish a joint Terms of Reference (ToR) for a stakeholder engagement process. This ToR outlines the process by which the natural gas utilities will engage with their stakeholders with respect to program review, evaluation, audit and all other aspects in which the stakeholders are involved. The ToR also established a Technical Evaluation Committee (TEC). The goal of the process is "to establish DSM technical and evaluations standards for measuring the impact of natural gas DSM programs in Ontario."

This RFP is being issued by the TEC. Though the utility members of the TEC will manage administrative aspects of the project, the TEC as a whole (by consensus) will select the winning bid and manage the content of the work. The TEC is comprised of the following members:

- Jay Shepherd representing School Energy Coalition
- Julie Girvan representing Consumers Council of Canada
- Chris Neme representing Green Energy Coalition
- Bob Wirtshafter, Ph.D., Independent Member

[14] Low-Income not included in this table because it is not within the scope of this NTG study
[15] Low-Income not included in this table because it is not within the scope of this NTG study

- Ted Kesik, Ph.D., Independent Member
- Enbridge Gas Distribution Inc.
- Union Gas Ltd.

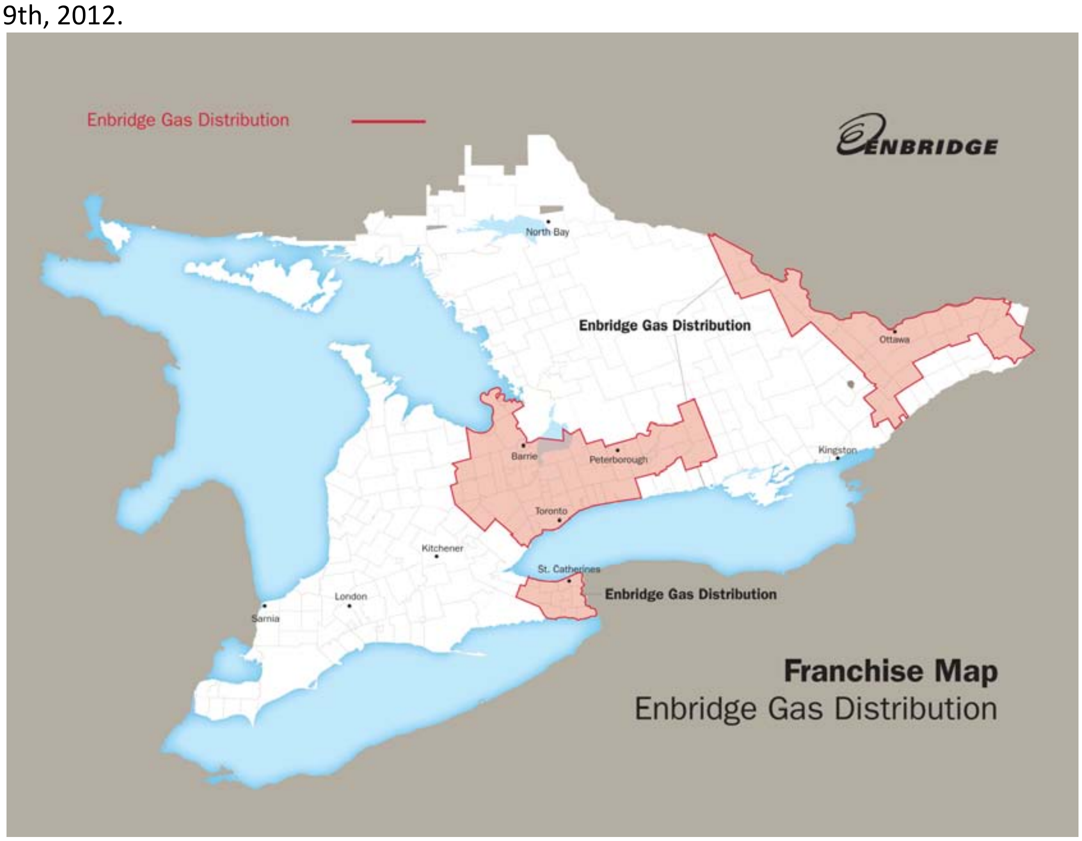
1.2 Enbridge and Union Custom Commercial and Industrial Programs
When considering the design for this study, the unique franchise territories, market segments and program designs for both Enbridge and Union should be taken into account.

Enbridge Gas Distribution:

Enbridge Gas Distribution serves approximately 1.6 million customers within its franchise area. Enbridge's 2012 – 2014 DSM Plan is the result of several years of work, with input from staff and external stakeholders. The plan reflects a new strategy and direction for the Company's DSM programs, an approach designed to respond to customer needs and changing market conditions. During August and September of 2011, Enbridge's extensive consultation with Intervenors resulted in acceptance of new program components, an expanded budget and Free Ridership value[16] for Low-Income programs. For this reason, Low Income custom projects will not be included for the purpose of this study. Agreement was also reached on budget allocation, metrics, and targets for the 2012 program year.

Under the 2012-2014 DSM Plan, the Total Resource Test (TRC) is used primarily as a program-screening tool while program evaluation focuses on gas savings by Cumulative Cubic Meters (CCM), participants, and cost-effectiveness ($/CCM). The Guidelines also establish budget limits and provide for new utility performance incentives for DSM activities.

The resulting Enbridge 2012 – 2014 DSM Plan (EB-2011-0295) was approved by the Board on February 9th, 2012.



[16] As a result of its negotiated Free Ridership value, Low Income will not be included in the study.

Union Gas Limited:
Union Gas' distribution business serves about 1.4 million residential, commercial and industrial customers in more than 400 communities across northern, southwestern and eastern Ontario. Its distribution service area extends throughout northern Ontario from the Manitoba border to the North Bay/Muskoka area, through southwestern Ontario from Windsor to just west of Toronto, and across eastern Ontario from Port Hope to Cornwall.

In 2011, Union sought approval for a proposed 2012 – 2014 portfolio of DSM programs which included custom based programs targeting commercial and industrial customers. Following a series of stakeholder discussions, Union received approval for its DSM plan with the caveat that the Large Volume Industrial program be filed as a separate application for 2013 and 2014.

In March 2013, Union Gas received Board approval for a 2013 – 2014 Large Volume DSM Plan that gives customers direct access to the full customer incentive budget they pay in rates as opposed to an aggregate pool of funds. Customers must use their funds to identify and implement energy efficiency projects by August 1st or lose the funds to be used by other customers in their rate class. This new Self Direct Program will now give large volume customers increased flexibility in accessing larger incentive amounts for larger projects. A more detailed description of the Union's Commercial and Industrial Custom Programs can be found in Appendix A.

1.3 Previous Net-to-Gross Research

During the fall and winter of 2008, while operating under an earlier DSM framework, Enbridge and Union commissioned a study to evaluate free ridership and spillover effects of their custom projects programs[17]. The study was designed to produce results at a 90% confidence level with +/- 10% precision at the utility level and a 90% confidence level with +/- 20% precision at the following segment levels:

[17] See Appendix B.

- Industrial
- Agriculture
- New Construction
- Commercial
- Multi-Residential

Following the study and based on its findings, the Board approved the resulting free ridership values; however spillover rates were not filed. With the establishment of the TEC, a review of these program effects is considered a priority.
Earlier this year through an RFP process, the TEC commissioned a North American jurisdictional review[18] which examined current trends in net-to gross factors for energy efficiency programs. The study was designed to provide the TEC with data to support them in determining appropriate next steps for updating the 2008 free ridership rates.

Based on the finding from the jurisdictional review and TEC discussions, the TEC has commissioned a full net to gross study as described in this RFP document.

[18] See Appendix C

1.4 Sources of Information

The following is a list of information which may assist the proponent in preparing a response to this RFP:

Title	Link/Location
Union Gas website	http://www.uniongas.com
Enbridge Gas Distribution website	https://www.enbridgegas.com
Summary of Enbridge and Union Gas Commercial and Industrial Natural Gas Custom Programs	Appendix A
Union Gas 2012 – 2014 DSM Plan	http://www.ontarioenergyboard.ca/OEB/_Documents/Documents/UNION_APPL_2012%20to%202014%20DSM%20Plan_20110923.pdf
Union Gas 2013 – 2014 Large Volume DSM Plan	http://www.ontarioenergyboard.ca/OEB/_Documents/Documents/UNION_APPL_DSM_LargeVolume_2013-14_20120831.pdf
Enbridge Gas Distribution 2012 – 2014 DSM Plan	http://www.ontarioenergyboard.ca/OEB/_Documents/Documents/EGDI_appl_DSM%20plan%202012-2014_20111104.PDF
Ontario Energy Board, Demand Side Management Guidelines for Natural Gas Utilities EB-2008-0346	http://www.ontarioenergyboard.ca/OEB/Industry/Regulatory%20Proceedings/Policy%20Initiatives%20and%20Consultations/DSM%20Guidelines%20for%20Gas%20Distributors
Enbridge Gas Distribution 2012 Commercial and Industrial Custom Projects	Appendix D
Union Gas 2012 Commercial and Industrial Custom Projects	Appendix E

Section 2 – Study Objectives, Work Scope and Deliverables

2.1 Study Goals and Objectives

As part of its mandate, the TEC prioritizes and oversees evaluation activities for Ontario's Natural Gas DSM programs. Following the review of other North American jurisdictions[19] the TEC concluded that a full NTG study was necessary. As such, the purpose of this Custom Program Free Ridership and Participant Spillover Study is to develop reliable NTG estimates that are applicable to Enbridge and Union Gas' commercial and industrial custom energy conservation programs. Descriptions of these programs can be found in Appendix A.

The primary objective for this study is to assist the TEC in developing NTG factors to be applied to each utility's custom commercial and industrial programs.[20] This includes:

- Estimating program free ridership factors by market sectors and precision targets for both the Enbridge and Union Gas' custom Commercial and Industrial programs. A 90/10 precision target is preferred for both the aggregate and sub segment level.
- Estimating participant inside and outside[21] spillover as per market sectors and precision target for both the Enbridge and Union Gas' custom Commercial and Industrial programs.[22]
- Provide guidance on the development of a strategy for applying free ridership and spillover data collected on previous program participation to forward looking DSM program activity.

Note: It is not intended that the study will include data collection of non-participant spillover.

The following section of this RFP describes requirements of the study on the assumption that the primary methodology will be surveying participants. The TEC understands that this is a common method used in North America to estimate NTG effects. The TEC is actively interested in proposals that rely on other methodologies, either in place of or in support of the participant survey approach, including non-participant surveys, econometric analyses, and other methods. Proponents that are able to provide higher acceptability of results through use of additional or alternative methods will be favourably considered. Any additional costs associated with an additional or alternative approach should be shown separately.

For the purposes of responding to this RFP, the TEC will rely on the bidder to provide recommended segmentations for both Enbridge and Union's commercial and industrial market sectors. At a minimum, the TEC would expect the bidder to provide a brief narrative explanation on viability of achieving a 90/10 precision target within the prescribed budget for the market segments targeted by the study. One required segment that must be looked at separately is Union's Large Volume Industrial customers due to the unique nature of that program. Proponents are encouraged to define additional segmentation as appropriate for approval by the TEC.

Table 2.1 Proposed Customer Segments

[19] See Appendix C.
[20] Supra note 11.
[21] Inside spillover refers to non-incented measures that were installed within the same project or facility. Participant outside spillover refers to measures for which the customer did not receive an incentive adopted in an outside location or unrelated project for a participating customer.
[22] Trade ally surveys should be considered and may be informative for evaluating non participant spillover program effects.

The TEC reserves the right to provide comments and requested revisions to the successful proponent after the bidding process.

2.2 Study Scope and Anticipated Tasks

The TEC seeks a qualified proponent or a team of proponents to perform the following expected tasks:

Project Kick-Off Meeting – The proponent will participate in a kick-off meeting with the TEC. The purpose of this meeting will be to introduce the proponent to the TEC members, review the proponent's proposed approach, work plan, timelines, and discuss any changes or questions. The proponent will be responsible for scheduling meetings, developing meeting agendas, running the meeting and drafting revised documents.

The proponent is expected to provide the TEC with study updates on a bi-monthly basis. The proponent will be responsible for scheduling and running the bi-monthly meetings. Meetings should align with scheduled TEC monthly meetings (to be scheduled).

Develop Survey and Sampling Plan – The proponent will develop a sampling plan which should include a proposed schedule for any interviews and the appropriate sample size that will achieve the prescribed precision targets. The proponent should consider accuracy for both free-ridership and participant spillover in the sample design and whether different years of participation be sampled for each (e.g. sample 2011 customers for participant spillover and 2012/13 customers for free-ridership).

There is an expectation that the proponent will enable the TEC to participate in a pre-test of any survey.

Data Collection– Developed in conjunction with the above mentioned, the proponent will develop a survey methodology, survey plan, research instruments, and calculation algorithms to meet the study objectives described in section 2.1.

Utilizing the above sampling and survey plans, the proponent will conduct interviews. An advance letter explaining the study will be facilitated by the Utilities prior to the survey. Research methods are not limited to telephone interviews and may include on-site in-depth interviews with more complicated processes. For the purpose of this proposal, proponents are expected to tell us how many on-site interviews they would envision and the associated costs for each.

Any customer inquiry or request for information outside of the study objectives should be forwarded to the Utilities as soon as possible so that they can respond to their customers' issues in a timely manner.

Data Analysis – After the data collection activities and preliminary analysis are concluded, the proponent will prepare a draft memorandum that discusses the proposed free ridership and participant spillover calculation algorithms. The final scoring methodology approved by the TEC, will become part of the final report.

Draft/Final Report - The proponent shall prepare a draft report for review and comment by the TEC. Considering draft report comments and feedback provided by the TEC, the proponent will produce a final report that may be published by the TEC.

2.3 Deliverables

The project deliverables should include the following:

- A detailed work plan and schedule guided and approved by the TEC.
- For any survey methodology that is proposed:
  - A draft and final sampling plan and scoring methodology approved by the TEC. As noted in the study objectives, a 90/10 precision target is preferred at both the aggregate and sub segment levels. If this is not possible within the suggested budget, please outline the additional budget required to achieve this target.
  - A draft and final of survey instrument and guides approved by the TEC and experienced utility staff.
  - A draft and final data tracking mechanism to ensure responses are collected in a systematic and consistent manner across different interviewers.
  - A draft and final calculation algorithms memo outlining the methodology used to translate survey scores into free ridership and participant spillover results as approved by the TEC.
- For any non-survey methodology that is proposed, such other plans and reports as would be consistent with that methodology. In addition, the proponent would be expected to explain how that methodology meets with desired precision levels.
- A draft report addressing the study objectives described in Section 2.1 Study Goals and Objectives.
- A final report incorporating comments from the TEC.

2.4 Proposal Requirements

The proposal should include the following:

- A detailed description of the recommended approach and methodology that will be used to achieve the study objectives, and, for any survey methodology that is proposed, to achieve the expected tasks described in Section 2.2 Study Scope and Anticipated Tasks. The proposed methodology must specifically address the 2013 change in the Union Large Industrial program described in this RFP, and how the proponent proposes to deal with that change in the context of the overall study objectives.
- An outline of the experience, skills and qualifications for all project team members.
- A list of three references including contact information for other projects. Examples of similar work would be helpful.
- An outline of a proposed schedule for delivery of the work, delegation of responsibility and work plan.
- An outline of fees and costs, including hours and rates by tasks and team member.
- **Subcontractors:**
  (a) Identification of any subcontractors, including any affiliates of the Proponent, to be used in performing the Services. Subcontractors cannot be changed without written approval of the TEC. Where no list of subcontractors is submitted, the Proponent will only use its own forces to perform the services.
  (b) Subcontractors' company name, address, contact name, relationship to the Proponent, and work to be contracted to subcontractor must be provided to the TEC as part of the Proposal.
- Insurance: Information demonstrating the proponent possesses adequate insurance, given project risks and requirements.

- Workplace Safety and Insurance Board (WSIB): Information demonstrating registration with the WSIB, as well as all compliance with its requirements as applicable.

2.5 Selection Criteria

Proposals will be evaluated based on the following criteria:

- Approach, work plan and methodology proposed:
    - o Does the approach/methodology present a comprehensive, sound approach for accomplishing the requirements of this RFP?
    - o Does the proposed approach demonstrate a clear understanding of the unique market segments and direct and indirect market approaches by Enbridge and Union Gas?
    - o Does the proposed methodology adequately measure impact on customer behavior beyond financial incentives or similar transactions?
    - o Does the approach/methodology reflect best practices associated with measuring net-to-gross factors?

- Qualification and experience of key project personnel particularly with their experience in NTG analysis and C&I custom programs:
    - o Does the proposed team have experience in conducting similar work?
    - o Demonstration that the firm has worked with a collaborative multi-stakeholder processes. Does the project team demonstrate a sufficient understanding of the Ontario marketplace, regulatory processes and DSM framework?
    - o Is the project team's overall capability appropriate?
- Proposal costs:
    - o How cost-effective is the proposal?
    - o Is the proponent's cost allocation by task and personnel appropriate when compared to the cost allocation of other comparable proposals and their projected results?
    - o Are hourly rates, overhead rates, and total hours reasonable and appropriate for completing each task?

2.6 Queries and Clarifications

- All inquiries or requests for clarification should be submitted electronically by email to the designated contact person. They will be shared with all members of the TEC.
- Only a response to a query that has been incorporated into or issued as an addendum will modify or amend this RFP and, otherwise, responses to queries will have no force or effect whatsoever and shall not be relied upon by any proponent.
- At the discretion of the TEC, responses to one proponent may be provided to all proponents.

2.7 Exclusion and Waiver of Liability

Neither the TEC nor any of its members nor the organizations with which they are associated (collectively referred to as "the TEC group" will have any liability to any person or entity for any damages, including, without limitation, direct, indirect, special or punitive damages, arising out of or otherwise relating to this RFP, including without limitation, (i) any proponent's proposal; or (ii) any compliant or non-compliant, qualified or unqualified submission or participation or involvement in this RFP process; or (iii) acts, omissions or any course of conduct by any members of the TEC group, the primary contact or any agent or representative of the TEC in connection with the conduct of this RFP process.

The waver and exclusion applies to all possible claims, whether arising in contract, tort, equity, or otherwise, including, without limitation, any claim for a breach by any of the TEC group of a duty of fairness or relating to the failure by any of the TEC group to comply with the rules set forth in this RFP. Each proponent has read, understood and agree that this waiver and exclusion of liability is clear and unambiguous and by making its submission it agrees that it has no claim in any way connected to any of the circumstances described in this section or the RFP. The provisions of this section shall survive any cancellation of this RFP and the conclusion of this RFP process.

2.8 Reservation of Rights

The TEC has the right, at their discretion, to change the dates, schedule, deadlines, process and requirements described in this RFP, to accept any Proposal, to reject any or all Proposals, to disqualify any Proponent, to change the RFP process or any of the RFP Documents, to change the limits and scope of the Services, to not accept the lowest price Proposal, to reissue the same RFP or a different request for proposals document in relation to the Services, to seek clarification around any Proposal to waive immaterial defects and minor irregularities in a Proposal, to receive any Proposal after the Proposal Submission Deadline, to cancel this RFP or the Services or to elect not to proceed with the Services for any reason whatsoever, at any time, without incurring any liability or obligation for costs and damages incurred by any Proponent.

The TEC may independently verify any information in any Proposal. The TEC also has the right to disqualify any Proponent and reject the Proposal of any Proponent which has failed to disclose any information that would, if disclosed, materially adversely affect the TEC's evaluation of the relevant Proponent's Proposal.

The TEC may, in its discretion, without liability, cost, or penalty, at any time, reject any Proposal or disqualify a Proponent if, in the judgment of the TEC, such Proposal contains materially false, incorrect, or misleading information or reveals a Conflict of Interest that the TEC is not prepared to waive in its discretion. The provisions of this Section shall survive any cancellation of this RFP and the conclusion of this RFP process.

2.9 No Implied Offer or Binding Commitment

No contract or other binding obligation on the TEC or any member of the TEC group will be implied (by law or otherwise) unless and until the utilities and the Proponent have executed the Services Agreement on terms and conditions acceptable to the utilities.

2.10 Media Release

No news release, advertisements, announcements or other communication pertaining to this RFP, the RFP Documents, the Proposal or the Services will be issued by any Proponent.

2.11 Incurred Costs

The Proponent participates in this RFP process at its sole discretion and risk. The Proponent is solely responsible for all costs of preparing and submitting its Proposal and any other prior or subsequent activity associated with the RFP process, including Proponent presentations, meeting attendance, due diligence and/or contract negotiations, regardless of whether or not the utilities, on behalf of the TEC, enters into a Services Agreement with the Proponent. No honorarium or reimbursement shall be provided to any of the Proponents.

2.12 Governing Law

The relationship of Proponent and the TEC and the members of the TEC group will be governed by the laws of the Province of Ontario and the laws of Canada applicable therein.

2.13 Addenda

The RFP may only be amended by addendum (an "Addendum" and collectively, the "Addenda") which will become part of the RFP. Clarification or information provided orally by the any member of the TEC group, the Primary Contact or any other person is not binding on the any member of the TEC group and should not be relied on by any Proponent unless a confirming Addendum is issued. Proponents shall submit with their Proposal written confirmation of the receipt of all Addenda during the RFP period.

Section 3 – RFP Information and Instructions

3.1 Title

RFP-002-2013 - Measuring Net-to-Gross (NTG) Estimates for Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs.

3.2 Designated Contact Person for this RFP

Haris Ginis
Program Evaluator
Union Gas Ltd
416-496-5240
hginis@uniongas.com

Please submit all questions and other communications regarding this RFP to the designated contact person listed above. Unless authorized specifically in writing by the designated contact person, neither the Proponent (nor any representative of the Proponent) shall, directly or indirectly, contact or attempt to contact any director, officer, employee, representative, consultant or agent of the any member of the TEC group, other than the designated contact person, in respect of any aspect of this RFP process or the Proposal. Failure to comply may result in disqualification of the Proponent from further consideration by the TEC.

3.3 Schedule of Activities

Activity	Due
Issue Date of RFP	November 1, 2013
Intent to Bid and Conflict of Interest Notice	Noon (EST) December 2, 2013
TEC Eligibility Responses Due	December 2, 2013
Proposal Submission Due Date	5pm (EST) December 23, 2013
Proposal Selection	Week of January 27, 2014
Anticipated Project Start-Up Meeting and Review of Initial Documents	February 2014

The TEC reserves the right to modify this schedule at its discretion.

Potential proponents are required to submit a notification of intent to submit a proposal along with both a statement of conflict or potential conflict of interest and the identification of any financial relationships the proponent (or its subcontractors) has with members of the TEC group by Noon EST on December 2, 2013. Proponents are advised not to prepare bids until their eligibility has been determined and communicated by the TEC.

For the purposes of this RFP, a conflict of interest exists when there is a professional interest (financial or otherwise) that could hinder your firm in providing objective insight and un-biased direction to the findings or recommendations from this study.

Questions regarding this RFP must be submitted by email to the Designated Contact Person listed in section 2.2 prior to the close of the question period.

3.4 Proposal Submittal Deadline

Proponents are required to submit electronic versions of their proposals to:

Haris Ginis
Program Evaluator
Union Gas Ltd
416-496-5240
hginis@uniongas.com

The proposal should be submitted in Adobe Acrobat format. An electronic receipt will be sent to those who submit proposals by 5 **pm EST on December 23, 2013**.

Late proposals will be rejected.

3.5 Contract Award

The TEC will notify all proponents of the contract award decision by email. The anticipated award date is specified in Section 3.3 Schedule of Activities.

3.6 Anticipated Project Budget

The project budget for this study will be as determined by the TEC after reviewing the proposals submitted in this RFP. For the guidance of the proponents, the preliminary budget for the Measurement of Net-to-Gross (NTG) Factors of Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs pursuant to this RFP is $400,000 CAN.

Applicants are welcome to propose additional study objectives or tasks that could increase the accuracy and/or understanding of research data and how they could be applied to future DSM growth and industry's best practices. All additional activities should be described and priced separately in the response to this RFP.

Appendix A – Summary of Commercial and Industrial Natural Gas Custom Programs

Enbridge Gas Distribution

The following summary of the Enbridge programs was prepared by Enbridge Gas Distribution.

1. **<u>Commercial Custom Savings Program</u>**

Target Market:

- Large and medium sized customers in all segments of the Commercial sector which includes institutional and multi-family.

Program Goals:

Reduce natural gas use through the capture of cost effective energy efficiency opportunities.

Program Strategy:

Enbridge offers a variety of incentive, service and educational based initiatives to Commercial sector customers. Given the myriad of building types and end-uses, ownership structures and leasing arrangements, the Commercial sector is a complex market in which to deliver energy efficiency. The initiatives offered under the Commercial Sector Custom program rely on a combination of outreach, consultation, education and incentives to encourage commercial customers to undertake energy efficiency investments.

Existing Buildings Custom Projects:

The custom project portfolio is aimed primarily at medium and larger users, providing them with support to identify energy saving opportunities, customized energy savings calculations, feasibility studies, and access to financial incentives. The program's main focus is on projects where multiple technologies are considered and where customized energy savings calculations are required. The size and complexity of custom projects often requires Enbridge support through a project development process lasting several months or even more than a year.

Energy Compass and Run It Right:

In 2012, Enbridge launched two new initiatives which encourage a continuous improvement strategy for larger commercial customers. These programs build on the Company's history of working with customers to identify single capital investment and operational improvement projects. Now, through an ongoing customer relationship, the Company will help customers to prioritize energy efficiency investments across their portfolio of buildings, implement efficiency measures, monitor building performance and operate their buildings at peak efficiency. More specifically, Energy Compass is a benchmarking program that is designed to help customers identify and focus their efforts on high energy intensity buildings. The program alone will not claim energy savings per se, but rather is an enabling program that will lead to the identification of energy efficiency opportunities. The Run It Right program (operational improvements) launched in 2012 requires a full year of energy monitoring; as a result savings will not be reported until 2013.

Summary:
Enbridge has an important role to play, directly and indirectly, in knowledge development, opportunity identification, measurement, engineering analysis and assisting customers with action and implementation, including financial support. By creating these added value partnerships and offerings, customers, business partners and Enbridge have a vested interest in working together towards measured savings. Through its expertise and unique access to a variety of delivery agents, Enbridge can identify and stimulate appropriate energy solutions directly with customers or indirectly by supporting their business partners.

The custom project portfolio is aimed primarily at medium and larger users, providing them with support to identify energy saving opportunities, customized energy savings calculations, feasibility studies, and access to financial incentives. Participation in the custom project portfolio has primarily come from boiler and building control projects, including but not limited to demand control ventilation, variable frequency drives as well as other energy efficiency measures such as operational improvements, building envelope and heat recovery.

2. Industrial Custom Savings Program

Target Market:
Targets market segments include:

- Large, medium and small industrial customers with requirements for industrial process heat, space heating, and water heating.

Program Goals:
Support industrial customers to achieve energy savings through a continuous improvement approach.

Program Design:
The Enbridge industrial program is designed around a continuous energy improvement cycle which includes five steps: Knowledge Development, Opportunity Identification, Measurement, Engineering Analysis, and Action & Implementation. Enbridge Energy Consultants work hand in hand with customers every step of the way, to remove the specific barriers that arise for each customer in implementing energy efficiency projects.

Knowledge Development: involves educating our customers with the knowledge necessary to implement energy efficiency projects. This is done through technical publications and in-person workshops on topics from energy efficient technologies, to new energy management standards.

Opportunity Identification: involves helping customers identify specific opportunities to improve their energy efficiency. Enbridge has a staff of experts, which work directly with customers to identify opportunities through various on-site assessments. Enbridge has specialized testing equipment that can be used for boiler, process heating, heating & ventilation and thermal imaging assessments. If an expert is needed, Enbridge has funding available to offset the cost of a 3rd party consultant. Enbridge staff can assist the customer in writing the scope of work to ensure the best possible result.

Measurement: Data is a key element for customers when making informed decisions about their energy use. Enbridge staff can assist customer in identifying what information is most important and the most effective way to measure it. Enbridge also offers incentives towards purchasing measurement equipment, including meters and data acquisition.

Engineering Analysis: Enbridge staff provides analysis for customers in a variety of forms. From interpretation of data, to mass and heat balance calculations, Enbridge staff will assist customers in quantifying the energy savings and costs associated with efficiency opportunities and assist them in building the business case for management. If an expert is required, funding is available for a third party consultant.

Action & Implementation: Enbridge staff can connect customers with product information and business partners to facilitate the project. Finally, funding is available to help offset the cost of energy efficient projects. Enbridge Energy Solutions Consultants work with each customer to overcome barriers to implementing a project.

Union Gas Limited

The following summary of the Union programs was prepared by Union Gas Limited.

1. Commercial and Industrial Custom Savings Program

Target Market:
Targets market segments include:

- New and existing commercial buildings in all segments of the commercial sector.
- Industrial process heat, space heating and water heating.

Program Goals:
To generate long-term and cost-effective energy savings for customers Union Gas:

- Promotes the identification of energy saving measures through proper analysis.
- Encourages the procurement and utilization of energy-efficient equipment and processes.
- Encourages the adoption of operations and maintenance actions.
- Encourages the adoption of process related improvements.
- Supports a continuous and wide-scope focus on energy management practices.
- Increases energy awareness through education and training initiatives.

Program Strategy:
Union Gas provides dedicated technical expertise to assist customers in obtaining value from the identification, adoption and implementation of energy efficient actions throughout their sites, facilities and operations. Union Gas engages customers to increase awareness surrounding the positive benefits achieved through active energy management. Customers are provided financial incentives and education/training initiatives that are value-added; this encourages customers to focus on continuous energy management as an integral part of their operations and practices.

Program Offerings:
Union Gas continues to encourage the adoption of energy efficient equipment, technologies and actions through direct customer interaction.

The program offerings ensure customers have access to education and awareness initiatives, technical assistance and financial incentives, supporting the continuous improvement approach (Plan/Do/Check/Act) to active energy management.

Program offerings include:

- Customer Engagement: Communication and Education
- Engineering Feasibility and Process Improvement Studies
- Operation and Maintenance Practices
- New Equipment and Processes
- Energy Management

<u>Customer Engagement: Communication and Education:</u>
Union Gas provides education, training and technical expertise and offers a wide variety of materials aimed at building an increased awareness of energy-efficiency opportunities and benefits.

<u>Engineering Feasibility and Process Improvement Studies:</u>

Union Gas supports the completion of studies to identify and quantify potential energy savings measures. Furthermore, Union Gas supports comprehensive process improvement studies to determine and assess financial costs and benefits of energy-efficiency opportunities, supporting the customer's internal decision making process.

<u>Operation and Maintenance Practices:</u>
Union Gas provides financial incentives to support the completion of operation and maintenance actions and practices which result in saving natural gas, and which may also increase energy-efficiency and/or improve productivity of customers' operations. These incentives are available for customers, with or without an engineering feasibility or process improvement study.

<u>New Equipment and Processes:</u>
Union Gas provides financial incentives to support the installation of new equipment and processes which result in saving natural gas, and which may also increase energy-efficiency and/or improve productivity of customer's operations. These incentives are available for customers, with or without an engineering feasibility or process improvement study.

<u>Energy Management:</u>
Union Gas provides financial incentives to support the installation of energy meters, monitoring and management systems, allowing customers to manage the energy intensity of their operations actively and continuously.

<u>Market Delivery:</u>
The program offerings are delivered directly to customers by dedicated Union Gas Account and Project Managers; energy experts who are knowledgeable about individual customer's businesses, operations and processes.

Collaboration with key organizations, original equipment manufacturers, vendors, suppliers and consultants is required to expand the reach of Union's program offerings, educate customers and encourage the adoption of energy-efficiency best practices. Furthermore, these collaborations develop customer's capacity to make informed energy-efficiency decisions while helping to promote the investigation and implementation of energy-efficiency projects.

2. <u>Large Industrial Rate T1/Rate 100 Program (New program 2013 and beyond)</u>

Target Market:

- Large industrial customers (Rate T1, Rate T2 and Rate 100)

Program Goals:

- Provide customers (Rate T2/Rate 100) with direct access to their associated incentive funds for a set period of time, allowing these customers the planning certainty to incorporate energy-efficiency incentives into their operations and providing flexibility for these customers to align funds with corporate initiatives.
- Provide all Large Volume customers with the tools, expertise and support to incorporate energy-efficiency into their everyday operations and practices through continuous improvement.
- Promote the identification of energy saving measures through proper analysis techniques.
- Encourage the procurement and utilization of energy-efficient equipment and processes.
- Encourage the adoption of operations and maintenance actions and process improvements that support a continuous focus on energy management.

- Generate long-term and cost-effective energy savings for customers, to enable increased competitiveness in the global economy.

Program Strategy:
To achieve these program goals, Union will provide dedicated technical expertise to assist customers in obtaining value from the identification, adoption and implementation of energy efficient actions throughout their sites, facilities and operations. Union will engage customers to increase awareness surrounding the positive benefits achieved through active energy management. Customers will be provided financial incentives and education/training initiatives that are value-added; this will encourage customers to focus on continuous energy management as an integral part of their operations and practices.

Program Offerings:
Consistent with the 2012 Program, Union will continue to encourage the adoption of energy efficient equipment, technologies and actions through direct customer interaction. The program offerings have been developed to ensure customers have access to education and awareness initiatives, technical assistance and financial incentives, supporting the continuous improvement approach (Plan/Do/Check/Act) to active energy management.

The following are the Program offerings:

- Customer Engagement: Communication and Education
- Engineering Feasibility and Process Improvement Studies
- Operation and Maintenance Practices
- New Equipment and Processes
- Energy Management

<u>Customer Engagement: Communication and Education:</u>
Union will provide education, training and technical expertise to Rate T1, Rate T2 and Rate 100 customers. Customers will be offered a wide variety of materials aimed at building an increased awareness of energy-efficiency opportunities and benefits. Union’s targeted and connected set of initiatives afford Rate T1, Rate T2 and Rate 100 customers the opportunity to incorporate continuous energy management into their operations.

<u>Engineering Feasibility and Process Improvement Studies:</u>
This offering will support studies to identify and quantify potential energy savings measures. Furthermore, the offering will support comprehensive process improvement studies to determine and assess financial costs and benefits of energy-efficiency opportunities, supporting the customer’s internal decision making process.

Filed: 2017-12-18
EB-2017-0323
Exhibit A
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MEASUREMENT OF NTG FACTORS FOR ONTARIO'S NATURAL GAS CUSTOM COMMERCIAL AND INDUSTRIAL DSM

Scope of Work

for Ontario Natural Gas Technical Evaluation Committee (TEC)

Date: 3/2/2016

Table of Contents

Tables, Figures, Equations

OVERVIEW

This document presents the scope of work for the measurement of net-to-gross (NTG) Factors for Ontario's Natural Gas Custom Commercial and Industrial demand side management (DSM) programs for the Ontario Natural Gas Technical Evaluation Committee (TEC).

The two largest gas utilities in Ontario, Union Gas Limited (Union) and Enbridge Gas Distribution (Enbridge), (together, the "utilities") have offered DSM incentives to businesses for implementing energy efficiency improvements for twenty years. The Union custom incentives are provided as part of the Union commercial program and as part of the direct access program for large industrial customers. The Enbridge custom incentives are provided as part of the Enbridge commercial and industrial programs as well as its Run-it-Right retro-commissioning program.

This evaluation will assess the NTG factors for custom measures in the Union large industrial and commercial programs and the Enbridge commercial, industrial, and Run-it-Right programs. This work plan is a living document that will be updated as new data is incorporated and additional decisions are made.

Evaluation Objectives

The overall goal of this evaluation is to develop transparent free ridership and spillover factors for custom commercial and industrial programs, to be used for future programs.

Evaluation Approach

The methodology selected for this evaluation will rely on end-user self-report surveys and interviews to estimate program NTG. The end user self-reports will be supplemented by project-specific interviews with vendors and vendors to capture indirect effects of the program on end-user decision making. Surveys and interviews will be collected from the most recent program years in order to create NTG factors that will be most meaningful for future years.

For Union's large industrial program and the largest commercial projects and the largest Enbridge industrial and commercial projects, we will estimate NTG using participating end user self-reports and project-specific interviews with vendors.

Key Concepts

This section defines several key concepts that will be used throughout this work plan, using the definitions from the Ontario DSM Guidelines for spillover and free rider.

- *Spillover* "refers to effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program." [1] We consider both inside and outside spillover through this project.
  - *Inside spillover* "refers to non-incented measures that were installed within the same project or facility."[2]
  - *Outside spillover* "refers to measures for which the customer did not receive an incentive adopted in an outside location or unrelated project for a participating customer." [3]

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[1] Ontario Energy Board *Demand Side Management Guidelines for Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

[2] Ontario Natural Gas Technical Evaluation Committee (TEC), *Request for Proposal: Measurement of Net-to-Gross (NTG) Factors for Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs*, RFP-002-2013 (2), December 2013, Section 2.

- A *free rider* is "a program participant who would have installed a measure on his or her own initiative even without the program." [4]
- *Gross savings* are "the changes in energy consumption and/or demand that result directly from program-related actions taken by participants in an efficiency program, regardless of why they participated."[5]
- *Net savings* are "the changes in energy consumption or demand that are attributable to an energy efficiency program. The primary, but not exclusive, considerations that account for the difference between net and gross savings are free riders (i.e., those who would have implemented the same or similar efficiency projects, to one degree or another, without the program now or in the near future) and participant and non-participant spillover (i.e., savings that result from actions taken as a result of a program's influence but which are not directly subsidized or required by the program). Net savings may also include consideration of market effects (changes in the structure of a market)."[6]
- The *net-to-gross* (NTG) ratio is an adjustment factor that reduces savings due to free ridership and increases savings to account for spillover. The NTG ratio "is the portion (it can be less than or greater than 1.0) of gross savings (those that occur irrespective of whether they are caused by the program or not) that are attributed to the program being evaluated."[7]

[3] Ontario Natural Gas Technical Evaluation Committee (TEC), *Request for Proposal: Measurement of Net-to-Gross (NTG) Factors for Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs*, RFP-002-2013 (2), December 2013, Section 2.

[4] Ontario Energy Board *Demand Side Management Guidelines for Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

[5] SEE Action, Energy Efficiency Program Impact Evaluation Guide: Evaluation, Measurement, and Verification Working Group, DOE/EE-0829, December 2012. https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/emv_ee_program_impact_guide_1.pdf, page xiv

[6] Ibid

[7] Ibid, page 5-1

SUMMARY OF TASKS

The DNV GL team has broken the project into six discrete tasks which are presented, along with their status, in Table 1. These tasks are discussed in greater detail in the next sections of the report.

Table 1: Key Project Tasks and Completion Status

Key Tasks		
☒	**Task 1: Project Kickoff**	
	☒	Convene a project kickoff meeting
	☒	Reach a consensus on methodology
☐	**Task 2: Sample Design**	
	☐	Explore the tracking data
	☐	Define the unit of analysis
	☐	Stratify the data
	☐	Design the sample
	☐	Prepare the sample frame
☐	**Task 3: Data Collection**	
	☒	Interview program managers and staff
	☐	Interview program Energy Solution Consultants (ESC)
	☐	Survey program participants
	☐	Interview large or complex program participants
	☐	Interview program trade allies
	☐	Conduct follow-up interviews with program participants
☐	**Task 4: Data Analysis**	
	☐	Analyze survey and interview data
	☐	Calculate estimates
☐	**Task 5: Reporting**	
	☐	Produce an evaluation report identifying free ridership and spillover factors for custom commercial and industrial programs
☐	**Task 6: Project Management**	
	☐	Complete evaluation on time, on budget and within scope
	☐	Keep client informed on progress

We have completed the project kickoff meeting, program manager and staff interviews, and initial sample design as part of the planning phase, which have informed the specific plan outlined in this document. Once DNV GL receives the complete tracking dataset we will create the full sample design which will be used to select projects for computer aided telephone interview (CATI) surveys and expert in-depth interviews (IDI). Next, we will request the contact information and necessary documentation to proceed to the participant data collection phase. This will also include interviews with Energy Solution Consultants (ESCs) and vendors who have completed projects through the program. We will calculate the free ridership, spillover, and NTG estimates for each program and domains within programs where there is sufficient sample to provide estimates while protecting respondent confidentiality. These estimates will be provided in the final evaluation report.

Task 1: Project Kickoff

Meeting and Follow-up Memorandum Overview

The kickoff meeting on March 17, 2014 was an in-person meeting between the TEC and Evaluation leadership. Most of the time was spent on high level evaluation concepts and in understanding different perspectives within the TEC. This meeting was followed by a series of memos with project decisions on April 1, 2014 (kickoff summary), June 12, 2014 (kickoff parking lot items), and July 2, 2014 (methodology explanation). The kickoff was held prior to contract negotiation, which was completed in mid-2015.

Table 2: Task 1 Tasks and Completion Status

Task 1: Project Kickoff Subtasks
☒ **Task 1.1: Convene a project kickoff meeting**
☒ **Task 1.2: Reach a consensus on methodology**

Resolved Items

- **Consensus around primary project objective.** The primary objective of this project is a transparent, reputable study that produces strong, credible, and defensible NTG ratios to be used on a go-forward basis. (4/1/2014)

- **Concern about scope creep.** The potential for scope creep, particularly analysis and reporting of information collected, but not part of the NTG estimation, is a concern of several members of the TEC and evaluation team. (4/1/2014)

- **Consensus for TEC review of data collection instruments.** DNV GL will submit survey instruments, along with probes, question rationale and scoring to the TEC. (6/12/2014)

- **Consensus for qualitative reporting of participant decision making reasons.** DNV GL will include qualitative discussion of participant-reported reasons for results describing NTG and spillover analysis results. (6/12/2014)

- **Stratification determined by DNV GL.** Stratification of survey participants will be representative, as determined by DNV GL's expert judgment. (6/12/2014)

- **First Year Net Savings (Y1NS) method recommended.** DNV GL recommends the use of the Y1NS method for the current NTG study. The LCNS method requires engineering calculations that would add additional scope to the standalone NTG study. (7/2/2014).[8]

[8] July 2, 2014 DNV GL Memo to TEC: *Attribution Method Comparison (Y1NS vs LCNS)*.

Task 2: Sample Design

The objective of the sample design is to select customers for surveys and IDIs to estimate the free ridership and spillover for the custom C&I projects and to create an optimized plan for data collection and expansion. Prior to completing the sample design, we determined that we are likely to attempt a census of participants due to the ratio of targeted completes to accounts in the data provided. Even though we intend to attempt a census, we completed most of the steps required in a sample design to have a basis for post-stratifying the completed surveys and IDIs for expansion to the population.

Through the sample design process, we define:

- The unit of analysis
- The number of surveys targeted for each program
- The number of IDIs targeted for each program
- The stratification that will be used for expansion

This section presents the stratification plan using the initial datasets for 2013 and 2014 custom C&I projects provided by Union and Enbridge. We anticipate receiving updated data, including 2015 projects and the Run-it-Right project data in early March. Table 3 presents the sample design tasks and their completion status.

Table 3: Task 2 Subtasks and Completion Status

Task 2: Sample Design Subtasks
☐ **Task 2.1: Explore the Tracking Data**
☒ Initial data exploration , Union and Enbridge
☐ Exploration of the full datasets, Union and Enbridge
☐ **Task 2.2: Define the Unit of Analysis**
☒ Initial unit of analysis definition
☐ Final unit of analysis definition using full datasets
☐ **Task 2.3: Stratify the Data**
☒ Initial stratification
☐ Final stratification using full datasets
☐ **Task 2.4: Design the Sample**
☒ Initial sample design
☐ Full sample design and precision optimization
☐ **Task 2.5: Prepare the Sample Frame**
☐ Sample contact information and documentation request
☐ Prepare the sample frame

Task 2.1: Explore the Tracking Data

We first explored the tracking data provided by Union and Enbridge to determine data availability, the number and types of measures installed, as well as the size and quantity of projects. We explored the Union and Enbridge datasets separately.

Enbridge Participant Data

The participant data files provided by Enbridge included custom C&I energy efficiency projects completed during the 2013 and 2014 program years (Table 4). DNV GL has not yet received the 2015 tracking data, nor data for the Run-it-Right program. These data will be included in the final version of this plan. In the 2013 and 2014 Enbridge tracking data, there are 1,603 records and 1,189 unique accounts. The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. Across the three program years, we expect to have approximately 2,400 records for approximately 1,600 unique accounts.

Table 4: Enbridge Participation Metrics by Year

Program Year	Accounts	Gas Savings (m^3)
2013	681	53,030,333
2014	576	46,195,015
2015 projection*	576	46,195,015

*These data are duplicates of 2014 for reference purposes only.

The tracking data includes measure level savings specific to a measure, site and date. As part of defining the unit of analysis, we used the tracking data variables *load type name*, *end use*, and *technology* to categorize measures into measure types (Table 5). The tracking data we received had some conflicts among identifiers that made it difficult to create consistent measure types across the sample frame. For our initial sample design we divided the measures into two categories: equipment and operations & maintenance (O&M), but we plan to revisit this decision once we receive the complete dataset and we know the overall distribution of measures.

Table 5: Approximate Enbridge Participation Metrics by Measure, 2013-2015*

Measure Type	Accounts	Gas Savings (m^3)
Building Shell	67	3,788,169
Controls	486	25,238,860
Greenhouse	17	5,295,971
Heat Recovery	23	1,696,982
Optimization and Maintenance	182	18,400,956
Other Equipment	107	36,085,459
Process Heat	12	4,179,649
Space Heat	765	39,517,947
Steam and Hot Water	233	4,076,918
Ventilation	211	7,139,452

*These data include duplicates of 2014 to represent the 2015 data.

Union Participant Data

The participant data files provided by Union included energy efficiency projects completed during the 2013 and 2014 program years. At the time of writing this plan, DNV GL does not have data for the 2015 program year. In the 2013 and 2014 Union tracking data, there are 803 records and 392 unique accounts. The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. Across the three program years, we expect to have approximately1,300 records for approximately 600 unique Union accounts.

Table 6: Union Participation Metrics by Year

Program Year	Accounts	Gas Savings (m^3)
2013	197	109,243,796
2014	260	176,508,753
2015 projection*	260	176,508,753

*These data are duplicates of 2014 for reference purposes only.

We used the *project type*, *equipment type*, and *project category* variables in the tracking data to categorize measures. The resulting measure types are presented in Table 7. The largest measure types in terms of savings were maintenance, heat recovery, and building shell. The tracking data we received had some conflicting identifiers that made it difficult to create consistent measure types across the sample frame. For our initial sample design we divided the measures into two categories: equipment and operations & maintenance (O&M), but we plan to revisit this decision once we receive the complete dataset and we know the distribution of completed measures.

Table 7: Union Participation Metrics by Measure, 2013-2015

Measure Type	Accounts	Gas Savings (m^3)
Ag and Greenhouse	65	45,958,821
Building Shell	302	56,606,840
Controls	70	23,204,063
HVAC	59	39,719,864
Heat Recovery	89	71,423,260
Maintenance (O&M)	179	179,305,508
New Construction	17	3,815,481
Optimization (O&M)	62	27,153,170
Other Equipment	38	1,137,342
Steam and Hot Water	45	13,936,954

*These data include duplicates of 2014 to represent the 2015 data.

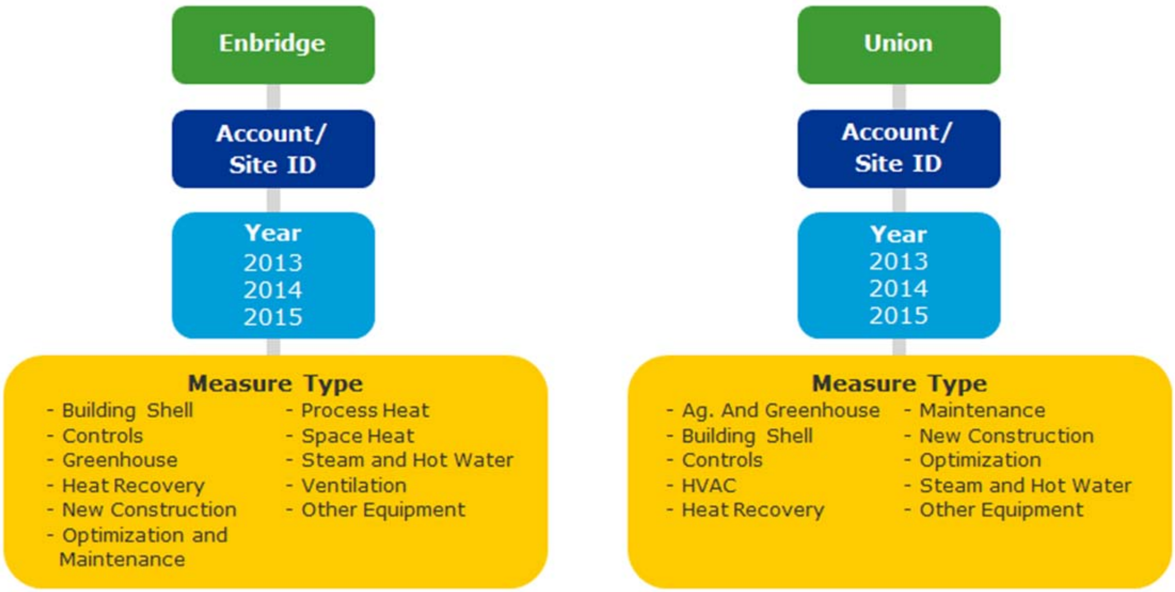
Task 2.2: Define the Unit of Analysis

Following data exploration, we defined the *unit of analysis*, which defines the level at which data will be analyzed, but not the level at which it will be collected, which is the *sampling unit*. We further discuss this distinction and how the sampling unit is defined in the Task 2.5 section.

The unit of analysis for this evaluation is a slight aggregation of the records in the tracking database. The purpose of the aggregation is to reduce the number of questions asked in each survey and to reduce the difficulty of parsing decision-making across multiple similar measures. We aggregated across elements that are likely to have less effect on decision making and did not aggregate across distinctions that are likely to play a larger role in how decisions were made.

The unit of analysis used in this sample design, presented in Figure 1, aggregates the data to the utility, account, year, and measure type. For Union, aggregating the tracking data to the unit of analysis reduced the number of records from 803 to 606 (2013 and 2014 data). For Enbridge, the number of records decreased from 1,603 to 1,471 (2013 and 2014 data).

Figure 1: Unit of Analysis



For this sample design, the unit of analysis and the sampling units are defined differently. While a unit of analysis separates units of different accounts/sites, program years or measure types, the sampling unit is specific to the customer. As an example, one Enbridge customer may have installed a new boiler in 2013 and insulation in 2014 which would be two different units of analysis, but since they were installed by the same customer they belong to one sampling unit. In the analysis phase, weights will be developed for each unit of analysis (account-measure type-year), but for the standard error calculation, data collected from a single customer (sample unit) will be a treated as a cluster rather than evaluated as if they are independent observations

Once aggregated to the unit of analysis, Union had an average of 1.5 units of analysis per account, while Enbridge has an average of 1.2 units per account across the 2013 and 2014 program years. In general, Union accounts tended to have more units of analysis per account than Enbridge accounts. Even so, with a handful of exceptions there were no more than 4 units of analysis per account. This will facilitate data collection, since it’s generally reasonable to ask about 3-4 units, especially if 2 of them are the same measure in multiple years.

At this time we are unable to comment on the number of units per customer, though we know accounts some customers will likely have multiple accounts. Customer contact information will be requested in a documentation request following receipt of the final tracking data.

Task 2.3: Stratify the Data

As this is an initial pass at the stratification for a census, we followed a decision making process consistent with sample design, but knowing that we will be reviewing these decisions and making adjustments after data collection is complete. There is a balance between having too many and too few strata. In sample designs, more strata allow the design to control representativeness and estimated precision along more dimensions. Having more strata can hurt overall precision if variation across strata is less than or equal to variation within each stratum. Our initial stratification design has 108 strata defined by:

- Utility - We are treating each utility's programs as separate populations.
- Commercial vs Industrial vs Run-it-Right – decision making at the broad segment level is likely different due to the different business structures, whereas the design of the Run-it-Right program is very different from the other Enbridge offers.
- O&M vs Equipment – Decision making on equipment is more different from that on O&M than it is on types of equipment
- Program Year – Program year determines the data collected (free ridership vs. spillover or both)
- Size of unit (m^3) - when using ratio estimation with m^3 saved as a weight in the results, stratifying by size ensures that large measures affect the result proportionally and do not have an outsize effect. If this is not a census, stratifying by size would ensure large measures were included in the sample, which is important for the ultimate precision of the study.

Optimization and maintenance measures were grouped separately from the other measures, which involved installing or removing equipment.

Enbridge Stratification

The Enbridge stratification process is presented in Figure 2 and the tracking data summary by the groupings is presented in Table 8. Run-it-Right will follow the same process as the commercial and industrial segments.

Figure 2: Enbridge Stratification

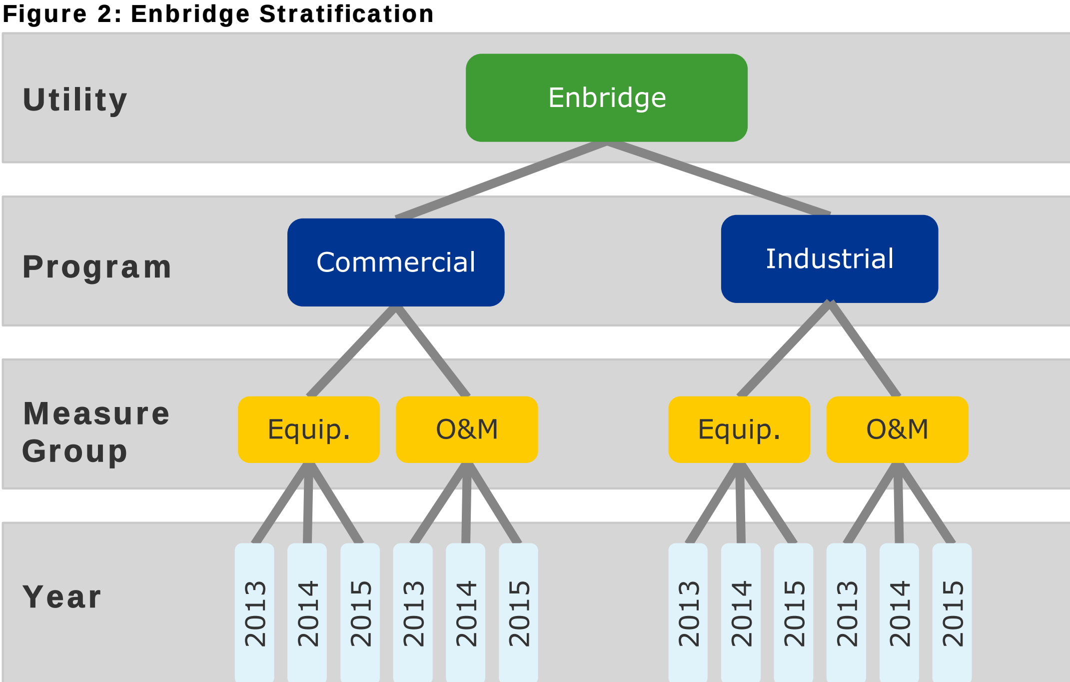


Table 8: Enbridge Participation Metrics by Grouping*

Utility	Program	Measure Group	Year	Accounts	Gas Savings (m^3)
Enbridge	Commercial	Equipment	2013	539	26,126,210
			2014	460	21,371,289
			2015	460	21,371,289
		O&M	2013	53	2,584,681
			2014	33	2,175,656
			2015	33	2,175,656
	Industrial	Equipment	2013	77	22,405,997
			2014	74	17,872,311
			2015	74	17,872,311
		O&M	2013	24	1,913,445
			2014	27	4,775,759
			2015	27	4,775,759

*These data are duplicates of 2014 for reference purposes only.

Union Stratification

The Union stratification process is presented in Figure 3 and the tracking data summary by the groupings is presented in Table 9.

Figure 3: Union Stratification

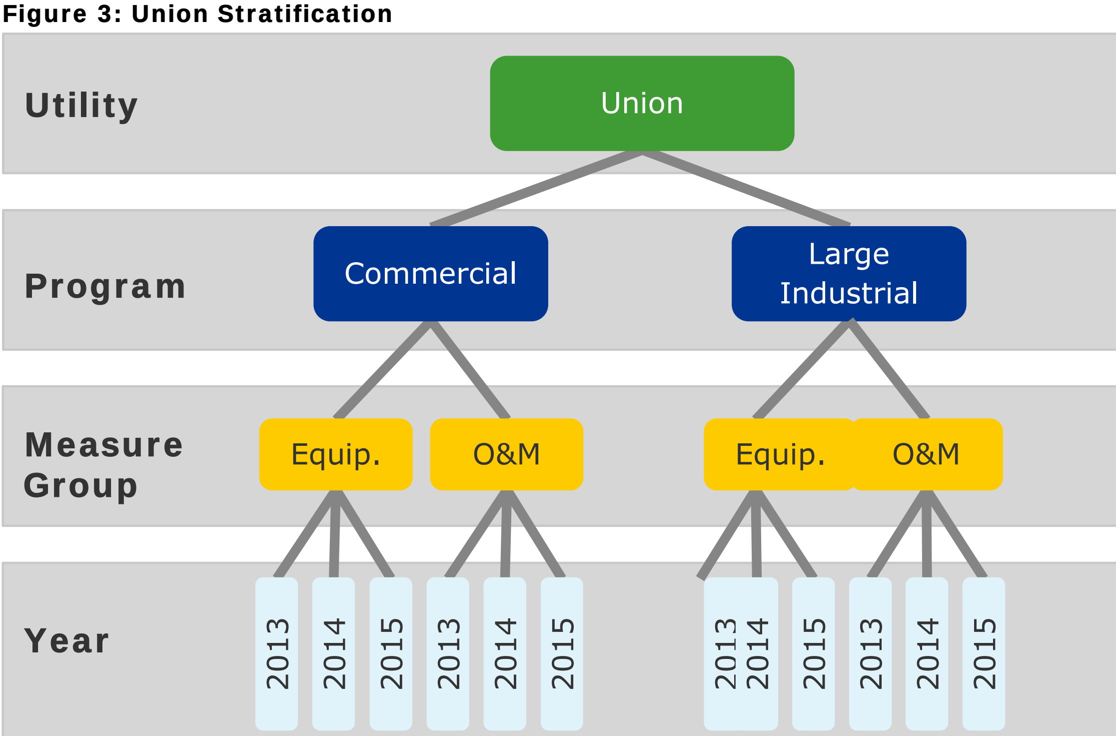


Table 9: Union Participation Metrics by Grouping

Utility	Program	Measure Group	Year	Accounts	Gas Savings (m^3)
Union	Commercial	Equipment	2013	147	28,658,112
			2014	184	45,508,018
			2015	184	45,508,018
		O&M	2013	38	12,823,518
			2014	58	17,855,569
			2015	58	17,855,569
	Large Industrial	Equipment	2013	21	50,632,883
			2014	28	42,747,797
			2015	28	42,747,797
		O&M	2013	16	17,129,283
			2014	36	70,397,369
			2015	36	70,397,369

*These data are duplicates of 2014 for reference purposes only.

Task 2.4: Design the Sample

Prior to completing the initial sample design, we assigned the data collection type for each customer.[9] We did this in order to determine the maximum expected number of respondents since IDI and CATI services have different response rates. We make these decisions at the customer level, rather than the unit of analysis (which includes measure group and year) to estimate the maximum expected number of respondents given the different expected response rates for IDI and CATI surveys. While the data collection will be completed at the sampling unit (customer), we assume that the account number provides a reasonable approximation.

We separated the preliminary IDI sample frame from the CATI sample frame based on three decision rules:

1. All Direct Access program measures
2. Customers with more than two measures
3. The largest customers up to a maximum IDI sample frame of 122 Union accounts and 90 Enbridge accounts. (106 IDIs with a 50 percent response rate).

In the final design, once we have project documentation complexity of measure will also be a consideration.

While we assumed a 50 percent response rate, our interviewers will be taking steps to ensure the highest response rate possible as detailed in Task 3: Data Collection. By assigning the data collection method at this point, we will be able to determine whether there are enough accounts assigned to CATI to use a sample design or if we should use a census. Figure 4 and Figure 5 present the number of units of analysis per account, which are the number of units about which a respondent would be asked, by data collection type using the 2013 and 2014 tracking data only.

[9] Currently this is at the account level, but will be at the customer level once we are able to identify customers with multiple accounts.

Figure 4: Enbridge Units of Analysis, 2013 and 2014

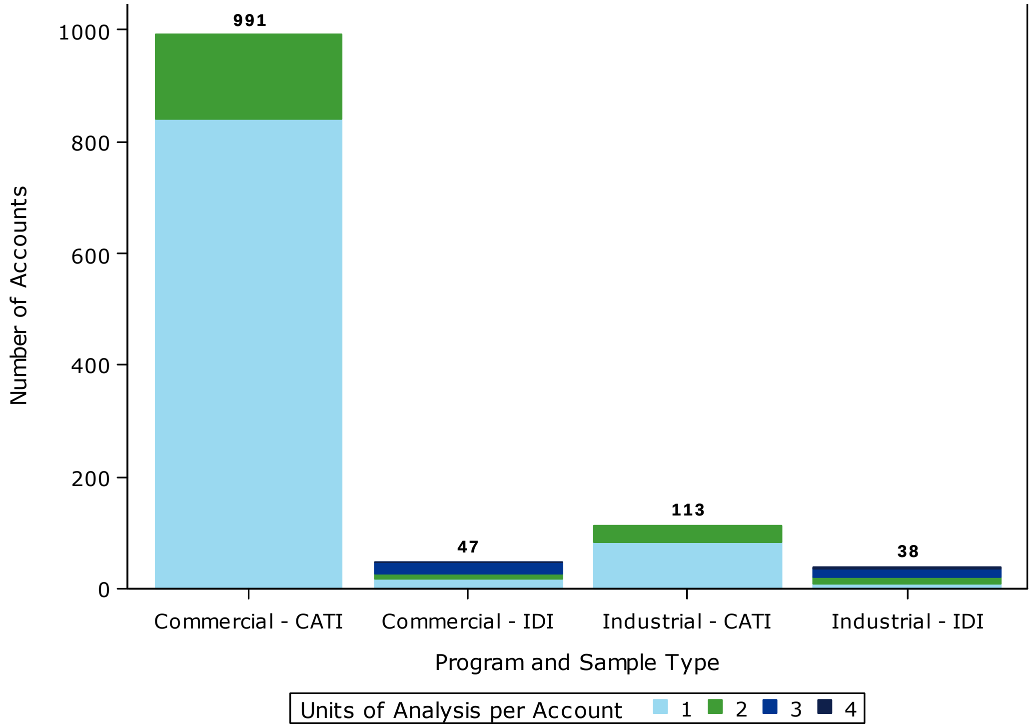


Figure 5: Union Units of Analysis, 2013 and 2014

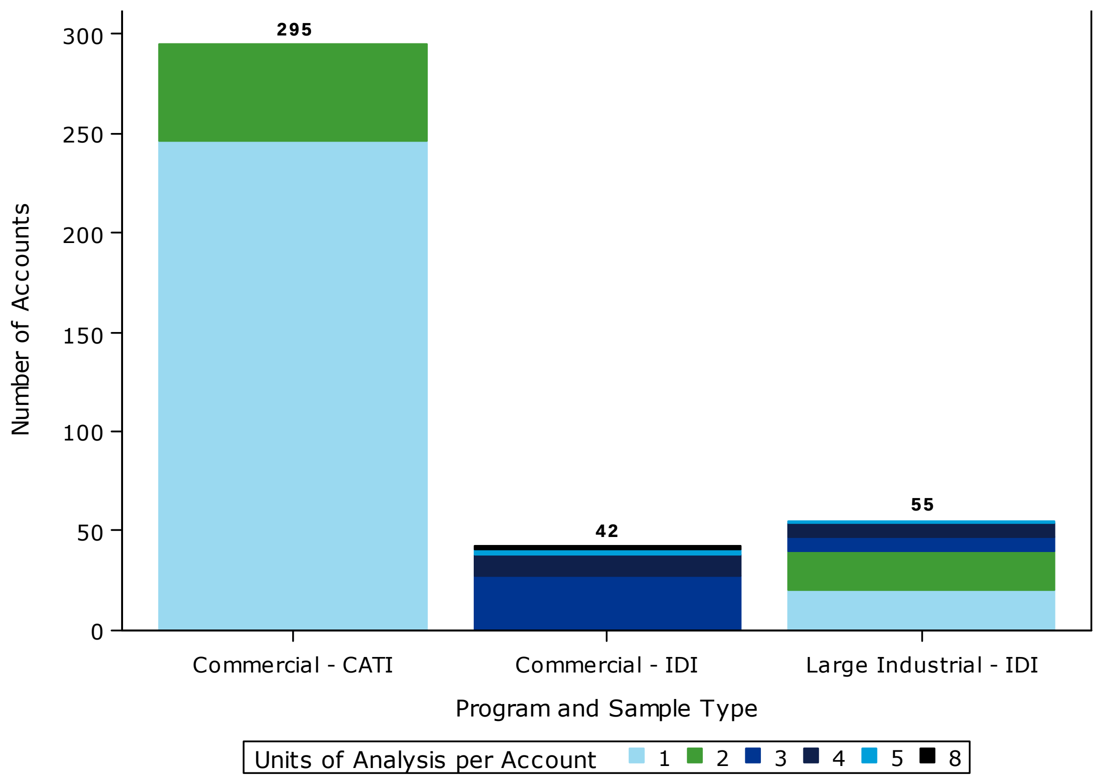


Table 10 summarizes the estimated sample sizes and the corresponding precision, for each overall program. Sample sizes are estimated based on our expected response rate attempting a census for all programs and years. Consistent with our recent experience in data collection for custom C&I programs, the sample sizes assume a 50 percent response rate for the IDI sample and a 33 percent response rate for the CATI sample. Since 2015 data is not currently available, we are using a copy of the 2014 program year as a placeholder for the 2015 data.

Table 10: Estimated Number of Completes and Sample Frame (Analysis Units)

Utility	Program	2013		2014		2015 Projected		All Three Years	
		n	N	n	N	n	N	n	N
Union	Comm and Small Ind	71	208	98	284	98	284	267	776
	Large Industrial	17	41	31	73	31	73	79	187
	Overall	**88**	**249**	**129**	**357**	**129**	**357**	**346**	**963**
Enbridge	Commercial	216	683	175	558	175	558	566	1,799
	Industrial	40	116	41	114	41	114	122	344
	Run-It-Right								
	Overall	**256**	**799**	**216**	**672**	**216**	**672**	**688**	**2,143**

Note; n= sample size (estimated number of completes), N= estimated number in sample frame

The study seeks to achieve 90/10 overall precision representing future participation. To project to future participants, treated as effectively an infinite population, we developed the precision estimate for the study without applying the Finite Population Correction. The table shows our estimates for the go forward non-FPC precision for each program. These estimates are based on the 33% CATI and 50% IDI response rate assumptions, a 0.7 error ratio (estimate of variance) the 2013/2014 program year data, and the stratification described above. Free ridership is based on 2014 and 2015 participants, while spillover is based on 2013 and 2014 participants. The final achieved precisions will depend primarily upon our response rates for the large customers.

Table 11: Anticipated Sample Sizes and Precision as Estimate for Future Program

Utility	Program	Free ridership		Spillover	
		n	RP	n	RP
Union	Comm and Small Ind	196	5%	169	5%
	Large Industrial	62	11%	48	17%
	Overall	**258**	**6%**	**217**	**10%**
Enbridge	Commercial	350	5%	391	5%
	Industrial	82	10%	81	10%
	Run-It-Right				
	Overall	**432**	**5%**	**472**	**5%**

Note; RP = relative precision at the 90% confidence level

Task 2.5: Prepare the Sample Frame

Once we have completed the final sample design, we will submit a data request to the utilities. The specific types of information we will be requesting are outlined in Table 12. The decision maker may not necessarily be located at the site where the project occurred and may be the same for multiple projects at multiple sites. The technical expert is someone who will be able to answer questions regarding the specific engineering specifications of the equipment. Vendors are the third party firms that were involved in the sale or design of the equipment, or the sale and performance of the O&M services.

Table 12: Information to Be Requested

Requested Information	Project Year		
	2013	2014	2015
Site Address	√	√	√
Project Documentation	√	√	√
Decision Maker Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√	√
Technical Expert Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√	
Vendor Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√	√

Once we have received the requested contact information, we will identify instances where a contact was involved in multiple projects, even across sites. While the projects are conducted at the site level, the decision maker, technical expert, or vendor may have been involved in projects at multiple sites. For example, multiple participating sites for the same retail chain may have one energy manager from the corporate office but the technical expert may be site specific. Using this contact information and taking into account cross-site involvement, we will assemble the CATI and the IDI sample frame.

Task 3: Data Collection

Table 13: Task 3 Subtasks and Completion Status

Task 3: Data Collection
☒ **Task 3.1: Program Managers and Staff Interviews**
☒ Union Gas Program Portfolio Management
☒ Enbridge Commercial Program Managers
☒ Enbridge Industrial Program Managers
☒ Enbridge Run-It-Right Program Managers
☐ **Task 3.2: Program Energy Solutions Consultants Interviews**
☐ Energy Solution Consultant Interview Guide
☐ 10 pre-survey interviews
☐ 10 follow up interviews
☐ **Task 3.3: Program Participant CATI Survey**
☐ CATI survey Instrument
☐ CATI survey interviews completions attempted
☐ **Task 3.4: Program Participant In-Depth Interviews**
☐ In-Depth Interview Instrument, mirroring CATI instrument
☐ IDI completions attempted
☐ **Task 3.5: Program Participant Engineer Interviews**
☐ **Task 3.6: Participating Vendor In-Depth Interviews**
☐ In-Depth Interview Instrument
☐ 80 IDI completions attempted

Note; the number of CATI and IDI completion attempts will be filled in once we receive the final dataset.

Objectives

To inform this NTG evaluation, the evaluation team will collect information from both Custom C&I program participants and key program actors. The following table shows the participants and key program actors we plan to target and what aspects of influence on the energy efficient project we are planning to explore. We expect that for some larger energy efficiency projects, but not all projects, the Energy Solutions Consultants will be familiar with some project-specific details.

Table 14: Aspects of Influence on the Energy Efficient Project

Aspects of Influence	Program Participants	Participating Vendors	Program Managers	Program Energy Advisers
Program influence on the participant's general practices	√		√	√
Program influence on the vendor's general practices and equipment recommendations		√	√	√
Program influence on the specific project	√	√		√ *
Vendor influence on the specific project	√	√		√ *

*(possibly for larger projects)

Activities

To inform this NTG evaluation, the evaluation team will collect information from both Custom C&I program participants and key program actors. The following table shows the participants and key program actors we plan to target and what aspects of influence on the energy efficient project we are planning to explore. We expect that for some larger energy efficiency projects, but not all projects, the energy advisers or utility account representatives will be familiar with some project-specific details.

The following is a summary of the number of interviews we plan to complete. A more detailed breakdown of our target number of surveys and interviews is provided in the description of the methodology in Task 2: Sample Design. As discussed in that section, many of the estimates of the targeted number of completed surveys are preliminary pending more precise information concerning the size of the participating customer populations, the mix of customer sizes, the mix of project sizes, the size of the participating vendor population, the number of participant spillover projects, etc.

Table 15: Target Number of Completed Surveys/Interviews

Phase 1		Phase 2		Phase 3	
Program Managers/Staff (In-Depth Interviews)	Program Energy Advisers[10]	Program Participants (CATI Surveys)	Program Participants (In-Depth Interviews)	Program Participants (Engineering Follow-Up Interviews for Spillover)	Participating Vendors (In-Depth Interviews)
Up to 6	10 + 10	≤2,200 *	≤430 *	≤80 *	≤80 *

*Note; The number of CATI and IDI completion attempts will be filled in once we receive the final dataset.
All numbers represent the maximum number of surveys or interviews.

Shortly after the scope of work is finalized and approved, DNV GL will submit draft interview guides and CATI surveys to the EAC for review. The final interview guides and survey instruments will address any comments or suggestions from these reviewers. While this review process is ongoing, we will also check with the EAC and the relevant utility and program contacts to insure that we are talking to the appropriate people, have the necessary contact information, and have an advance letters from the utilities.

Timing

DNV GL recognizes the limitations of the calendar in conducting survey research. During summer months, holidays increase the difficulty in reaching individuals. DNV GL will take efforts to conduct the majority of data collection before the height of summer holidays. Typical survey protocol dictates that contact with a survey respondent should be attempted 6-8 times before being considered 'exhausted'; DNV GL will adapt survey protocols to ensure that contact with an individual is not attempted more than 2x in a given calendar week and 3x in any two weeks to ensure that holidays do not influence response rates.

Informed Respondent

For data collection efforts involving non-program staff (e.g., participant surveys, participant interviews, participant follow-up interviews, participating vendor interviews), DNV GL will include a question battery designed to ensure that only informed respondents are participating. For participating customer

[10] Program Energy Advisors will be interviewed both in Phase 1 and Phase 2.

respondents, DNV GL will define informed respondents as interviewees who directly participated in the project(s) in question. For participating customer respondents, DNV GL will make every effort to reach informed respondents. We define informed respondents as interviewees who were:

1) Aware of the program at the time of the project; and
2) Either directly involved in the decision to choose equipment and go forward with the project or reasonably familiar with the project's decision-making process.

Some companies with multiple projects and diverse decision makers may require multiple interviews. We will not administer survey for projects where the informed respondents are not available. DNV GL will include a battery in each relevant instrument aimed at confirming the individual interviewed is an appropriate informed respondent.

Response Rates

Survey response rates have been in decline over the past decade. This is especially true for residential surveys, where cell-phone only households have made surveying difficult, but there has also been erosion of response rates for business surveys. In order to achieve increased response rates, DNV GL will prompt program participants with both advance emails and advance letters, informing them of the survey and requesting participation. Advance letters, sent through traditional postal mail, are generally better received (and read) when sent by the recognized energy provider and should be sent on utility letterhead, if possible.

In order to execute the mailings, it is critical that DNV GL be provided with accurate contact information for the correct informed respondent. This will include, but is not limited to, the correct individual's:

- Full Name
- Role
- Mailing Address
- Email Address
- Direct Business Phone Number

DNV GL will send the above-mentioned emails and letters to all program participants included in the CATI sample frame as well as those program participants identified for IDI, and participating vendors. For IDIs, there is an additional opportunity to improve response rates – providing respondents with the opportunity to schedule their own interview time. DNV GL will accomplish this with either an invitation to email DNV GL directly about preferred times or will utilize an online scheduling service where individuals may choose their own preferred times.

Handling of Optimization and Maintenance Projects

Optimization and Maintenance projects will be separated from equipment installation in the sample design and require special consideration for data collection as well. Maintenance projects in particular are by their nature recurring. The question of how to credit the program for maintenance this year when the customer participated in the past is complex. DNV GL and the TEC considered this issue while finalizing the contract and decided that the primary objective of the free ridership estimation will be to capture the effect of the program(s) on the current project. The effect on the current project of prior and indirect program experience will be captured in a secondary, less rigorous question sequence.

The primary attribution questions will be framed by questions that ask about decision making for the current project alone so that the scored attribution sequence will capture the effect of the program on the current project. After the scored section of the survey is complete we will capture the indirect, longer term attribution effect by asking:

- "Now, without *any* utility assistance for *any* projects in the past, on a scale of 1-10 what is the likelihood that you would have <taken this EE Action>?

The maximum of the primary attribution and this score will provide us with an idea of how much higher attribution would be if a longer term view were taken.

To limit customer burden and ensure the validity of our spillover analysis we will limit the investigation of secondary attribution to:

- *Measures with less than 100 percent primary attribution*: if primary attribution is 100 percent, then secondary attribution is as well
- *2015 participants*: 2015 participants will not be asked spillover questions. It would be awkward to ask about spillover and then secondary attribution. It could affect the results to ask about secondary attribution prior to asking about spillover.

Deliverables

- Program participant CATI survey instrument (draft and final)
- Program participant IDI guide (draft and final)
- Participating vendor IDI guide (draft and final)
- Program manager and staff IDI guide (draft and final)
- Program Energy Solutions Consultant IDI guide (draft and final)
- CATI and IDI participation email & mail scripts

Task 3.1: Program Managers/Staff (In-Depth Interviews, Phase 1)

In order to better understand program logic, methods, execution, and intent, DNV GL conducted IDIs with program managers and then program staff. These interviews focused one:

- Details of how the program design
- Details of how the program is implemented and marketed
- Understanding the program theory and logic
- Identifying key staff such as Energy Solutions Consultants and what roles they play,
- Identifying how decisions are made
- Identifying how communication between parties occurs.

DNV GL staff interviewed program staff from Enbridge and Union on the following dates:

Table 16: Program Manager Interviews

Date	Company	Program
1/22/2016	Union Gas	Program Management - Portfolio
1/25/2016	Enbridge	Commercial Programs Interview
1/29/2016	Enbridge	Industrial Programs Interview
1/29/2016	Enbridge	Run-It-Right Program Interview

Task 3.2: Program Energy Solutions Consultants (Phases 1&2)

Ten Energy Solutions Consultants will be interviewed by experienced DNV GL staff prior to the creation of program participant survey instruments, in order to better inform those instruments. Five ESCs will be interviewed from both Enbridge and Union Gas (10 total interviews), with a distribution of consultants speaking to all commercial and industrial programs. An original list of topics has been modified following interviews with program managers. Topics for interview will include:

- Their typical responsibilities
- The nature of their routine communications and interactions with Custom C&I customers and how this might vary with the size of the customer or the customer type (e.g. chain stores)
- How they target program recruitment at Custom C&I customers of certain types or in certain areas
- Nature of program recruitment; communication type by customer size and rate class
- How they become aware of potential energy efficiency projects
- How they promote energy efficiency
- How they identify which customer representatives are the key project decision makers
- Which customer representatives are the key project decision makers and how this might vary depending on company/organization size or type
- At what stage in project development they typically get involved with a project
- How many projects are typically rejected
- What are the barriers to program participation and how they try to mitigate them
- What information, financial incentives or technical assistance they offer to Custom C&I customers for energy efficiency projects
- What they perceive to be their most valuable contributions to the development of energy efficiency projects
- How frequently the rely on program technical support staff for project support
- How closely they monitor the progress of active projects
    - If there is any evidence of project cancellations due to free ridership
- Whether they have received any training or guidance on how to minimize free ridership
- Whether there are any warning signs that a project might be a free rider
- What roles trade allies play in project identification and how they interact with them
    - How trade allies work to mitigate free ridership

Following initial interviews and surveys of program participants, DNV GL staff and engineers will return to call up to ten of Energy Solutions Consultants to collect additional information about specific projects that will be useful for measuring program attribution. In such cases staff will ask project-specific questions such as:

- Whether they were involved in originating the project idea and, if so, what was their role
- Whether they were involved in planning and the development of the project details, and if so, what was their role

- Whether they were involved in the decision to go ahead with the project, and if so, what was their role
- At what stage in this project conception, planning and development process they got involved
- Whether they thought the availability of the Custom C&I program financial incentives had any influence on the timing or character of the project and if so, what was the nature of this influence
- Whether they thought any other Custom C&I program services (e.g., training, audits, technical assistance, helping find a vendor, selling the project to upper management, etc.) that the participant received had any influence on the timing or character of the project and if so, what was the nature of this influence

Task 3.3: Program Participant CATI Survey (Phase 2)

For the CATI surveys and IDIs with participants, we are developing flexible instruments that will have different modules depending on the year in which the Custom C&I customer participated. Table 17 shows how these modules will be distributed across the program years.

Table 17: Net-to-Gross Survey Modules Depending on Program Year

Net-to-Gross Modules	2013 Participants	2014 Participants	2015 Participants
Free Ridership	√*	√	√
Spillover	√	√	

*The free ridership estimates from this program year will only be used to inform the spillover analysis and will not be used for the core free ridership analysis.

There is no spillover module for the 2015 participants because we are assuming that not enough time has elapsed for the large majority of these participants to have done a spillover project. It is possible that some of the largest customers may have done a spillover project in this short timeframe. Since these large customers (3 or more projects) will be covered by IDIs, we will give the interviewers the flexibility to administer the spillover questions if a spillover project is identified. However, our survey cost estimates assume that for most of the 2015 participants we will not administer the battery of spillover-related questions. As the table indicates, we will be collecting free ridership information from the 2013 participants because this information is required for our participant spillover methodology, but we will not be using these data for our core free ridership calculations because we would prefer to use more recent program years.

OUTLINE:

- **Introduction**
- **Informed Respondent**
    - o Cite specific project, determine involvement
        - Program awareness
        - Equipment choice
    - o Role
    - o Responsibilities
    - o Ask about how long at company (since before the project date?)
- Identify names of other primary project contacts, for potential follow up conversation with DNV GL engineer

- **Organization Policies and Purchase Procedures**

- **General Program Awareness and Interactions**
- **Specific project verification (Framing)**
  - When first considered?
  - Reasons for project?
  - Major sources of info?
  - The general decision-making concerning energy related purchases and practices
  - Who in their company or organization makes decisions about equipment replacement and retrofit projects and how this might vary with the size or cost of the project
  - What information sources are used in making these decisions
  - Whether the company/organization has any formal requirements or informal guidelines about the purchasing of energy using equipment and, if so, what are these requirements/guidelines
  - Whether their company has a corporate "green " mandate
  - The development of the specific program-incentivized project
  - Where the idea for the project originated and who were the key persons involved in the project conception -- whether within the participant's company/organization or without (e.g., vendors, Custom C&I program Energy Solutions Consultants)
  - Who was involved in the planning and development of the project details
  - Who was involved in the decision to go ahead with the project
  - At what stage in this project conception, planning and development process did the Custom C&I program get involved
  - Whether the program provided any services to the respondent's company/organization beyond the financial incentives (e.g., training, audits, technical assistance, helping find a vendor, selling the project to upper management, etc.). To inform the free ridership questions, the interviewers will have information on all program activities reported by the tracking databases, but this query is designed to collect information on program activities that may be unreported and also to find out which program activities were top-of-mind for the respondent.
  - Whether the project changed from its original conception and what these changes were and why they were made

- **Direct attribution battery**
  - Determining the overall influence of the program, along with program effects on
    - Timing
    - Efficiency
    - Sizing or Quantity

- **Spillover battery**
  - Inquire about additional projects *after* other projects[11]
    - First check to ensure not rebated
    - Project type
    - Project data
    - Project contact

[11] Information collected regarding additional projects will be used not only to calculate spillover, but to check against program records and ensure that the project was not a tracked project with direct attribution.

- Project location
- Project dates

- **Firmographics**
  - Business type and
  - Business size (ft2 and # of employees)
  - whether they lease or own their facilities

- **Closing**

Task 3.4: Program Participant In-Depth Interview (Phase 2)

In addition to executing telephone interview surveys for standard projects, DNV GL staff will conduct IDIs with participants of particularly large or complex projects. The subjects covered in the IDIs are the same as with standard projects, following the same outline. In DNV GL's experience large and complex projects do not lend to pre-programmed interviews in the same way that standard (single) projects do, as it may be necessary to speak with multiple individuals or to dive deeper into questions to determine answers to questions than can be completed in a fully programmed interview. Conducting IDIs of customers with large or complex projects is a standard method for DNV GL, with experienced and expert interviewers conducting all interviews. These interviews are typically conducted with the 'decision maker' – an informed respondent who has at least some say in whether or not to proceed with a project and is aware of the project's impacts.

Task 3.5: Program Participants (Engineering Follow-Up Interviews for Spillover, Phase 3)

For some projects, it will be necessary to follow up with an additional individual or individuals, aside from the 'decision maker'. Engineering follow up calls are a specialized form of IDI that are conducted between a DNV GL engineer and an individual at the customer site that can speak to the specific engineering specifications of the equipment. DNV GL will ask specific questions that will allow for the calculation of energy savings.

These interviews will be individually tailored, depending on equipment installations, with the goal of gaining information to calculate energy savings.

Task 3.6: Participating Vendors (In-Depth Interviews, Phase 3)

Vendors that performed work on projects identified in the sample will also be interviewed. IDIs with up to 80 of these vendors will follow the following outline:

- **Introduction**
- **Informed Respondent**
- **Company background**
  - Which products or services they sell
  - Which types of C&I customers they typically do business with
  - What the size of their company is

- **Sales and marketing**
  - How they promote energy efficiency
  - How they identify which customer representatives are the key project decision makers
  - Which customer representatives are the key project decision makers and how this might vary depending on company/organization size or type
  - What role the Custom C&I program incentives play in their sales pitches

- **General program involvement and influence**
  - How they became involved with the Custom C&I program
  - Why they became involved with the program
  - How frequently they offer program incentives
  - How frequently they interact with program staff
  - How they keep track of Custom C&I program incentives and requirements
  - Whether the Custom C&I programs have provided them with any sales leads
  - Whether they have received any training from the program
  - Whether there are other services that the program provide them
  - To what degree the Custom C&I program incentives and other services influence the implementation of energy efficiency projects in the C&I sector
  - What types of C&I customers are more likely to be influenced by program incentives and which types are less likely to be influenced
  - Whether they are offering energy efficient products or services through the program that they did not offer before becoming involved with the program
  - Whether they are recommending energy efficient products or services more frequently now than they did before becoming involved with the program
  - Whether they have suggestions as to what kind of interventions would increase the program's influence in the project

We will call back some of the vendors to collect additional information about the project that will be useful for measuring program attribution. In such cases we will ask some project-specific questions such as:

- Whether they were involved in originating the project idea and, if so, what was their role (informed respondent)
- Whether they were involved in planning and the development of the project details, and if so, what was their role
- Whether they were involved in the decision to go ahead with the project, and if so, what was their role
- At what stage in this project conception, planning and development process they got involved
- Whether they thought the availability of the Custom C&I program financial incentives had any influence on the timing or character of the project and if so, what was the nature of this influence
- Whether they thought any other Custom C&I program services (e.g., training, audits, technical assistance, helping find a vendor, selling the project to upper management, etc.) that the participant received had any influence on the timing or character of the project and if so, what was the nature of this influence.

Task 4: Data Analysis

Table 18: Task 4 Subtasks and Completion Status

Task 4: Data Analysis Subtasks
☐ **Task 4.1: Analyze Survey and Interview Data**
☐ Sample frame data transformation
☐ Sampling weight
☐ Data validity check
☐ **Task 4.2 Calculate estimates**
☐ Attribution
☐ Spillover
☐ Net-to-gross

Objectives

Once a critical mass of CATI surveys and IDIs have been completed, we will begin the analysis phase (in parallel with the completion of data collection). In this section, we describe the initial survey and interview data analysis as well as the calculation of attribution, spillover, and NTG.

Task 4.1: Analyze survey and interview data

The analysis flow after data collection begins with transforming the collected data back to the level of the unit of analysis. This translation depends on the number and grouping of program measures or projects asked about for an individual customer, and whether subsampling was required.[12]

The survey will collect attribution information on each measure type. We apply the free ridership and spillover "scoring" methods to determine the free rider and spillover factors for each measure type. We then apply these factors to the associated gross savings to produce net-of-free riders and spillover savings for each measure type. Data collected from a single customer will be treated as a single cluster in error estimates.

We will use the sampling weights created during the sample design process to expand the customer sample in each sampling cell (stratum) to represent the full participant population in that cell. Targeted cells for which we are unable to obtain any responses will either be treated as not represented by the sample, or will be collapsed with other cells for sample expansion.

The application of attribution and spillover algorithms that convert survey and interview data into energy savings values ready for expansion involves consistency checks for each respondent. These checks utilize both questions directly used in the algorithms and verbatim responses that contain information on the reasoning of the respondent's responses.

Task 4.2: Calculate Estimates

The last analysis step involves expanding the attribution and spillover savings to the population via ratio estimation, and generating the combined NTG ratio for each segment of interest. . We will estimate inside

[12] Based on the initial data we do not anticipate needing to subsample: few accounts had more than two units. This may change once we have 2015 data and information that allows us to identify unique customers.

and outside spillover (inside spillover occurs at the same site as the program measure) separately for each segment, and sum them to determine total spillover.

We will then calculate corresponding ratios across the segment:

Equation 1: Free Rider Savings

$$FR = \frac{Weighted\ sum\ of\ NFR}{Weighted\ sum\ of\ G}$$

Where:

NFR = Net of free rider savings

G = Gross savings

Equation 2: Net of Free Rider Savings

$$NFR = 1 - FR$$

Equation 3: Inside Spillover

$$SO_{inside} = \frac{Weighted\ sum\ of\ S_{OI}}{Weighted\ sum\ of\ NFR}$$

Equation 4: Outside Spillover

$$SO_{outside} = \frac{(Weighted\ sum\ of\ S_{OO})}{Weighted\ sum\ of\ NFR}$$

Equation 5: Total Spillover

$$SO = SO_{inside} + SO_{outside}$$

Where:

S_{OI} = Inside spillover savings (0 for customers with no spillover)

S_{OO} = Outside spillover savings (0 for customers with no outside spillover)

Equation 6: Net-to-gross Ratio

$$NTG = (1 - FR)(1 + SO)$$

We calculate spillover as a fraction of net of free rider savings, but this can also be reported as a fraction of gross savings.

Task 5: Reporting

Table 19: Task 5 Subtasks and Completion Status

Task 5: Reporting Subtasks
☐ **Task 5.1: Monthly Status Reports**
☐ **Task 5.2: Bi-Monthly Updates**
☐ **Task 5.3: Methodology Memo**
☐ **Task 5.4: Draft report**
☐ Include estimates of free ridership
☐ Include estimates of participant spillover
☐ Include forward free ridership and spillover data
☐ **Task 5.5: Final report and presentation**
☐ Final report addressing comments on draft report
☐ In-person presentation

Objectives

DNV GL recognizes the importance of providing clear and timely reports on project progress, evaluation activities and results.

Activities

Our approach to reporting for this project includes:

- **Monthly emailed status reports:** Every month the DNV GL project manager will submit a monthly status report to the EAC, via email, which will summarize the past month's activities, notify them of the next month's activities, and report on how closely the evaluation is adhering to the original schedule. However, if there are methodological questions or delays in responses to data requests that could put the evaluation off schedule, the program manager will notify the EAC of these issues immediately for proposed resolution so that the evaluation schedule is not compromised.

- **Bi-monthly study updates to the EAC:** the DNV GL project manager will provide the EAC with study updates via teleconference on a bi-monthly basis in alignment with scheduled EAC meetings. These bi-monthly study updates will provide similar information as in the monthly emailed status reports, although the more interactive format of the teleconference should allow for greater discussion and quicker resolution of any key issues.
- **Methodology Memo:** DNV GL will produce a memo detailing the methodology and rationale for the calculations to be used in the analysis. This memo will constitute most of the methodology section in the draft report and will allow the EAC to review and comment on the methods prior to receiving the results of the analysis.
- **Draft report:** At the conclusion of the evaluation, DNV GL will submit to the EAC a draft report that will present all the information requested in the RFP's research objectives including:
  - Estimates of program free ridership factors by market sectors and precision targets for both the Enbridge and Union Gas' custom C&I programs;
  - Estimates of participant inside and outside spillover[13] by market sectors and precision targets for both the Enbridge and Union Gas' custom C&I programs;
  - Guidance on the development of a strategy for applying free ridership and spillover data collected on previous program participation to forward looking DSM program activity.

[13] Potential electric spillover will not be reported in kWh, but descriptively, as electric spillover is outside the specific scope of this evaluation.

Along with these key findings, we will also show how these estimates were derived and what data from the IDIs and CATI survey were used to inform these estimates, including any qualitative findings regarding non-incentive based utility services.

- **Final report and presentation:** After receiving comments on the draft report from the EAC members, DNV GL will produce a final report which addresses all these comments along with a comment matrix that shows how we addressed them and why. We also plan to deliver an in-person presentation of these results to the EAC and the Ontario gas utilities.

Task 6: Project Management

Table 20: Task 6 Subtasks and Completion Status

Task 6: Project Management
Task 6.1: Complete evaluation on time, on budget and within scope.
Task 6.2: Keep client informed

Objectives

Ensure timely and on-budget deliverables.

Keep clients informed of project progress.

Activities

- Meetings and status updates to PAs
- Invoicing
- Budget and workflow tracking
- Quality control
- Scope 2016 deliverable

Deliverables

- The primary deliverable from project management is the final report.
- Various other materials include weekly status reporting, invoices, monthly and bi-monthly status reports, and ongoing communication with stakeholders.

PROJECT BUDGET AND TIMELINE

The budget is denominated in US dollars. The original budget was $398,700, with the $31,000 Run-it-Right Add-on, the total is now 429,700. The add-on is listed as a separate line in the budget table and will be paid with the Analysis Methodology Memo milestone.

Table 21: Budget Summary and Milestones

Milestones	Estimated Date	Incremental (USD)	Cumulative (USD)
Contract Signed by all parties	Complete	$ 28,200	$ 28,200
Work Plan and Participant Surveys Approved	March 31, 2016	$ 65,800	$ 94,000
Analysis Methodology Memo Complete	July 29, 2016	$ 141,000	$ 235,000
Run-it-Right Add-on	July 29, 2016	$ 31,000	$ 266,000
Draft Report Delivered	September 30, 2016	$ 94,000	$ 360,000
Final Invoice (Approved Final Report/Presentation)	November 16, 2016	$ 45,778	**$ 405,778**

Our current schedule has the project completion as November 16.

Table 22. Schedule of Deliverables

Tasks	2016											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Initial Staff Interviews	✓											
Kickoff Meeting			10									
Tracking Data Merge/Cleaning												
Draft Work Plan			2									
Work Plan Comments			17									
Final Work Plan			31									
Draft Survey and IDI Instruments			17									
Survey and IDI Instrument Comments			31									
Final Survey and IDI Instruments				14								
Review Project Documents												
Data Collection												
Data Analysis												
Methods Memo							29					
Draft Report									30			
Draft Comments												
Final Report & Presentation											16	

RISKS AND CONTINGENCIES

The tables in this section document the risks to project schedule, finances and quality and the contingencies DNV GL has in place to handle them.

Table 23: Schedule Risks

Schedule Risks	Explanation	Contingency
Data Reception	Timing Controlled by Union/Enbridge. Currently have no data for Run-it-Right and no data for 2015 program year. Anticipate data in March, but unsure of exact timing.	1) Move forward with work plan without missing data. Use 2014 data to proxy 2015.
Data Processing	Categorizing and Aggregating data in a way that is meaningful to eventual respondent and in the context of the NTG analysis. Initial data has some conflicting and unclear information.	1) Use best judgment with initial data for work plan. 2) Maintain list of "judgment calls" to clarify 2) confirm and clarify based on project documentation when it arrives 3) request clarifications where project documentation does not resolve questions.
Documentation Reception	Timing Controlled by Union/Enbridge	1) Send formal documentation request with explicit, agreed upon deadline for documents needed.

Schedule Risks	Explanation	Contingency
Documentation Reviews	Projects may have considerable documentation, some of which does not have bearing on the NTG effort.	1) Establish clear guidelines for information to be reviewed 2) provide full context of evaluation, goals and information needed from project documentation to satisfy project objectives 3) Utilize engineers familiar with a) custom gas projects and b) NTG methods and interviews
Contact information Reception	Timing Controlled by Union/Enbridge	1) send worksheet for contact information request 2) include clear directions for worksheet completion, including context of what we are attempting to learn from the interviews. 3) ensure the worksheet is simple and easy to complete.
Contact information processing	Contact information may be incomplete or come in hard to use format	1) Clear directions for the request 2) use experienced analyst to prepare data for survey
Resourcing	Having the right resources available at the right time is a challenge with projects that have experienced delays	1) reserve necessary resources for project in DNV GL's internal systems. 2) keep project on schedule to avoid conflicts with other project needs. 3) keep project sponsor aware of needs and championing project
Survey House Availability	Availability at the right time is a challenge with projects that have experienced delays	1) start conversation with Nielson now. 2) identify potential backups (Malatest) in case Nielson is unable to work on project due to long delay.
Review Periods	Dependent upon OEB/EAC/TEC priorities	1) establish clear and explicit deadlines for reviews
Decision Making	Dependent upon OEB/EAC/TEC priorities	1) schedule meetings with clear agendas that have key decisions up front.
Response Rates	Response rates on surveys have been declining, which can extend the time required for data collection	1) *attempt* a census so that call order does not matter, provided number of sample units makes this manageable and within original scope size. 2) IDI rather than CATI for the most complex and large projects 3) email participants prior to call to ask for cooperation 4) send advance letter to participants prior to call to ask for cooperation

Table 24: Financial Risks

Financial Risks	Explanation	Contingency
Currency Exchange Rates	USD/CAD rates have been highly variable	Fix prices in USD.
IDI Sample Size	Attempting a census with best practice approaches (minimum number of calls for all sites, and all efforts made to increase response rates) and an assumed 50 percent response rate could mean more completed IDIs than we have budgeted for.	1) Clear concise instruments to reduce time on phone 2) Simple data entry forms to reduce time entering data 3) Use admin staff to enter data for engineers who use paper form on phone (engineer review digital data after entry) 4) Advance letters and emails to decrease number of attempts per complete 5) limited number of dedicated engineers to reduce training costs and increase efficiency on attempted calls
Survey House re-negotiation	Project delays may prompt survey house to request re-negotiation	1) exchange rate may allow increase in survey costs if survey house paid in CAD. 2) open negotiations with alternative provider 3) census may provide survey house with cost efficiencies
Resourcing	Planned resources have been promoted since project scoped and now cost more. Planned resources have left company	1) substitute with acceptable alternatives. Inform TEC of new staff qualifications.
Travel	Additional kickoff meeting was not in original scope	1) cost may be absorbed by having OEB as decision make rather than consensus based TEC.
Timeline	Longer timeline tends to use project funds more than shorter timeline	1) seek to reduce schedule delays 2) Ensure efficiency or delay non-critical work when critical path is delayed to avoid additional expense

Table 25: Quality Risks

Quality Risks	Explanation	Contingency
Response Rates	Response rates on surveys have been declining, which can reduce sample sizes, introduce uncertainty about bias and make it hard to get data from large customers who have a large effect on final result	1) attempt a census so that call order does not matter. 2) IDI rather than CATI for the most complex and large projects 3) email participants prior to call to ask for cooperation 4) send advance letter to participants prior to call to ask for cooperation
Informed Respondents	Multiple people in a business are often involved in the decision to purchase capital equipment or spend money on optimizing or maintaining existing equipment. For consistency and cost reasons a single respondent from a company is preferable to interviewing multiple people at a business about the decision. Ensuring we have a respondent who knows enough about the decision to complete the project and the influence of the program on that decision is the crucial challenge of the data collection effort	1) Clear guidelines and screening questions to determine an informed respondent 2) removal from study of un-informed respondents 3) single interview for a project may require contacting multiple people at the site to determine an informed respondent.
Engineering Estimates	Spillover estimates will be based on engineer estimates of savings for projects that were not part of a program. We expect that these projects will not have the typical amount of documentation that we see for program rebated projects. The engineering estimates will be based on respondent provided information, and in some cases may not include specific sizes or operating characteristics.	1) Engineers will be required to thoroughly document information collected from the respondents and from third party sources. Justification for savings estimates will be provided, along with values and sources of key assumptions and calculation methods. 2) A senior engineer (Tammy) will review all estimates. 3) transparently provide documentation of project savings (within confidentiality limits) in appendix of report
Analyst Experience	Since the project start, turnover in our analyst group has meant a resourcing change for this project. The planned analyst has less experience, but has proven herself capable on similar projects	1) direct oversight of analyst by PM who has performed the same work previously 2) Any further substitution will be with an analyst PM has personal experience of success working with in the past.

APPENDIX A SAMPLING PROCESS

A sample is a collection of data items such as those collected through surveys, metering or onsite observation. A sample design is required when a sample does not include the entire target population. Most sample designs are driven by cost constraints (including schedule constraints), desired precision or both. The sampling process described here ensures that all bases are covered, ensuring optimal precision around estimates of interest for the data collected. The process we followed was:

1. **Identify Goals, Methods and Constraints**: for sampling, the goals consist of identifying the primary and secondary estimates of interest: what quantitative results are most important. Defining the data collection methodology –the process used to gather the data for the analysis – and the estimation method – the approach used to calculate the primary estimate of interest – is critical for defining elements of the design. Cost and schedule constraints surrounding the data collection and analysis then determine an upper bound for the sample size.

   - **Goals**: For this study the primary estimate of interest is the NTG ratio for each program. The NTG ratio is the parameter that we are targeting for 90/10 precision for each program.

     As will be described later in the methodology memo, we calculate the NTG ratio as

     NTG = (1-FR)(1+SO).

     Since spillover tends to be small, this formulation is mathematically very close to the simpler formula indicated in the recent Ontario evaluations

     NTG = 1-FR + SO.

     We prefer the multiplicative formula as a more complete expression of the relationship between free ridership and spillover.

     Previous work in Ontario indicates that free ridership is on the order of 10% to 60% across program segments, 50% overall on a savings-weighted basis. Spillover is on the order of 5%. Because spillover is generally small, the precision of the full NTG will in most cases be close to that of the net-of-free rider factor, even with a modest spillover sample size.

   - **Methods and Constraints:** We are using two data collection methods, each of which have different costs associated. Due to cost constraints we must limit our use of in depth interviews to those projects where it will make the most difference in the estimate: we have budgeted for 132 IDIs and these will be deployed on the largest and most complex projects as identified based on tracking data descriptions. CATI surveys will be used to collect the balance of the data that we do not have the funds to collect with IDIs. For smaller and simpler projects where the decisions made are more straight forward, CATI surveys provide accurate data at a reasonable cost..

2. **Define the unit of analysis**: The unit of analysis is the level at which final estimates will be made. Some studies have multiple units of analysis: process evaluation results may be based on respondent level estimates, while impact evaluation results may be based on measure or project level estimates. Sampling units do not need to be the same as the unit of analysis, but identifying both early is crucial.

For these programs we are recommending a unit of analysis that is a measure type at a site in a given year. We are using the same definition for our sampling unit. Most customers have no more than three projects in a given year, and most projects are of only one or two measure types, so that we will be able to inquire about all of these in a single survey or interview of reasonable length.

We plan to ask each sampled customer about attribution for all of the customers measures. The handful of customers with more than three measures will be included in the IDI sample frame in order to handle their complex projects.

For customers with large numbers of projects and measures, we will ask about groups of measures or projects. The groupings will depend on details of the types of measures and savings magnitudes. We will select a subsample of three groups with probability proportional to size. Typically this will mean asking about two groups that account for the large majority of savings, and a third smaller one selected at random.

3. **Identify the target population:** The target population is the universe of items that inferences and estimates are desired for. For this evaluation the primary target population is future programs of the same type. Having future program years as the target population has two implications for the sample design. First, the applicable error associated with our estimates is the non-finite population corrected error (described in our discussion of sample size below) which requires larger sample sizes for a given precision. Second, analysis by sub-domains such as measure types within the programs becomes more important. The measure mix in programs changes from year to year and typically NTG varies more across measure types than within. For more accurate estimates of net savings for future program years, applying measure type NTG ratios will be preferred to program as a whole NTG ratios.

4. **Establish the Sample Frame:** The sample frame refers to the list or mechanism from which the sample is drawn. A perfect frame will match the target population exactly.

   Since the target populations of this study are the future programs, we will not have a perfect sample frame; however, if the program designs remain relatively stable, using past program participants as the sample frame will provide a good list from which to draw our sample.

5. **Determine sample size:** Sample size refers to the number of items that are selected from the sample frame in order to draw inferences and create estimates about the target population. In stratified designs, sample sizes are determined for each stratum.

   Critical to the sample size determination is the error ratio for each sampling cell with respect to the ratio to the estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean. Our experience with conducting similar NTG studies of commercial-industrial customers is that the error ratio for the free rider NTG factor is between 0.7 and 0.8 within reasonably defined sampling cells.

   In determining these sample sizes, the number of customers in the full population is also important for two reasons. First, if we are trying to estimate a parameter for a finite population, the sample size required is reduced by the Finite Population Correction or FPC. Second, we need to consider the number of completed surveys we can realistically complete given likely response rates.

Use of the FPC is appropriate when the parameter of interest represents a particular population. This situation applies when we are determining the free ridership factor or spillover rate for a particular program and time frame. When we determine these factors for all future theoretical projects, it is arguably more appropriate to treat the sample drawn from recent participants as coming from an essentially infinite population. Thus, for projection to future years we generally recommend against applying the FPC.

Because we recommend against applying the FPC and we anticipate response rates of 50 percent for our IDIs and 25 percent for our CATI surveys, we recommend *attempting* a census of participants[14]. This will allow for faster data collection as we will not need to maintain a strict call order and will result in the most completes possible for the data collection methods used.

6. **Stratification:** Stratification is the partitioning of a target population. Stratification is often introduced in a design for two reasons:

   When one desires a specific sample size within small groups of the target population, the groups are often used as a stratification variable. For example, the EAC is interested results by measure type, so measure type is being included as a stratification variable in order to obtain a specific number of selected units in each measure type.

   Stratification is also used in a design to increase precision. A sample design is optimized when strata can be formed so that the variability of the primary and secondary outcome measures are as small as possible within strata and as large as possible between strata. We optimized the sample design's size-based strata (m^3) using a model based optimization algorithm appropriate for ratio estimation. Optimization based on size ensures more data collected from large sampling units, which improves the precision of the estimates.

7. **Sample Selection:** Sample selection refers to the process of obtaining the sample of units from the sample frame. If all units on the sample frame are selected then the design is referred to as a census or certainty sample. Otherwise units may be selected either randomly or nonrandomly, depending on the evaluation goals, constraints and amount of acceptable bias. The sample selection process is a critical feature of the sample design and has a direct impact on the expected precision and bias of estimates. The optimal sample selection process for a particular project can vary greatly.

8. **Unit and Item non-response** Unit and item nonresponse are potential sources of bias, depending on the nonresponse mechanism and the level of nonresponse encountered. Unit nonresponse refers to the absence of information from an entire sampled unit. Item nonresponse refers to the situation where some data are collected, but not all, from a sampled unit. The nonresponse mechanism refers to the process that is causing the nonresponse. If the probability of responding depends on the data items being sought then the nonresponse mechanism is said to be nonignorable. Otherwise it is called an ignorable nonresponse mechanism. Nonresponse bias tends to be greater when the nonresponse mechanism is non-ignorable and as levels of item nonresponse increase.

[14] DNV GL will attempt a census if total size falls within the original scope. If the number of participants provides too great a sample size for the established scope, sampling will be used.

There are various ways to address nonresponse in a sample. For example, weight adjustments are often used to account for unit nonresponse and item imputation techniques are often used to account for item nonresponse.

If nonresponse levels are low and the response mechanism is thought to be ignorable then one could ignore nonresponse and simply create estimates among the respondents.

We recommend treating unit nonresponse as ignorable for this study since it does not depend on the data items being sought. Instead, it depends on the willingness of the decision maker at the participating business agreeing to respond to the survey.

For item nonresponse in the scored portion of the surveys we recommend treating the nonresponse as nonignorable if all three of the T,E,Q portions of the free ridership sequence contain non-response. Otherwise we plan to treat the item nonresponse as ignorable and will impute the average response for the missing item from among scored units of the same measure type and utility. The exception to this rule is when we find conflicting responses in our QC of the data collection that indicates the nonresponse is nonignorable. For nonignorable item nonresponse we will drop the unit from the analysis.

9. **Expansion** Sample expansion refers to the process of extrapolating results from a sample back to the target population of interest. Often times this is done using a sample weight. The weight is a numeric quantity associated with each responding unit and conceptually represents the amount of the target population the responding unit represents during the analysis. The sample weight is some function of the total number of units on the sample frame.

   The sample weight for our analysis will be built from the inverse probability of selection, incorporating additional adjustment factors to account for nonresponse and coverage errors. The sample weight will be utilized along with the "size" of the unit (energy savings) to expand results using ratio estimation, as described in the ratio estimation appendix of this work plan.

10. **Domains of interest:** Often times, estimates for an entire target population are of interest, but so are estimates for various subgroups. Subgroups may or may not overlap. Identifying the population domains of interest is another critically important design feature because it affects the decisions being made about other design features, such as the desired sample size, stratification variables and primary and secondary estimates of interest.

We are providing the EAC with estimated precision for domains of interest in the next section of this work plan. After EAC review of the draft work plan, we can add adjust the definitions of the domains of interest to best reflect the level at which the EAC is likely to want results presented in the final report.

APPENDIX B NET-TO-GROSS METHODOLOGY

The Ontario DSM Guidelines define a free rider as "a program participant who would have installed a measure on his or her own initiative even without the program." [15]

A great deal of attention has been given to the challenges of "scoring" attribution surveys. In DNV GL's free ridership approach, we use a critical set of lead-in questions to establish the framing, determine that we have the right respondent, and clarify what measure is being asked about. We then have essentially one question each identifying the effect of the program on the efficiency, the quantity, and the timing of the measure installed. We include some cross-checks; if an inconsistency is identified in these checks we probe to resolve that inconsistency.

DNV GL has developed a streamlined and effective approach to these question sequences. While many of the set-up questions are not used explicitly in calculating measure free ridership, our experience is that dispensing with these framing questions, or attempting to compress the scored questions into a more general subset, results in responses of ambiguous meaning.

Other practitioners prefer to ask the same question multiple ways and then average the corresponding responses. We find this approach typically means blending a looser question with a tighter one, and also increases response burden. We prefer to ask each needed element one way, with appropriate framing and wording to ensure meaningful responses, and to probe as needed.

A frequent challenge in this context is how "don't know" responses are treated. We typically find that with well framed questions addressed to appropriate respondents, "don't know" responses are rare, on the order of 5 to 10 percent. As a result, our overall estimates are not highly sensitive to how these cases are treated. If a respondent gives a large number of don't know responses, we treat that survey as essentially uninformative.

The outcome of our free ridership analysis for a particular respondent and measure is the net program-attributable savings for that measure. This net savings takes into account

- The program may get credit for part but not all of the energy efficiency improvement
- The program may get credit for some but not all of the units installed
- The program may get credit for accelerating the timing of the measure implementation, with or without getting credit for increased efficiency or quantity.
- For a complex project, the program may get credit for some elements of the project, and not for others.

This approach treats free ridership as a fraction of gross savings, for both individual measures and for the program as a whole. DNV GL believes this is a more meaningful approach than attempting to classify each participant, project, or measure as a free rider or not. An excerpt from a prior report detailing the survey approach and associated calculation rules are provided in Appendix C.

Likewise for spillover, after collecting information on what additional measures were implemented based on experience with a program-attributable measure, we determine the savings associated with these measures via engineering analysis.

[15] Ontario Energy Board *Demand Side Management Guidelines For Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

Interpreting Customer Responses on Program Effect on Timing.

There are two general ways to treat survey responses indicating that the program caused a measure to be implemented sooner than it otherwise would have. DNV GL has tools and procedures for handling both of these approaches, with a range of specific for either.

Scaling based on reported acceleration

One way to treat the statement that the measure would otherwise have been implemented x months or years later is essentially like a scaling or probability factor. If the measure reportedly would have been implemented within a very short time absent the program, it's highly likely that it would indeed have been implemented. If the measure reportedly would have been implemented a long time out, it's less certain that it ever would have been implemented. Accordingly, attribution is scaled down if the reported timing acceleration is very short, but scaled down less for greater acceleration. The simplified version of this approach gives no credit if the measure would have been done within say 1 or 2 years, and full credit thereafter. An approach DNV GL has used for multiple programs is to give full credit if the reported acceleration is greater than 4 years, and scale the credit linearly between 0 months and 4 years.

We will be using 4 years as our standard for this project.

Dual baseline

The second general way to account for acceleration is to take the reported acceleration at face value, and recognize a different baseline condition before and after the acceleration period. For example, if old equipment would otherwise have been replaced 2 years later, the baseline for those first 2 years is the old equipment. For the remainder of the measure life, the baseline is the efficiency that would otherwise have been installed at that point.

Even with the dual baseline approach, we recommend disregarding reported acceleration greater than 4 or 5 years, since customer investment plans are unlikely to be determined that far out. With the dual baseline approach, the attribution factor is the ratio of the total net savings over the life of the measure to the total gross savings over that period.

We will not be using the dual baseline approach on project: TEC agreed on using Y1NS method after the kickoff meeting.

Determining Attribution Parameters for the Program.

Once we have determined the program-attributable savings for the program measures for each surveyed customer, we calculate the in-program attribution rate by sample expansion and ratio estimation. That is, we calculate the ratio estimator

NTG_{FR} = (Net Savings)$_{FR}$/(Gross Savings)$_{FR}$
FR = 1-NTG_{FR}

Where

NTG_{FR} = net-to-gross ratio considering free ridership only (not spillover)
(Net Savings)$_{FR}$ = estimated program non-free rider savings, from expanding the FR survey sample
(Gross Savings)$_{FR}$ = estimated program gross savings, from expanding the FR survey sample.
FR = free ridership as a fraction of program gross savings.

Likewise for spillover (SO):

SO = (Spillover Savings)/(Gross Savings)

(Spillover Savings) = estimated total spillover savings, from expanding the spillover survey sample

$(\text{Gross Savings})_{SP}$ = estimated program gross savings, from expanding the spillover survey sample.

Overall NTG is then calculated as

NTG = (1-FR) x (1 + SO).

APPENDIX C SPILLOVER METHODOLOGY

Spillover "refers to effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program."[16] As in many jurisdictions, Ontario's Demand-Side Management Guidelines recognize the importance of spillover in determining program benefits, and also require "comprehensive and convincing empirical evidence" to support any program spillover claim.

Key challenges to providing convincing quantified evidence of spillover for a particular customer include:

- Determining that a particular subsequent action was due to the influence of the program
- Confirming that the action was not taken as part of the original or another program, hence already counted by the program
- Quantifying the savings associated with confirmed spillover actions.

DNV GL's proposed approach provides a high level of rigor to address each of these issues.

- We determine program influence using participant surveys that start with the framing of our free ridership questions, and the identification of the influence of the program on the original measures. This framing helps ensure more meaningful responses to questions of the influence of the original measure on subsequent actions. As for the free rider surveys, obtaining the right respondents is also essential to obtaining meaningful responses to these questions.

- We confirm that the actions tentatively identified as spillover were not already counted by another program by cross-checking tracking data bases. Also critical to separation of spillover from program-claimed savings is understanding what savings if any are claimed by the programs for facilitation support such as opportunity identification, feasibility studies, audits, and related continuous improvement program engagement.

- We quantify the savings for confirmed spillover actions by collecting engineering specifications and calculating associated savings. This approach gives more accurate results than asking customers to estimate the magnitude of spillover savings relative to the original measure.

Thus, our participant spillover methodology addresses the following key issues:

- *Locating the right decision-maker* - Large commercial and industrial companies have multiple decision-makers and it is often difficult to find someone who is familiar with both the tracked program-influenced measure and the spillover measure. Employee turnover can also complicate this. Our approaches to ensure appropriate respondents are discussed above.

- *Avoiding double-counting* – Companies that received financial incentives from an energy efficiency program for one measure are likely to seek these incentives for future measures. Hence it is important to get the program's latest tracking data to make sure that a potential participant spillover measure did not receive program support.

- *Estimating program attribution for potential spillover measures* - A common way of assessing participant spillover is to ask how much the participant's experience with the tracked program-influenced measure influenced their decision to implement measures that are candidates for spillover

[16] Ontario Energy Board *Demand Side Management Guidelines For Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

attribution. It is difficult to turn this "fuzzy" assessment of program influence into a more concrete attribution factor necessary for attributing a certain quantity of therms from the spillover measure to the program.

- *Estimating the energy savings for the participant spillover measures.* Because spillover measures occurred outside the program, evaluators do not have access to the same information about the size, type, and quantity of the implemented energy-efficient measures that they would find in a program tracking database.

Our approach to these issues is described in more detail below. This approach is based on one we used successfully in Wisconsin C&I programs over many years.

Understanding Energy-Related Standard Practices

The first objective of the survey will be to find out whether the participant's company or organization had installed any energy-efficient equipment or made any energy-efficient changes in operation or maintenance (O&M) procedures after the implementation of the tracked project. But before doing that we will collect some information about the company's or organization's energy-related decision-making process. We will ask the participants a series of questions about:

- Who in their company makes decisions about equipment replacement and retrofit projects;
- What information sources are used in making these decisions; and
- Possible barriers to energy efficiency implementation.

This information will be valuable for a number of different reasons. First, it should help program implementers devise strategies for increasing program awareness and mitigating barriers to project implementation, especially for participants who did not identify any subsequent energy-efficient projects after the tracked project. Second, by shedding light on the project decision-making process, it should help the evaluators make better judgments about assigning program attribution to a given project. Finally, it should make the survey appear less peremptory for those who did not report any new energy-efficient projects after the tracked projects, since otherwise their survey would be terminated fairly quickly.

After we collect this information about participant energy practices, we will ask the participants whether their company/organization had installed any energy-efficient projects after the installation of the tracked project. If the participants report no subsequent actions, we will terminate the survey since there is no participant spillover to be measured. If they do identify subsequent projects, then we will collect some basic information about the project including:

- The approximate year of the project;
- The geographic location of the project (e.g. city);
- The types of energy-efficient measures installed or energy-efficient O&M practices implemented; and
- Whether the tracked project and the subsequent project were in the same facility or not (needed for the calculation of inside vs. outside spillover).

Because this information will be collected by CATI program surveyors who do not have an energy background, we will not ask them to try to collect too detailed information about the energy-efficient project. It just needs to be detailed enough to allow the evaluators to make a reasonable match with any projects in the program tracking data.

Calculating Program Attribution for Candidate Spillover Actions

The next stage of the survey will focus on program attribution. Our method only awards spillover energy savings if two criteria are met:

1. The original tracked project is at least partially attributable to the program (Attribution Factor A).
2. The subsequent project is at least partially attributable to the participant's experience with their earlier tracked project (Attribution Factor B).

If a measure met these two criteria, we assign it spillover savings according to the following formula.

(Spillover Savings) = (the measure's annual savings) X (Attribution Factor A) X (Attribution Factor B).

We apply both Attribution Factor A and Attribution Factor B because if the program had no influence on the original tracked project, the program should not get credit for any additional measure installations resulting from that tracked project. To reduce respondent fatigue, if Attribution Factor A is zero (a total free rider) we will not ask them the questions for calculating Attribution Factor B.

To determine attribution factor A we will use the NTG question battery already described in this proposal. For Attribution factor B we will use a scoring method that will be triggered off the question, "If you had not made the earlier energy-efficiency improvements I just listed, how likely would you have been to make this additional energy efficiency improvement?" The scoring method, which we used in Wisconsin for many years, is shown in Table C-1. If the participant said they were very likely to have made the additional energy efficiency improvement without the program, then we will terminate the survey since there will be no participant spillover to be measured.

Table C-1: Program Attribution for Subsequent Measures

If had not made tracked program-influenced energy efficiency improvement, reported likelihood of making subsequent energy efficiency improvement	Assigned Attribution Factor B
Very likely	0.00
Somewhat likely	0.55
Not very likely	0.90
Very unlikely	1.00

The reason we use a different method for Attribution Factor B than for Attribution Factor A is that the character of influence is different. For the program's influence on the tracked project (Attribution Factor A) financial incentives usually account for much of the influence in terms of reducing payback periods and therefore we want to measure things like acceleration effects. However, with participant spillover the influence is less tangible and more likely to be general positive experience with a new energy-efficient technology and the energy savings it produces. We believe that using a Likert scale question will better capture the less tangible character of this type of influence.

Avoiding Double Counting of Energy Savings

Once a participant has identified a subsequent project that is attributable – e.g. one where Attribution Factor A and Attribution Factor B are both greater than zero -- then we will conduct some additional checks to insure that the subsequent project is not also a tracked project. Some of these checks will occur in the survey itself. For example, we will ask the participants if they recall receiving financial incentives from an energy efficiency program for the subsequent projects. We will also examine the program tracking data to make sure that the subsequent project is not in the tracking program data for future years. For example, if we interview a 2011 participant and they identify a subsequent project in 2013 we will look at the 2012-2013 program tracking data (we will look at both program years in case their memory of the project timing was faulty) to see if we can find that project. If we do find the subsequent project in program tracking data, then we will remove that project as a candidate for spillover energy savings since the savings for that project has already been claimed by the program.

Estimating Energy Savings for Participant Spillover Measures

Once a project has been identified as having spillover energy savings (it is program attributable and we could not locate it in the program tracking data) the final step will be to estimate its energy savings. To estimate the annual energy savings for participant spillover measures, we plan to have engineers conduct follow-up interviews with the persons identified in the CATI surveys as being most familiar with the spillover projects. The engineers will have some basic project information collected from the CATI survey as well as some information about deemed savings algorithms for that measure which will allow them to prepare ahead of time the types of questions they will need to ask (e.g., about baseline measures, hours-of-use, etc.). Once they have conducted the interview and collected the necessary information they will calculate the first year savings for the measure. If a deemed savings algorithm exists for that measure they will use that as a default. If none exists then they will use their best professional judgment to estimate the energy savings.

The final step will be separating the spillover energy savings estimates that were reported for “inside” facilities vs. those reported for “outside” facilities. These savings estimates will then be used to produce the inside and outside spillover energy savings estimates for the report.

APPENDIX D PROJECT TASKS AND SUBTASKS

Task 1: Project Kickoff

☒ **Task 1.1: Convene a project kickoff meeting**

☒ **Task 1.2: Reach a consensus on methodology**

Task 2: Sample Design

☐ **Task 2.1: Data Exploration**
- ☒ Initial data exploration , Union and Enbridge
- ☐ Exploration of the full datasets, Union and Enbridge

☐ **Task 2.2: Define the Unit of Analysis**
- ☒ Initial unit of analysis definition
- ☐ Final unit of analysis definition using full datasets

☐ **Task 2.3: Stratify the Data**
- ☒ Initial stratification
- ☐ Final stratification using full datasets

☐ **Task 2.4: Design the Sample**
- ☒ Initial sample design
- ☐ Full sample design and precision optimization

☐ **Task 2.5: Prepare the Sample Frame**
- ☐ Sample contact information and documentation request
- ☐ Prepare the sample frame

Task 3: Data Collection

☒ **Task 3.1: Program Managers and Staff Interviews**
- ☒ Union Gas Program Portfolio Management
- ☒ Enbridge Commercial Program Managers
- ☒ Enbridge Industrial Program Managers
- ☒ Enbridge Run-It-Right Program Managers

☐ **Task 3.2: Program Energy Solutions Consultants Interviews**
- ☐ Energy Solution Consultant Interview Guide
- ☐ 10 pre-survey interviews
- ☐ 10 follow up interviews

☐ **Task 3.3: Program Participant CATI Survey**
- ☐ CATI survey Instrument
- ☐ ## CATI survey interviews completions attempted

☐ **Task 3.4: Program Participant In-Depth Interviews**
- ☐ In-Depth Interview Instrument, mirroring CATI instrument
- ☐ ## IDI completions attempted

☐ **Task 3.5: Program Participant Engineer Interviews**

☐ **Task 3.6: Participating Vendor In-Depth Interviews**
- ☐ In-Depth Interview Instrument
- ☐ 80 IDI completions attempted

Task 4: Data Analysis Subtasks
☐ **Task 4.1: Analyze survey and interview data**
☐ Sample frame data transformation
☐ Sampling weight
☐ Data validity check
☐ **Task 4.2 Calculate estimates**
☐ Attribution
☐ Spillover
☐ Net-to-Gross
Task 5: Reporting Subtasks
☐ **Task 5.1: Monthly Status Reports**
☐ **Task 5.2: Bi-Monthly Updates**
☒ **Task 5.3: Methodology Memo**
☐ **Task 5.4: Draft report**
☐ Include estimates of free ridership
☐ Include estimates of participant spillover
☐ Include forward free ridership and spillover data
☐ **Task 5.5: Final report and presentation**
☐ Final report addressing comments on draft report
☐ In-person presentation
Task 6: Project Management
Task 6.1: Complete evaluation on time, on budget and within scope.
Task 6.2: Keep client informed

DNV·GL

MEASUREMENT OF NTG FACTORS AND CUSTOM SAVINGS VERIFICATION FOR ONTARIO'S NATURAL GAS CUSTOM COMMERCIAL AND INDUSTRIAL DSM

Scope of Work

for Ontario Energy Board

Date: December 14, 2016

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OVERVIEW

This document has been prepared for the Ontario Energy Board (OEB) and provides the scope of work for the combined Custom Program Savings Verification (CPSV) and Net-to-Gross (NTG) Evaluation of Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) programs delivered in 2015. The combined study will produce verified savings, free ridership (FR) and spillover (SO) ratios. Whereas the CPSV and FR results will rely on 2015 program results, the SO results will be based on data collected from 2013 and 2014 program participants. Results from the SO study will be applied to the 2015 program results (along with the CPSV and FR results) in the calculation of verified net savings. Projects included in each portion of the study are shown in Table 1.

Table 1: CPSV, FR, and SO by program

Program		2015 CPSV	2015 FR	2013/14 SO
Union				
Custom	Large Volume	✓	✓	✓
Custom	Commercial & Industrial*	✓	✓	✓
Custom	Low Income Multi-Residential	✓		
Enbridge				
Custom	Commercial*	✓	✓	✓
Custom	Industrial	✓	✓	✓
Custom	Low Income Multi-Family	✓		
RunitRight			✓	✓

*Custom Market-Rate Multi-Residential projects are included as a part of this program.

Evaluation Objectives

The overall goals of the combined evaluation are to develop transparent

1. verified gross and net savings for 2015 custom commercial, industrial and large volume projects
2. free ridership rate for Enbridge's 2015 RunitRight program
3. spillover factors applicable to custom commercial, industrial and large volume projects and RunitRight, based on projects claimed in 2013 and 2014 and applicable to projects installed in 2015 and future program years

Evaluation Approach

The methodology selected for the CPSV portion of the study consists of engineer reviews of gross savings. Reviews of complex projects will include on-site verification and data collection, while less complex projects will be verified with Telephone Supported Engineering Reviews (TSERs).

The methodology selected for the NTG evaluation will rely on end-user self-report surveys and interviews. The end user self-reports will be supplemented by project-specific interviews with vendors to capture indirect effects of the program on end-user decision making. Surveys and interviews will be collected from the most recent program years in order to create NTG factors that will be most meaningful for future years.

Deliverables and Schedule

This study will result in three final deliverables:

1. 2015 CPSV and Free ridership Report
2. Spillover Report
3. Final 2015 verified and net savings memo

The current project schedule is shown in Table 2. Because data collection is schedule to fall during the holiday season, we included four weeks of additional time for those tasks.

Table 2: High Level Schedule

Task	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
SOW	■	■	■	■						
Data Collection Planning	■	■	■	■						
Data Collection					■	■	■			
Analysis					■	■	■	■	■	
Reporting						D (1)	F (1)	■	D (2,3)	F (2,3)
Project Management	■	■	■	■	■	■	■	■	■	■

D. Draft
F. Final

1. 2015 CPSV and Free ridership Report
2. Spillover Report
3. Final 2015 verified and net savings memo

Key Concepts and Terms

This section defines several key concepts that will be used throughout this work plan, using the definitions from the Ontario DSM Guidelines for spillover and free rider.

- *Spillover* "refers to effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program." [1] We consider both inside and outside, and both like and unlike spillover through this project.
    - *Inside spillover* "refers to non-incented measures that were installed within the same project or facility."[2]
    - *Outside spillover* "refers to measures for which the customer did not receive an incentive adopted in an outside location or unrelated project for a participating customer." [3]
    - *Like spillover* refers to non-incented measures of the same type as incented measures.[4]
    - *Unlike spillover* refers to non-incented measures of a different type as incented measures[5]
- A *free rider* is "a program participant who would have installed a measure on his or her own initiative even without the program."[6]
- *Gross savings* are "the changes in energy consumption and/or demand that result directly from program-related actions taken by participants in an efficiency program, regardless of why they participated."[7]
- *Net savings* are "the changes in energy consumption or demand that are attributable to an energy efficiency program. The primary, but not exclusive, considerations that account for the difference between net and gross savings are free riders (i.e., those who would have implemented the same or similar efficiency projects, to one degree or another, without the program now or in the near future) and participant and non-participant spillover[8] (i.e., savings that result from actions taken as a result of a program's influence but which are not directly subsidized or required by the program). Net savings may also include consideration of market effects (changes in the structure of a market)."[9]
- The *net-to-gross* (NTG) ratio is an adjustment factor that reduces savings due to free ridership and increases savings to account for spillover. The NTG ratio "is the portion (it can be less than or greater than 1.0) of gross savings (those that occur irrespective of whether they are caused by the program or not) that are attributed to the program being evaluated."[10] The NTG ratio is a combination of NTG factors that include the spillover and free ridership rates.
- *Attribution* is the portion of a measure that is attributable to the program. For program measures attribution is the complement of free ridership (1-FR).
- *Energy Advisors* are utility and/or program staff who provide information to customers about energy saving opportunities and program participation. This is a general term that includes, but is not limited to Enbridge's Energy Solutions Consultants and Union's Account Managers.

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[1] Ontario Energy Board *Demand Side Management Guidelines for Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

[2] Ontario Natural Gas Technical Evaluation Committee (TEC), *Request for Proposal: Measurement of Net-to-Gross (NTG) Factors for Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs*, RFP-002-2013 (2), December 2013, Section 2.

[3] Ontario Natural Gas Technical Evaluation Committee (TEC), *Request for Proposal: Measurement of Net-to-Gross (NTG) Factors for Ontario's Natural Gas Custom Commercial and Industrial Demand Side Management (DSM) Programs*, RFP-002-2013 (2), December 2013, Section 2.

[4] NREL, Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, December 2014. http://www.nrel.gov/docs/fy14osti/62678.pdf

[5] Ibid

[6] Ontario Energy Board *Demand Side Management Guidelines for Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

[7] SEE Action, Energy Efficiency Program Impact Evaluation Guide: Evaluation, Measurement, and Verification Working Group, DOE/EE-0829, December 2012. https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/emv_ee_program_impact_guide_1.pdf, page xiv

[8] Note: Non-participant spillover is not within the scope of this study.

[9] Ibid

[10] Ibid, page 5-1

- *Vendors* are program trade allies, business partners, contractors and suppliers who work with program participants to implement energy saving measures.
- *Computer-Aided Technical Interviews* (CATI surveys) are structured surveys administered by a third-party survey firm. CATI surveys require clearly defined skip logic and structured formats. CATI surveys are a lower cost data collection approach that is suitable for structured gathering of information from large samples of respondents.
- *In-Depth Interviews* (IDIs) are structured technical interviews administered by evaluation engineers and market researchers either in person or more frequently, over the phone. IDIs offer more flexibility than CATIs and are best leveraged for complex projects and topics.

Description of Included Programs

The programs included in the evaluation include portions of the utilities' resource acquisition, low income, market transformation, performance-based and large volume portfolios.

Low Income Multi Residential Affordable Housing (Enbridge) Low-Income Multi-Family Offering (Union)

The programs offer multi-family low income housing customers with incentives to encourage energy efficient upgrades and funding for energy audits. The programs also provide technical services, benchmarking, and education for housing providers, building operators and tenants about their building's energy usage and ways to achieve energy efficiency. Eligible measures include boilers, ventilation systems, building envelope, window upgrades, in-suite water conservation measures (faucet aerators, showerheads), and heat reflector panels.

The target markets for both programs are social and assisted housing providers who own and operate Part 3[11] buildings and private multi-residential building owners that provide housing to low income households. In addition, Enbridge targets shelters and supportive housing.

In this Scope of Work we refer to these programs collectively as Low Income Multi-Family (LI MF).

Custom projects implemented as part of these programs and claimed in 2015 are included in the CPSV portion of the study.

The NTG (FR and SO) evaluation portion will not look at projects implemented as part of these programs.

The program metrics for the full program and the cumulative savings included in the 2015 evaluation are shown in Table 3. Ten percent of the combined LI MF program savings are from custom projects, 4% of Enbridge's program and 33% of Union's program.

Table 3: Low Income Multi-Family 2015 Scorecard Metrics

Low Income Multi-Family	Budget	Savings	S. incentive	Budget	Savings	S. incentive	Budget	Savings	S. incentive
	Enbridge			Union			Combined		
Scorecard Metrics	$ 2,111,746	69,226,782	$1,223,674	$ 2,271,917	16,965,778	$1,316,926	$ 4,383,663	86,192,560	$2,540,600
Custom Projects included in 2015 CPSV and FR Evaluation		63,801,575			5,624,627			69,426,202	

[11] "Part 3" references buildings covered by Part 3 of the Ontario Building Code, defined as those exceeding 600 square meters in area or greater than three storeys in height; for residential energy efficiency programs, these are typically multifamily buildings.

Large Volume (Union)

Union continues to encourage the adoption of energy efficient equipment, technologies, and actions through direct customer interaction via its Large Volume program. The Large Volume program is applicable to customers in Rate 1 (2015 only) and Rate T2/Rate 100.

The 2015 to 2020 program uses a direct access budget mechanism for the customer incentive budget process for Rate T2/Rate 100 customers. This mechanism grants each customer direct access to the customer incentive budget they pay in rates. Customers must use these funds to identify and implement energy efficiency projects, or lose the funds which will consequently become available for use by other customers in the same rate class. This "use it or lose it" approach ensures each customer has first access to the amount of incentive budget funded by their rates. The incentive approach for Rate T1 customers remains unchanged from the aggregate pool approach offered in 2014.

The Large Volume program is the only "direct access" program offered in Ontario. It is similar in concept, though not in funding mechanism design, to the standard custom programs offered by the two gas utilities and to the electricity CDM Process and Systems program offered by electricity distributors. It also overlaps to some extent with the Custom Track of the electricity CDM Retrofit program.

Custom projects implemented as part of this program and claimed in 2015 are included in the CPSV and FR portions of the study.

Custom projects implemented as part of this program and claimed in 2013 or 2014 are included in the SO portion of the study.

The program metrics for the full program and the cumulative savings included in the 2015 evaluation are shown in Table 4.[12] The table shows that while most of the Large Volume is Custom and falls within the scope of this evaluation, a small percent of savings (<1%) come from prescriptive projects.[13]

Table 4: Large Volume 2015 Scorecard Metrics

Large Volume	Budget	Savings	S. incentive	Budget	Savings	S. incentive	Budget	Savings	S. incentive
	Enbridge			Union			Combined		
Scorecard Metrics				$ 3,209,716	578,023,195	$ -	$ 3,209,716	578,023,195	$ -
Custom Projects included in 2015 CPSV and FR Evaluation					575,404,661			575,404,661	

Commercial and Industrial Custom Program (Enbridge & Union)

The custom program offerings have been designed to encourage commercial and industrial customers to reduce their energy consumption by providing customer-specific energy efficiency and conservation solutions. The custom programs provide financial incentives, technical expertise, and guidance with respect to energy related decision making and business justification, including helping customers to prioritize energy efficiency projects against their own internal competing factors and demonstrate the competitive advantage customers can gain through efficiency upgrades. These custom programs differ from the prescriptive and direct install programs as they provide tailored services and varying financial incentives based on overall natural gas savings realized by the customer to address customer-specific needs. The custom programs build upon

[12] Cumulative savings included in the evaluation are based on project data sent by Union on August 8, 2016.
[13] Union Gas provided the savings from and counts of prescriptive projects that were claimed as part of the Large Volume program via email May 31, 2016.

those deployed by the gas utilities in past. They are very similar to, and serve effectively the same customers as, the electricity CDM Retrofit Program's Custom Track.

The goal of the Enbridge Commercial Custom offer is to reduce natural gas use through the capture of energy efficiency opportunities in commercial buildings, including retrofits of building components and upgrades at the time of replacement. The offer aims to promote the highest level of energy efficiency.

The Enbridge Industrial Custom Solutions offer is designed to capture cost-effective energy savings within the industrial sector by delivering customized energy solutions aimed at supporting customers through a continuous improvement approach. Industrial Energy Solutions Consultants (ESCs) focus on assisting customers with the adoption of energy efficient technologies by overcoming financial, knowledge or technical barriers.

Union focuses on advancing customer energy efficiency and productivity by providing a mix of custom incentives, education and awareness to C&I customers across all segments. The objective of the Custom offering is to generate long-term and cost effective energy savings for Union's customers.

The Union Custom offering covers opportunities where energy savings are linked to unique building specifications, design concepts, processes and new technologies that are outside the scope of prescriptive and quasi-prescriptive measures. The offering and incentives are targeted directly to the end user, while trade allies involved in the design, engineering and consulting communities assist to expand the message of energy efficiency.

A subset of the projects in these programs is part of the multi-family or multi-residential segment. In this scope of work we refer to these projects as Market-Rate Multi-family (MR MF) in order to distinguish them from the low income multi-family projects.

All projects implemented as part of these programs and claimed in 2015 are included in the CPSV and FR portions of the study.

All projects implemented as part of these programs and claimed in 2013 and 2014 are included in the SO portion of the study.

Table 5 shows the 2015 scorecard metrics and the cumulative savings included in the CPSV and FR evaluation of 2015.[14]

Table 5: Custom C&I 2015 Scorecard Metrics

C&I Custom	Budget	Savings	S. incentive	Budget	Savings	S. incentive	Budget	Savings	S. incentive
	Enbridge			Union			Combined		
Scorecard Metrics	$ 5,489,284	556,659,946	$4,322,644	$ 7,297,352	678,002,610	$3,348,014	$12,786,636	1,234,662,556	$7,670,657
Custom Projects included in 2015 CPSV and FR Evaluation		556,241,778			678,002,610			1,234,244,388	

Run it Right (Enbridge)

Both Enbridge and Union offer similar building optimization programs that are focused on improving operational efficiency among commercial customers.

[14] Cumulative savings included in the evaluation are based on project data sent by Enbridge on August 4, 2016 and Union on August 8, 2016. Enbridge's updated data removed two projects which account for the difference in savings shown.

Through its program, RunitRight, Enbridge provides customers with an energy assessment, technical and implementation assistance and performance monitoring, while Union offers customers incentives for undertaking low or no-cost energy improvements and activities in their facilities through its RunSmart Program.

The SO portion of the study will include projects implemented as part of the RunitRight program in 2013 and claimed in 2014. The FR portion will evaluate projects implemented in 2014 and claimed in 2015.

RunitRight is not part of the CPSV scope for the verification of 2015 projects and is the only program with non-custom projects included in the scope of the evaluation.

RunSmart is not included in this study.

Table 6 shows the 2015 scorecard metrics and the cumulative savings included in the FR evaluation of 2015.[15]

Table 6: RunitRight 2015 Scorecard Metrics

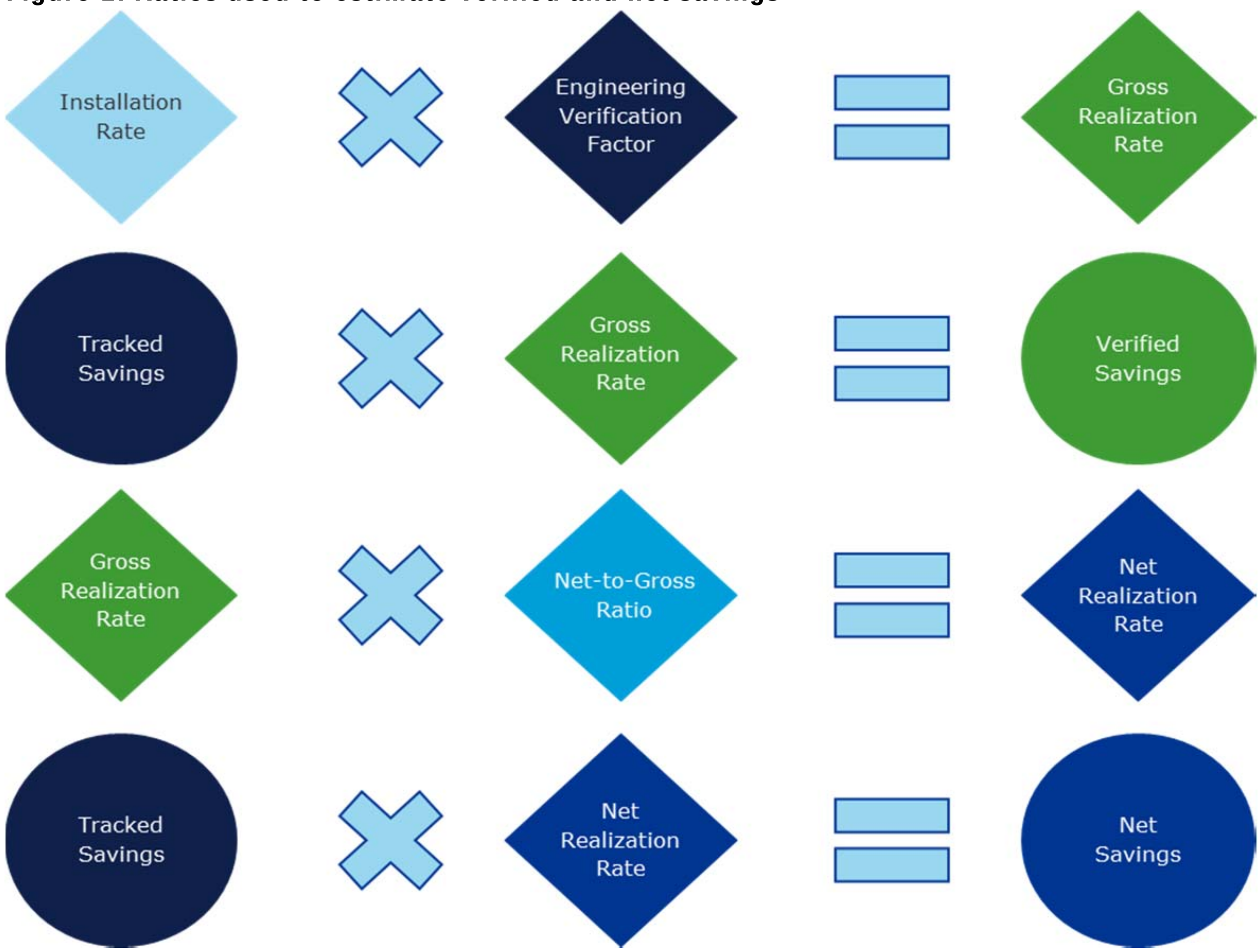
Run-it-Right	Budget	Savings	S. incentive	Budget	Savings	S. incentive	Budget	Savings	S. incentive
	Enbridge			Union			Combined		
Scorecard Metrics	$ 1,181,403	2,684,105	$ 20,843				$ 1,181,403	2,684,105	$ 20,843
Projects included in 2015 FR Evaluation		2,684,105						2,684,105	

Methodology

The overall methodology combines the efforts of the CPSV and the NTG analysis into a single adjustment factor, called the net savings realization rate (Net RR), that can be applied to the reported savings data (or tracked savings) to produce the verified net savings. Figure 1 shows the process for calculating the net RR from the gross savings realization rate (Gross RR) and the NTG ratio, and how it is applied to the tracked savings to produce net savings. The figure also shows the development of the gross RR from the installation rate and engineering adjustment factor, and how it is applied to the tracking savings to produce the verified gross savings.

15 Cumulative savings in the evaluation are based on project data sent by Enbridge on August 4, 2016.

Figure 1: Ratios used to estimate verified and net savings



At its heart, the analysis is built on three unique adjustment factors, which ultimately combine to produce the gross RR and net RR. The three unique factors are:

- **Installation rate.** This factor corresponds to the fraction of measures that were installed. Each measure is assigned a binary factor that identifies whether it was installed or not installed. Adjustments to the number of units installed for a particular measure are included in the engineering verification factor, not in the installation rate.
- **Engineering verification factor.** This is the ratio of the verified gross savings to the tracking estimate of gross savings for installed measures. The engineering verification factor includes corrections to the numbers of units installed, changes in operating hours, changes in operating levels, etc.
- **Attribution factors.** These factors (which include FR and spillover) are used to determine the proportion of the verified gross savings attributable to the program. The attribution factors are determined from the participant's responses to a battery of survey questions designed to determine how influential the program was in the decision to install a particular measure.

The next sections describe the process used to develop the gross RR (from the installation rate and engineering adjustment factor) and the NTG ratio (from the attribution factors) in greater detail. They also describe the process for expanding the results of the sample to the population, and the methodology for estimating spillover savings and adjustment factors.

Gross Realization Rate

The gross RR is developed through data collected during the CPSV effort, which will verify program-achieved gross savings for measures at a sample of sites. The two components are the installation rate and the engineering verification factor.

- The installation rate is derived through the participant survey data collection, which confirms that the reported equipment / measure or something like it was installed at the facility. The resulting analysis value is binary; any similar project to the one reported is considered installed. At the individual measure level, the installation rate is either 100% or 0%.
- The engineering verification factor is derived from the data collected during the participant survey data collection for TSER projects and through the onsite visits for other projects. Differences between the reported measure and the "substantially similar" measure installed at the facility are accounted for here. The engineering adjustment factor is the ratio of the evaluator-verified savings to the program-reported savings.

The majority of the CPSV process involves determining the evaluator-verified savings estimate for each measure. The measure-level results are then combined using weights from the sample design to an overall adjustment factor.

To get the evaluation-verified savings for each evaluated measure, the CPSV effort will verify savings based on the applicable standard program baseline and measure life based on the best available information. The formula for estimating measure level verified savings is shown here:

$$VGS_L = VY_L \times VGS_S$$

Where:

VGS_L – Verified Gross Savings versus standard efficiency equipment on the market (lifetime)

VY_L – Verified Estimated Useful Life of the equipment/action

VGS_S – Verified Gross Savings versus standard efficiency equipment on the market (annual)

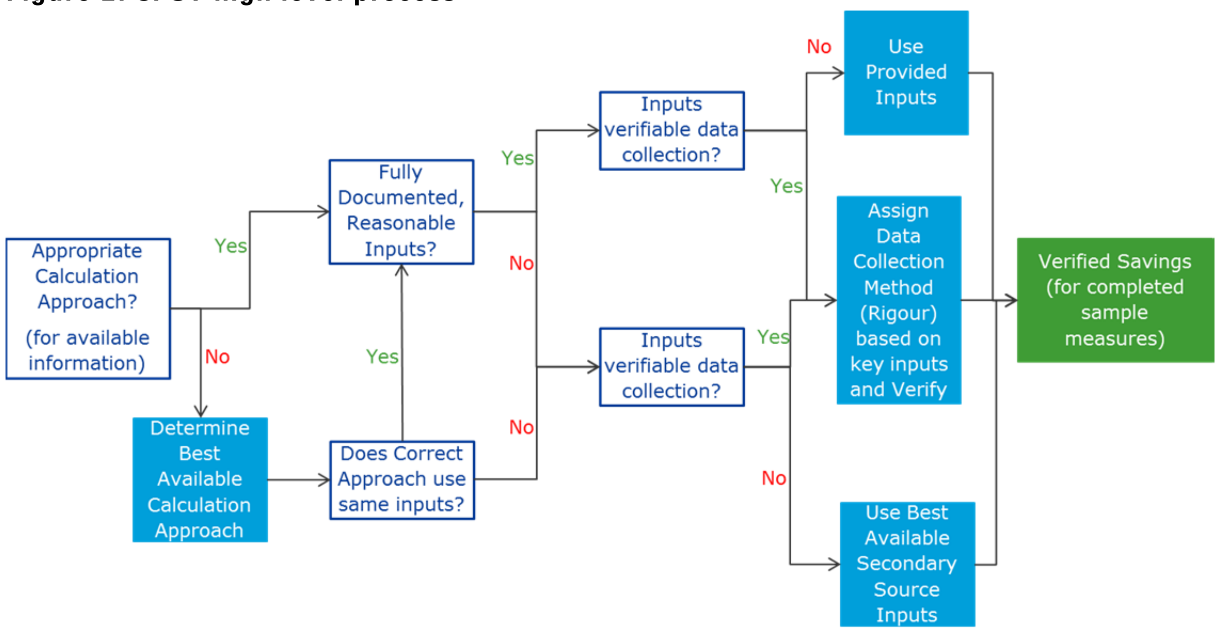
In the Life-Cycle Net Savings (LCNS) method used for this evaluation, the CPSV will also produce a verified savings estimate for accelerated measures using the pre-existing equipment as the baseline (VGS_E). Whether or not the measure is accelerated depends on the responses to the attribution survey and will be discussed later. The "versus existing" verified savings will be used in estimating net savings and will not be included in the verified gross savings. The LCNS methodology is further explained in Appendix B.

The CPSV will produce verified values for three required inputs in the Life-Cycle Net Savings (LCNS) attribution:

- **VGS_S** – Verified Gross Savings versus standard efficiency equipment on the market
- **VY_L** – Verified Estimated Useful Life of the equipment/action
- **VGS_E** – Verified Gross Savings versus existing equipment configuration at the time of installation/action: for a sub-set of measures that are accelerated

CPSV site reports will be completed by assigned evaluation engineers and reviewed by an experienced evaluation engineer at another partner firm. Each review will follow the same basic process shown in Figure 2.

Figure 2: CPSV high level process



After the initial review and savings calculation, an engineer from a partner firm on the EC team (either DNV GL or Itron) will review the site report, approach, calculation, and verified savings. Following this review the verified savings, verified estimated useful life, reasons for deviation and other pertinent information will be compiled into a single dataset at the unit of analysis level for expansion and integration with the FR analysis.

NTG Ratio

The NTG ratio is developed primarily through the data collected from participant and vendor interviews. Data from the engineering verification will also inform the NTG ratio (for the lifecycle net savings (LCNS) approach to free ridership). Where possible, all FR data will be collected via IDIs prior to onsite visits.

The two components of the NTG Ratio are the free ridership and the spillover rates.

- Free ridership (FR) represents the program's influence on the participant's decision to install the measure that received an incentive through the program.
- Spillover represents the program-influenced measures that were installed at the facility as a result of their experience with the original measure. Spillover measures do not receive an incentive.

FR is made up of three factors related to efficiency, quantity and timing. All three attribution factors are based on responses to the attribution questions in the impact evaluation survey. The following is a brief description of each factor:

- **Efficiency attribution, A_E**, measures the effect the program had on the *efficiency* of the equipment installed. The efficiency attribution measures the proportion of savings attributable to the program for increasing the efficiency of the equipment above what would have been installed otherwise.
- **Quantity attribution, A_Q**, measures the effect the program had on the *size or amount* of the equipment installed. The quantity attribution measures the proportion of savings attributable to the program for increasing or decreasing the quantity of equipment above or below what would have been installed otherwise.

- **Timing attribution, A_T,** measures the effect the program had on *when* the equipment was installed. In the LCNS approach the timing attribution is a function of:
  - **Acceleration Period, Y_a,** which corresponds to the number of years between when the equipment was actually installed and when it would have been installed in the absence of the program
  - **Acceleration Period Gas Savings (VGS_E)**, which are estimated versus the pre-existing equipment configuration rather than versus standard efficiency on the market or code. For CPSV sample, this component is calculated as part of the CPSV process and will be included EC team reviews for quality control. This component will not be included in review steps that include OEB or EAC reviewers for respondent confidentiality reasons. For non-CPSV sampled projects in the FR sample, this component will be estimated through using an average ratio from the CPSV sampled projects or based on the age of the existing equipment

The measure-level survey responses are analyzed using a custom software program that objectively determines the FR components and overall rate (see Appendix B and Appendix C for details on the scoring algorithms used) The program includes quality control checks at multiple points in the process. DNV GL has also established a number of metrics that allow us to identify "questionable" results for further investigation and possible correction (details provided in Appendix C). The output of the software program is the source data for the expansion process.

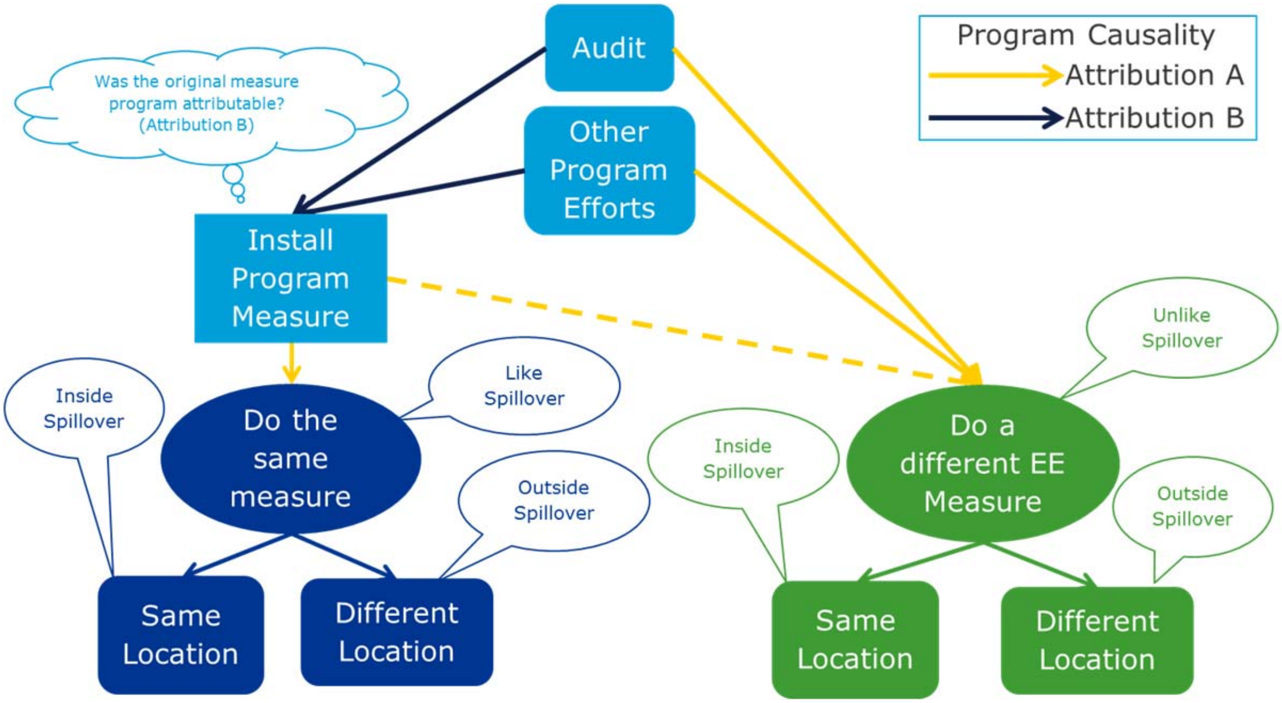
Spillover Estimation

The spillover estimate is developed through data collected from participant and vendor surveys, and a follow-up participant interview. Spillover is present when (see Figure 12):

- A measure is installed after initial program participation
- The measure did not receive an incentive
- The measure was at least partially attributable to the participant's experience with the program in implementing the original measure (Attribution A), **and** (for all like SO and some unlike SO) the original measure is at least partially attributable to the program (Attribution B)

Figure 3 shows how program causality ties to different types of spillover. Attribution B applies to like spillover in all cases, while for unlike spillover, Attribution B applies to the spillover if the original program measure was part of the program influence that led to the spillover measure being implemented.

Figure 3: Program influence on Spillover by Type



Potential spillover projects are identified during an initial survey with the customer and the surveyor collects initial general information on what was installed and whether the new measure was at least partially attributable to the earlier program (attribution A). The analysis team then confirms attribution and compares the participant description with the tracking data for that customer to ensure that the measure did not receive an incentive. If a potential spillover project is identified, a DNV GL engineer will conduct a follow-up phone call to gather the information necessary to estimate the energy savings resulting from that measure, which produces a more accurate savings estimate than asking the customer to provide an estimate themselves. The engineer also will collect the information required for calculating attribution B where it applies.

The relevant attribution estimates are determined based on the information collected during the survey battery and calculated using a custom software program written by DNV GL. The program includes quality control checks at multiple points in the process. DNV GL has also established a number of metrics that allow us to identify “questionable” results for further investigation and possible correction. The program produces measure-level ratios of spillover CCM to tracked or verified CCM, which is the source data for the expansion process.

Sample Expansion

Samples are a necessary part of program evaluation. Sampling reduces costs and customer burden. Nonresponse, whether due to a lack of desire to respond, or because the person that should respond cannot, means that evaluating the entire population usually cannot be done. Any time we evaluate a sample of savings from a program we must expand the sample results to the population. Expanding the results to the population produces results that are representative of the population rather than the sample. Expansion is a key part of calculating important program metrics such as total verified gross and net savings. More detail on sample expansion is provided in Appendix E .

Expansion is done using weights that are determined based on the sample design. The weight is a numeric quantity associated with each responding unit and conceptually represents the amount of the target population the responding unit represents during the analysis. The sample weight is some function of the total number of units in the sample frame. In the CPSV and NTG studies, the sample weight will be built from the inverse probability of selection, incorporating additional adjustment factors to account for nonresponse and coverage errors.

Notation:

N_x = number of units of analysis in stratum X

n_x = number of completed sample units of analysis in stratum X

The weight W_x is calculated as

$$W_x = N_x / n_x$$

The method used to develop the verified or net savings will not affect the weight. In the CPSV, each level of rigour is measuring the same thing (verified savings), only varying in their level of detail. For the NTG portion of the study, the IDI vs CATI distinction operates the same way. In both cases we are looking at energy savings with reliable, valid methods that avoid systematic bias, but with additional magnification on the largest, most variable projects. It is similar to measuring a length using millimetres or eighths of an inch. Both provide accurate measurements of length, but the millimetre measurement is more precise. In terms of expansion, both measurements would get equal weights (once put into comparable units, of course).

DNV GL uses the ratio estimation method to expand our results to the population. The energy saving estimates (tracking savings, installed savings, verified savings or net savings) of the sampled units (measures, projects, sites) are present in both the numerator and the denominator of the ratios, when combined with the sample weights the ratio estimation method produces unbiased, savings weighted adjustment factors. The mathematics of ratio estimation and an example calculation can be found in an appendix.

SUMMARY OF TASKS

The DNV GL team has divided the project into six discrete tasks which are presented, along with their status (as indicated by the box preceding each activity), in Table 7. These tasks are discussed in greater detail in the next sections of the report.

Table 7: Key Project Tasks and Completion Status

Key Tasks
☒ **Task 1: Project Kickoff**
☒ Convene a project kickoff meeting
☒ Reach a consensus on methodology
☐ **Task 2: Sample Design**
☒ Explore the tracking data
☒ Define the unit of analysis
☒ Stratify the data
☒ Design the sample
☒ Select the sample
☐ **Task 3: Data Collection**
☒ Interview program managers and staff
☐ Interview program Energy Advisors
☐ Survey a sample of program participants
☐ Interview a sample of program participants
☐ Onsite verification of a sample projects
☐ Telephone Supported Engineering Review of a sample of projects
☐ Interview program trade allies
☐ Conduct follow-up interviews with program participants
☐ **Task 4: Data Analysis**
☐ Analyze survey and interview data
☐ Calculate estimates
☐ **Task 5: Reporting**
☐ Monthly status reports
☐ Bi-monthly updates
☐ Draft deliverables
☐ Final report and presentation
☐ **Task 6: Project Management**
☐ Complete evaluation on time, on budget and within scope
☐ Keep client informed on progress

We have completed the project kickoff meeting, program manager and staff interviews, and sample design as part of the planning phase, which have informed the specific plan outlined in this document. Next, we will interview utility energy advisors about provide the data collection instruments and associated methodology and will request the contact information and necessary documentation to proceed to the participant data collection phase. The contact request will also ask for vendors associated with the each sampled project. We will calculate the verified savings, free ridership, spillover, and net savings estimates for each program and for domains within programs where there is sufficient sample to provide estimates while protecting respondent confidentiality. These estimates will be provided in the final evaluation reports.

Task 1: Project Kickoff

The initial project kickoff meeting was held on March 17, 2014. At the time, the study did not include CPSV and the client was the Technical Evaluation Committee (TEC). After a long delay, the project was resumed on March 10, 2016 with a reset meeting. Following the reset, oversight of the NTG study was moved from the TEC to the OEB, advised by the EAC. In addition, the January, 2016 OEB DSM Decision included new guidance on how inputs and assumptions (including NTG) for custom programs should be handled in evaluating net impacts.[16] The CPSV scope was added to the project in the months that followed.

Table 8: Task 1 Tasks and Completion Status

Key Tasks	
☒	Task 1: Project Kickoff
☒	Task 1.1: Convene a project kickoff meeting
☒	Task 1.2: Reach a consensus on methodology
☐	Task 2: Sample Design
☐	Task 3: Data Collection
☐	Task 4: Data Analysis
☐	Task 5: Reporting
☐	Task 6: Project Management

[16] Ontario Energy Board, "Decision and Order EB-2015-0029/EB-2015-0049 Union Gas Limited and Enbridge Gas Distribution Inc. Applications for approval of 2015-2020 demand side management plans." January 20, 2016. Page 75.

Task 2: Sample Design

This section presents the stratification plan using the data provided by Union and Enbridge for 2013-2015 custom C&I and multi-family, 2014-2015 RunitRight[17] and 2015 custom Low Income Multi-family projects. Table 9 presents the sample design tasks and their completion status.

Table 9: Task 2 Subtasks and Completion Status

Key Tasks
☒ Task 1: Project Kickoff
☐ **Task 2: Sample Design**
☒ **Task 2.1: Explore the Tracking Data**
☒ Initial data exploration, Union and Enbridge
☒ Exploration of the full datasets, Union and Enbridge
☒ **Task 2.2: Define the Unit of Analysis**
☒ Initial unit of analysis definition
☒ Final unit of analysis definition using full datasets
☒ **Task 2.3: Stratify the Data**
☒ Initial stratification
☒ Final stratification using full datasets
☒ **Task 2.4: Design the Sample**
☒ Initial sample design
☒ Full sample design and precision optimization
☐ **Task 2.5: Prepare the Sample and Backup Sample**
☐ Sample contact information and documentation request
☐ Prepare the sample and backup sample
☐ Task 3: Data Collection
☐ Task 4: Data Analysis
☐ Task 5: Reporting
☐ Task 6: Project Management

The objectives of this task are to:

- Design representative samples for participant data collection for gross savings verification (CPSV), free ridership (FR), and spillover (SO)
- Achieve 90/10 precision[18] at the desired stratification segment levels (see Table 10):
  - Union FR: three program segments (Custom Large Volume, Custom Commercial, Custom Industrial)
  - Enbridge FR: three program segments (Custom Commercial, Custom Industrial, Run it Right)
  - Union SO: three program segments (Custom Large Volume, Custom Commercial, Custom Industrial)
  - Enbridge SO: three program segments (Custom Commercial, Custom Industrial, Run it Right)
  - Union CPSV: two program segments (Custom Large Volume; Custom Commercial, Industrial, & Multi-family (including market rate and low income))
  - Enbridge CPSV: two program segments (Custom Industrial; Custom Commercial & Multi-Family (including market rate and low income))

[17] RunitRight projects claimed in 2014-2015 filings, implemented in 2013-2014.
[18] 90/10 precision refers to 10% relative precision with 90% confidence.

Table 10: Enbridge and Union minimum precision targets by stratification segment

<table>
<tr><th colspan="4">Enbridge</th></tr>
<tr><th rowspan="2">Stratification Segment</th><th>FR Sample Design</th><th>SO Sample Design</th><th>CPSV Sample Design</th></tr>
<tr><th>Rel. Prec.</th><th>Rel. Prec.</th><th>Rel. Prec.</th></tr>
<tr><td>Industrial</td><td>10%</td><td>10%</td><td>10%</td></tr>
<tr><td>Commercial</td><td rowspan="2">10%</td><td rowspan="2">10%</td><td rowspan="3">10%</td></tr>
<tr><td>Market Rate Multi-Family</td></tr>
<tr><td>Low Income Multi-Family</td><td>N/A</td><td>N/A</td></tr>
<tr><td>RunitRight</td><td>10%</td><td>10%</td><td>N/A</td></tr>
</table>

<table>
<tr><th colspan="4">Union</th></tr>
<tr><th rowspan="2">Stratification Segment</th><th>FR Sample Design</th><th>SO Sample Design</th><th>CPSV Sample Design</th></tr>
<tr><th>Rel. Prec.</th><th>Rel. Prec.</th><th>Rel. Prec.</th></tr>
<tr><td>Industrial</td><td>10%</td><td>10%</td><td rowspan="4">10%</td></tr>
<tr><td>Commercial</td><td rowspan="2">10%</td><td rowspan="2">10%</td></tr>
<tr><td>Market Rate Multi-Family</td></tr>
<tr><td>Low Income Multi-Family</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Large Volume</td><td>10%</td><td>10%</td><td>10%</td></tr>
</table>

This task began with the electronic tracking data and paper documentation submitted by the utilities. The outcome is ordered, stratified samples and backup samples for surveying participants to learn about FR, SO, and verification.

Activities

The actual sample design activities are 2, 3, and 4 in the list below. They are flanked by an exploration of the data to characterize what is available and the actual sample preparation. Each of the activities are described briefly subsequent sections and in detail in Appendix A .

1. Explore the tracking data. This activity ensures that the records provided by the utilities match the records used to develop the reported savings. The activity also characterizes the data in terms of the size of measures, types of measures, and quantity of projects.
2. Define the unit of analysis. The unit of analysis defines the level at which data will be analyzed, but not the level at which it will be collected, which is the sampling unit. It is an important distinction which affects the way the surveys are written, the data is collected, and the domains that can be analyzed from the collected data.
3. Stratify the data. In sample designs, more strata allow the design to control representativeness and estimated precision along more dimensions. Having more strata does not hurt overall precision, but it can increase the sample sizes required. Each stratification level serves to improve efficiency, improve representativeness, or both.
4. Design the sample. In this step, the appropriate coefficient of variation is selected, and the number of targeted data points is determined for each stratum.
5. Prepare the sample and backup sample. The data is organized according to the sample design and an appropriate number of participants are selected as potential study participants.

Deliverables

- Documentation Request
  - CPSV/FR Samples and backup
  - Spillover Sample and backup
- Contact Information Request
  - CPSV/FR Sample and backup
  - Spillover Sample and backup
- Sample Design Appendix for each Report

Task 2.1: Explore the Tracking Data

We explored the tracking data provided by Union and Enbridge to determine data availability, the number and types of measures installed, and the size and quantity of projects. We explored the Union and Enbridge datasets separately. Additional detail can be found in Appendix A .

Enbridge Custom Participant Data

The custom program participant data files provided by Enbridge included custom C&I energy efficiency projects claimed during the 2013-2015 program years and custom Low Income Multi-Family projects claimed in 2015 (Table 11). The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. There are 124 accounts that appear in both the 2015 program year and the 2013/14 program years.

Table 11: Enbridge Custom C&I and Multi-Residential Program Participation Metrics by Year

Program Year	Accounts	Gas Savings (m^3)
2013	680	53,030,333
2014	573	46,195,015
2015	706	51,330,067

Enbridge RunitRight Participation Data

For RunitRight, the program tracking data includes projects claimed in the 2014-2015 program years. These projects were all implemented in 2013-2014; savings for a project in the program are claimed after one year of site metering is complete.

Table 12: Enbridge RunitRight Program Participation Metrics by Year Claimed

Program Year	Accounts	Gas Savings (m^3)
2014	45	625,088
2015	28	542,442

The RunitRight program has only one measure type. It also has several projects with negative savings. Negative savings (increases in energy use) are possible results from retro-commissioning projects, sometimes due to calculation method (billing analysis based savings without weather, occupancy adjustment or production adjustment) or due to actual increases in energy use. Negative saving measures need to be handled carefully in ratio estimation: high FR on large negative savings projects can result in overall program FR <0, which is not a valid FR result.[19] Our recommended approach to the problem is to produce and apply ratios with separate domains for positive and negative savings projects. Applying the ratios by separate domains based on positive or negative savings provides meaningful FR ratios and accurate net savings. Ratio estimation by domains is described in detail in Appendix E .

Union Custom Participant Data

The participant data files provided by Union included energy efficiency projects claimed during the 2013-2015 program years. The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. There are 67 accounts that appear in both the 2015 program year and the 2013/14 program years.

Table 13: Union Participation Metrics by Year

Program Year	Accounts	Gas Savings (m^3)
2013	352	369,438,742
2014	392	285,752,549
2015	462	201,620,726

Task 2.2: Define the Unit of Analysis

Following data exploration, we defined the *unit of analysis*, which established the level at which data will be analyzed but not the level at which it will be collected, which is the *sampling unit*. We further discuss this distinction, how the sampling unit is defined and provide more detail on defining the unit of analysis in Appendix A .

The definition of the unit of analysis is one of the most important and least discussed aspects of DSM program evaluation. Consider the following four dimensions: end -use, measure type, equipment or "action," and calculation approach.

- The **end use** can be important in decision making because lowering the cost per unit produced is a different decision than lowering the cost of heating a facility or office, for example. It can also be used as a proxy for the complexity of the calculation, as process-related end uses tend to have more complex and site-specific calculation approaches. End use can be used in surveys by listing the measure types that fall into the category; however, this is not ideal for NTG as the program's influence on decision making may differ by measure type, affecting the attribution response.
- **Measure type** is important for surveys to aid participant recall by providing a concrete, simple description of what equipment was altered or installed. This aggregation is less appropriate for CPSV where the calculation method may differ.
- **Equipment or Action** is a very important distinction for NTG. Continuous improvement actions, such as maintenance, operations, and optimization, have fewer barriers to implementation than equipment purchases due to lower total cost, shorter term planning horizons and often fewer approvals. Businesses typically have separate budgets for capital and operating expenses. Purchases of new or replacement equipment falls under a capital budget, while actions are usually part of the operating budget or performed by salaried employees. Capital budgets typically have long term planning and allocation, while an operating budget is by nature more flexible to conditions in a given year. The ability of programs to affect equipment and action decision making is necessarily different as well. For the unit of analysis, actions were defined by three categories: maintenance, operational improvement, and optimization.

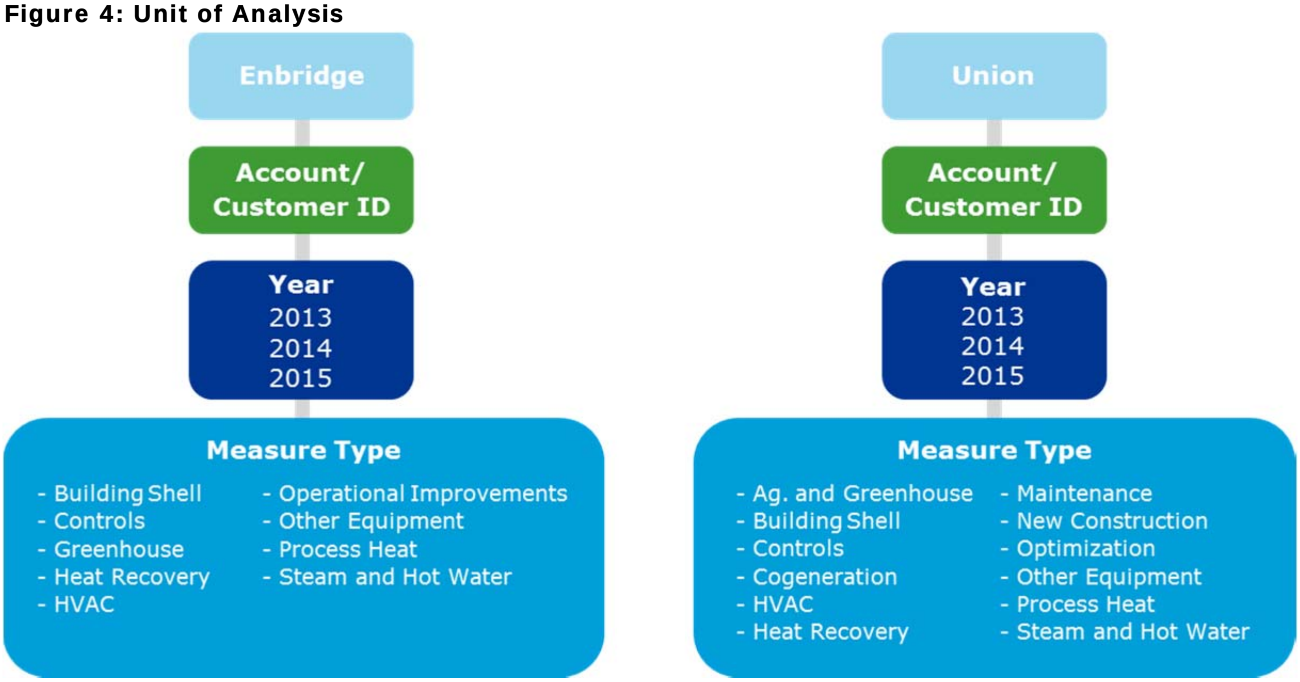
[19] Free ridership on negative savings results in more program savings, rather than less.

- **Calculation type** is important for CPSV. Simple, commonly implemented measures in custom programs do not require the same depth of data collection to verify calculations and inputs as more complex measures. Simple measures also use standardized calculation approaches that reduce variance. Evaluators tend to find fewer adjustments and, even when adjustments are found, the adjustment often affects all measures of a calculation approach similarly. For CPSV of the 2015 program year, the utilities indicated that projects that used eTools or standard spreadsheet calculation approaches could not be easily identified in the tracking data. In lieu of this information, evaluation engineers reviewed the provided program tracking database and categorized measures as simple or complex based on the best technology, enduse, and facility type descriptors available. A subset of measures (generally "other" measures) was categorized after the utilities provided additional detail.

Aggregating across any of the four listed dimensions is a trade-off of accuracy for increased precision, reduced customer burden and reduced evaluation costs. Not aggregating makes the same trade-off, but in reverse.

The unit of analysis for the evaluation, presented in Figure 4, aggregates the data to the utility, account, year, and measure type. For Union, aggregating the tracking data to the unit of analysis reduced the number of records from 744 to 597 records for 2015 and from 1,468 to 1,091 records for 2013 to 2014. For Enbridge, the number of records for 2015 decreased from 955 to 858 records and for 2013 to 2014 decreased from 1,648 to 1,511 records.

Figure 4: Unit of Analysis



Once aggregated to the unit of analysis, Union had an average of 1.5 units of analysis per account in 2013 and 2014 and 1.3 units per account in 2015[20] while Enbridge has an average of 1.2 units per account in 2013, 2014, and in 2015. In general, Union accounts tended to have more units of analysis per account than Enbridge accounts. Only 26 Union accounts have 5 units and none had more than 5. For Enbridge, 9

[20] We are assuming a 1:1 account to customer ratio for sampling. For the analysis, customer will be defined by contact information (phone number primarily), which is not included in the provided tracking data.

accounts have 4 units and no accounts have more than 4. This will facilitate data collection, since it's reasonable to ask about 3-4 units.

At this time we are unable to comment on the number of units per customer, because some customers will likely have multiple accounts. Customers will be defined by their contact information which will be requested along with the documentation request following submission of the scope of work.

Task 2.3: Stratify the NTG and CPSV Data

There is a balance between having too many and too few strata.[21] In sample designs, more strata allow the design to control representativeness and estimated precision along more dimensions. Having more strata does not hurt overall precision, but it can increase the sample sizes required. Each stratification level serves to improve efficiency, improve representativeness, or both.

There are four populations across which the evaluation findings will be completely separate from one another.[22] These populations are defined by having separate program designs. The divisions between these populations are hard lines; none of the reported ratio results will include a mix of information across these populations. We can think of this as four evaluations using a common methodology and data collection effort.

1. Union Large Volume
2. Union Custom C&I
3. Enbridge Custom C&I
4. Enbridge RunitRight

Within the stratification segments (see Table 10) we categorize measures to improve the efficiency and representativeness of the sample. [23] The stratification for the 2015 data collection effort balances the needs of two studies, with the CPSV sample a subset of the NTG sample. DNV GL's experience is that each has differing measure categorization priorities.[24]

- For NTG the measure categorization most predictive of free ridership rates is whether the project is installation of efficient equipment or whether the project was an action taken with existing equipment, regardless of whether that action is maintenance or an optimization that leads to energy savings.
- For CPSV the measure categorization most predictive of verification rates is a simple calculation versus one that is complex. Simple projects that follow consistent approaches and vary less from site to site typically have verification rates with lower variance than more complex projects that require more site specific knowledge and truly custom calculations. Stratifying by rigour allows us to assign a lower ER (0.3) to the simple project strata and higher to the more complex strata (0.4 ER) which provides better sample allocation. Simple strata projects will receive a TSER verification, while complex strata projects will receive an onsite verification.

[21] DNV GL agrees with the approaches described in "Sampling Methodology for Custom C&I Programs" which was prepared by Navigant for the TEC in 2012 and used to inform previous CPSV sample designs. Our sample design approach is consistent with the approaches recommended and follows the recommended seven step process (pages 17-23).
Dan Violette, Ph.D. & Brad Rogers, M.S., MBA, Navigant Consulting, Inc. "A Sampling Methodology for Custom C&I Programs," Prepared for: Sub-Committee of the Technical Evaluation Committee. November 12, 2012 (Revised October 28, 2014).

[22] For the CPSV, LI MF will be reported with MR MF either together with Custom C&I or as a separate Multi-Family domain, depending on final sample sizes and precisions.

[23] Page 14 in the Navigant report provides an explanation of the rationale for stratification.

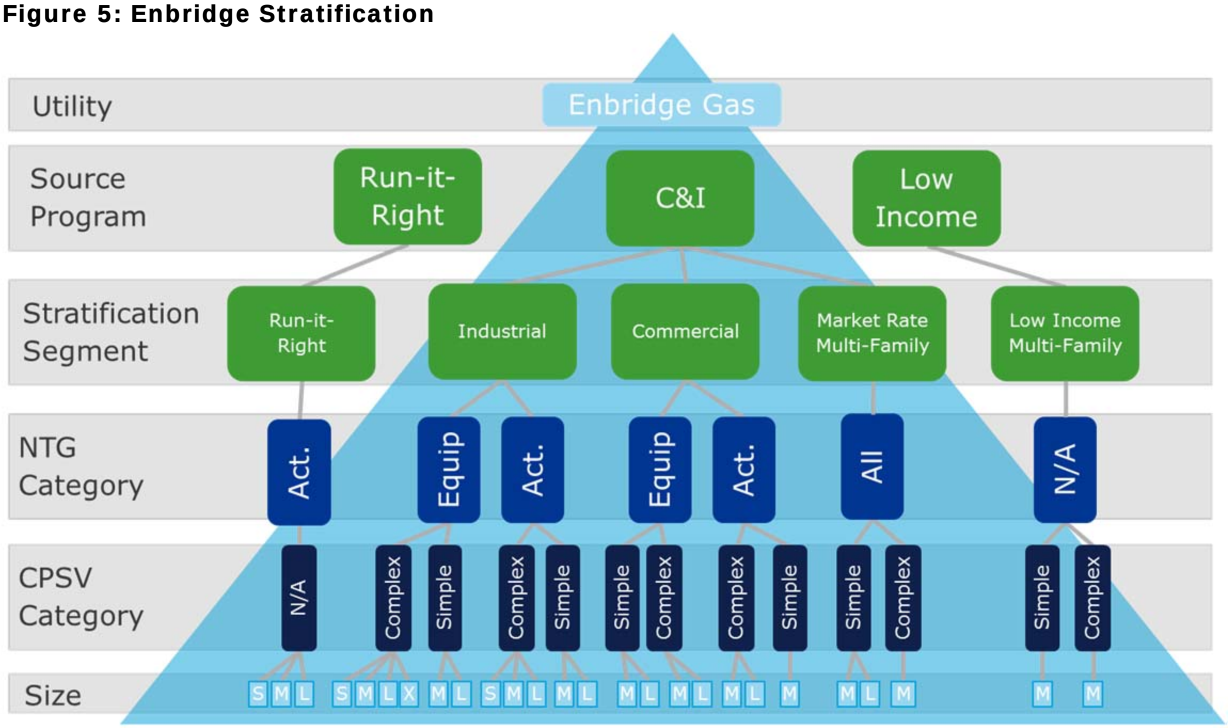
[24] The current stratification plan has more aggregated program segment categories than were described in the original proposal. When developing the proposal sample design we did not have access to the data or savings amounts specific to measure types.

The final stratification level segments projects by the magnitude of energy savings resulting from that project. Large projects represent a greater portion of the population, so sampling them at increased rates will result in greater precision with fewer verification visits or calls. Smaller projects must also be sampled to ensure representativeness. In the final 2015 sample design, DNV GL used cumulative savings as a measure of size; for 2013/14 sampling annual savings were used. Cumulative gross savings were not provided for some of the 2013/14 programs.[25] In terms of sample allocation, using cumulative savings selects longer life measures at a higher rate than would occur if annual savings were used.

It is important to note that the stratification used for sampling and expansion does not need to correspond directly to the level of reporting. For example, while we have chosen to use broad categories of customer segments in our stratification, this does not preclude reporting or applying ratios by more disaggregate customer segments. Our intended (pending final precisions) application domains are provided later in this section.

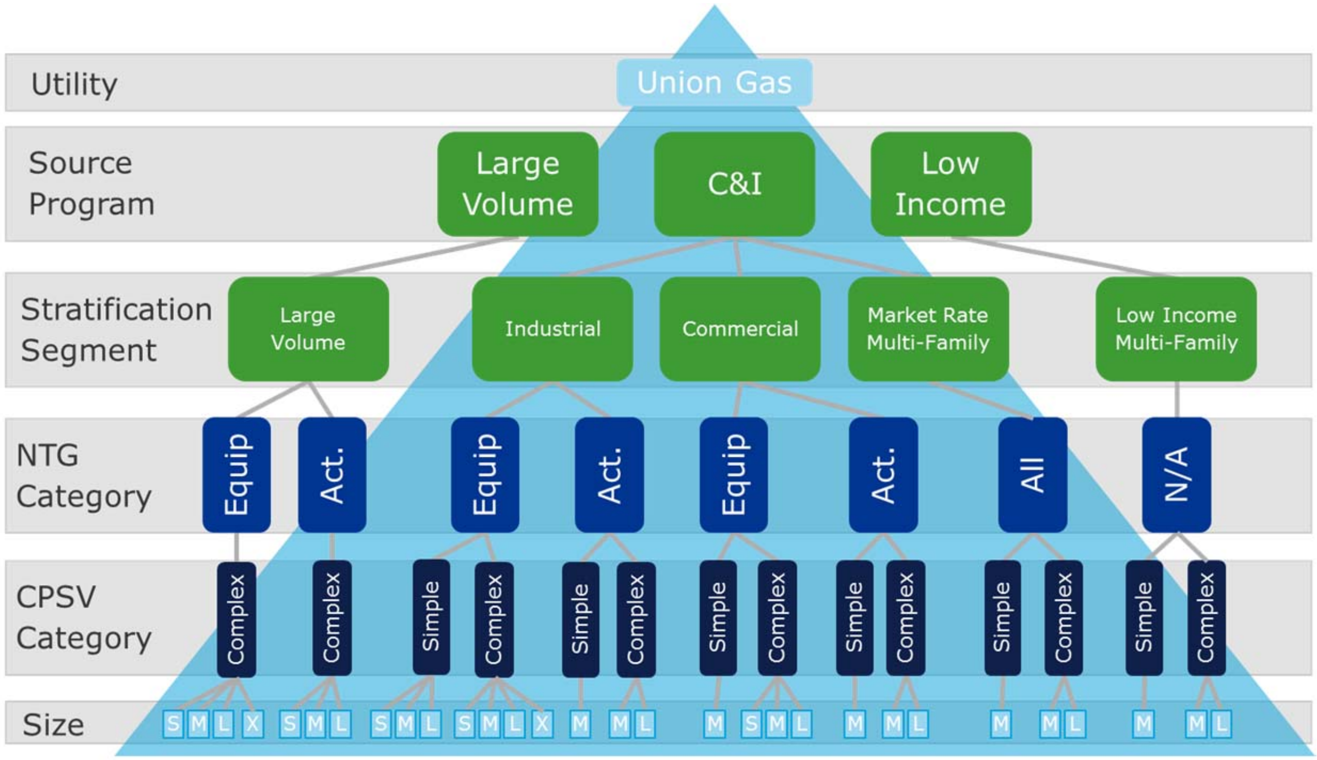
Figure 5 and Figure 6 show the CPSV and NTG stratification for Enbridge and Union respectively.

Figure 5: Enbridge Stratification



25 The August 4, 2016 data provided by Enbridge included cumulative savings for 2015, but not 2013 and 2014.

Figure 6: Union Stratification



Task 2.3: Design the Samples

Critical to the sample size determination is the error ratio for each sampling cell with respect to the ratio to be estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean. A higher ER assumption results in a larger required sample size.

The error ratios used in the sample design are lower than typical ER assumptions[26] due to the stratification described above:

- 0.6 for FR
- 0.3 for Simple CPSV strata (TSERs)
- 0.4 for Complex CPSV strata (Onsites)
- 0.35 for Complex Multi-Family CPSV strata (includes both MR MF and LI MF)

2015 Enbridge Stratification

The 2015 Enbridge stratification is presented in Figure 7. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total there are 26 Strata.

Table 14 shows the 2015 Enbridge sample design in table form with the expected relative precisions and sample for targeted programs shown for each portion of the study. Data collection for FR will be completed

[26] In general, a typical ER for FR with size-only stratification would be 0.7, while for CPSV, 0.4 or 0.5 would be appropriate.

through IDI, while the CPSV group indicates strata that will have onsite data collection (complex) or TSER (simple).

Table 14: Enbridge CPSV and FR Sample Design

Stratification Segment	NTG Group	CPSV Group	Size Strata	Sample Frame		FR Sample Design		CPSV Sample Design	
				N	m3	n	Rel. Prec.	n	Rel. Prec.
Industrial	Action	Complex	3	13	18,898,127	8	10%	7	10%
		Simple	2	8	4,964,165	4		4	
	Equipment	Complex	4	70	276,569,945	24		15	
		Simple	2	25	43,925,065	6		6	
Commercial	Action	Complex	2	3	10,988,780	3	10%	3	10%
		Simple	1	24	3,875,430	4		4	
	Equipment	Complex	3	59	61,573,901	22		9	
		Simple	2	293	236,656,958	34		10	
Market Rate Multi-Family	All	Complex	1	53	23,584,650	8		5	
		Simple	2	175	129,568,929	19		8	
Low Income	All	Complex	1	6	5,125,020	0	N/A	2	
		Simple	1	104	58,676,555	0		6	
RunitRight	Optimization	IDI	3	28	2,712,210	17	10%	0	N/A
Total				**861**		**149**		**79**	

Table 15 shows the anticipated relative precisions for less aggregated program segments. We expect that the final relative precisions will be close to 90/10 for these segments as well as the targeted programs above. The domains that will be included in the report and the domains which will be used for ratio application will be determined based on the decision making structure provided in Appendix E.

Table 15: Enbridge Expected Precisions by Program Segment

Stratification Segment	Sample Frame		NTG		CPSV	
	N	Savings	n	Rel Prec.	n	Rel Prec.
Industrial	116	344,357,302	42	10%	32	10%
Commercial	379	313,095,069	63	11%	26	14%
MR MF + LI MF	338	216,955,154			21	14%
MR MF	228	153,153,579	27	21%		
RunitRight	28	2,712,210	17	10%		

2015 Union Stratification

The Union stratification is shown in Figure 8. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency.[27] In total there are 30 strata.

Table 16 shows the 2015 Union sample design in table form with the expected relative precisions and sample for targeted programs shown for each portion of the study. Data collection for FR will all be completed through IDI, while the CPSV group indicates strata that will be have onsite data collection (complex) or TSER (simple) for CPSV.

[27] Size strata have different cutoffs between large/medium/small etc within each category. The cut points were determined using a Model Based Stratified Sampling (MBSS) algorithm that optimizes the cut-points and sample allocation to produce the best precision overall for a given number of sampled units.

Table 16: 2015 Union CPSV and FR Sample Design

Stratification Segment	NTG Group	CPSV Group	Size Strata	Sample Frame		FR Sample Design		CPSV Sample Design	
				N	m3	n	Rel. Prec.	n	Rel. Prec.
Industrial	Action	Complex	1	21	75,487,148	7	11%	6	10%
		Simple	1	44	102,200,503	4		3	
	Equipment	Complex	4	136	862,582,429	35		17	
		Simple	3	111	165,066,284	10		9	
Commercial	Action	Complex	2	8	81,635,903	5	10%	4	
		Simple	1	13	22,029,892	6		3	
	Equipment	Complex	3	109	142,631,725	14		7	
		Simple	1	42	14,831,059	5		3	
	All	Complex	2	6	7,409,515	3		2	
		Simple	1	1	44,260	1		1	
Low Income	All	Complex	2	2	1,454,295	0	N/A	2	
		Simple	1	35	4,466,365	0		3	
Large Volume	Action	Onsite	3	35	404,398,149	10	10%	8	10%
	Equipment	Onsite	4	37	846,481,549	22		13	
Total				**579**		**115**		**75**	

Table 17 shows the anticipated relative precisions for less aggregated program segments. We expect that the final relative precisions will be close to 90/10 for these segments as well as the targeted programs above. The domains that will be included in the report and the domains which will be used for ratio application will be determined based on the decision making structure provided in Appendix E.

Table 17: 2015 Anticipated Precisions by Program Segment

Stratification Segment	Sample Frame		NTG		CPSV	
	N	Savings	n	Rel Prec.	n	Rel Prec.
Industrial	312	1,205,336,364	56	11%	35	12%
Commercial	172	261,128,579	30	12%	17	16%
Large Volume	72	1,250,879,698	32	10%	21	10%
MR MF + LI MF	44	13,374,435			8	10%
MR MF	7	7,453,775	4	25%		

Task 2.4: Spillover Sample

The sample design for spillover omits the CPSV category, but is otherwise consistent with the sample design for the 2015 FR and CPSV evaluation task. For spillover the ER used was 0.8; 90/10 precision was targeted. The assumed ER of 0.8 reflects the weaker correlation between SO and the size of the original measure than there is for FR or CPSV.

2013/14 Enbridge Stratification

The 2013/14 Enbridge stratification is presented in Figure 7. The final stratification includes 4 evaluation programs, two NTG categories, and up to six size categories optimized for sampling efficiency. In total there are 28 strata.

Figure 7: 2013/14 Enbridge Stratification

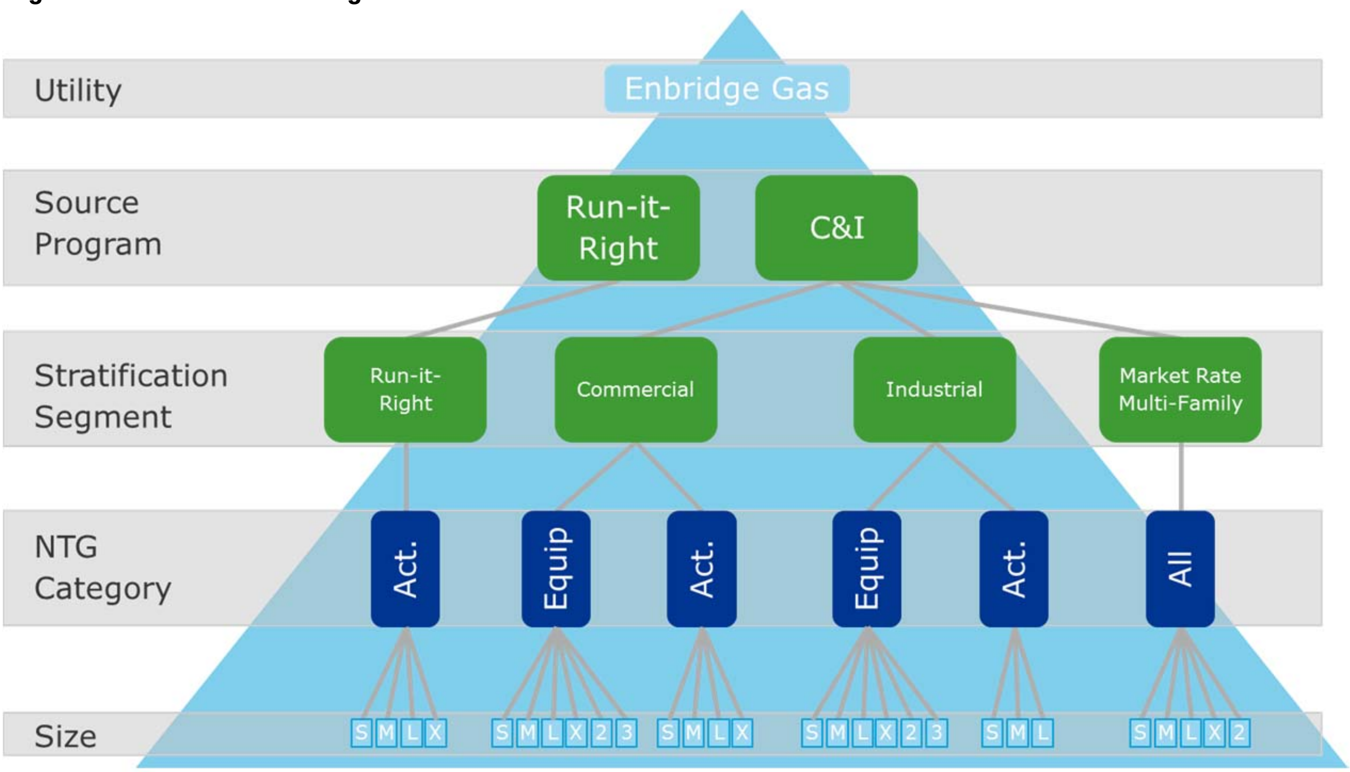


Table 18 shows the number of accounts and savings in the sample frame and the targeted spillover sample size for each grouping. The domains that will be included in the report and the domains which will be used for ratio application will be determined based on the decision making structure provided in Appendix E.

Table 18: 2013/14 Enbridge Spillover Sample Design

Stratification Segment	NTG Group	Size Strata	Sample Frame		SO Sample Design	
			N	m3	n	Rel. Prec.
Industrial	Action	3	40	5,067,923	20	10%
	Equipment	6	191	41,899,589	50	
Commercial	Action	4	79	4,604,864	25	10%
	Equipment	6	603	27,240,429	60	
MR MF	All	5	553	20,412,543	65	
RunitRight	Action	4	45	625,088	26	10%
Total			**1,511**		**246**	

2013/14 Union Stratification

The Union stratification is presented in Figure 8. In total there are 35 strata.

Figure 8: 2013/14 Union Stratification

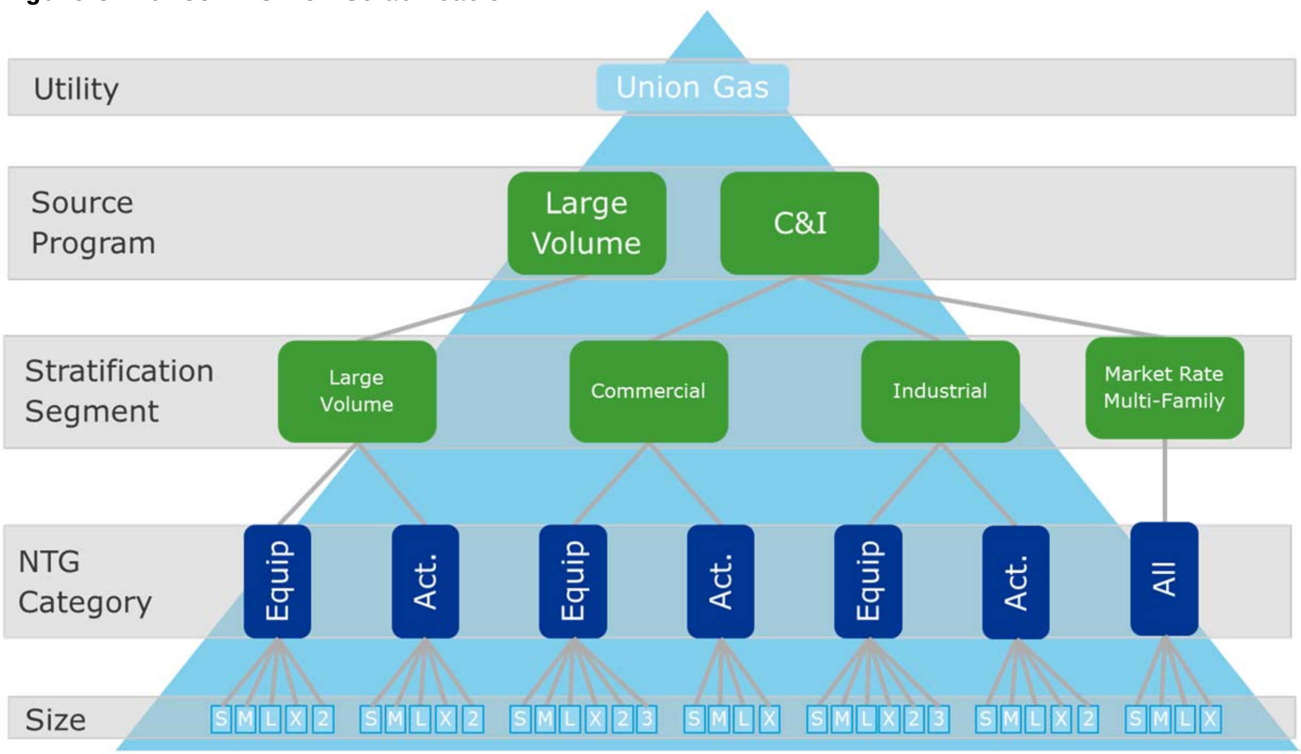


Table 19 shows the number of accounts and savings in the sample frame and the targeted spillover sample size for each grouping. The domains that will be included in the report and the domains which will be used for ratio application will be determined based on the decision making structure provided in Appendix E.

Table 19: Union Spillover Sample Design

Stratification Segment	NTG Group	Size Strata	Sample Frame		SO Sample Design	
			N	m3	n	Rel. Prec.
Industrial	Action	5	167	64,448,800	38	10%
	Equipment	6	412	107,347,726	57	
Commercial	Action	4	74	9,687,715	24	10%
	Equipment	5	190	15,744,760	40	
MR MF	All	2	38	564,428	8	
Large Volume	Action	5	130	317,638,812	38	10%
	Equipment	5	94	139,759,050	33	
Total			**1,105**		**238**	

Task 2.5: Prepare the Sample and Backup Sample

Once we have completed the final sample design, we will submit a data request to the utilities. For the 2015 NTG sample we will request documentation and contact information for 50 percent more projects that are in the primary sample. The 50 percent additional constitutes the initial backup for the FR sample. This corresponds to a minimum 66 percent response rate. If response rates are lower than 66 percent in specific strata, we will request documentation and contact information for additional projects in the stratum as needed to meet targets.

For the 2013/14 spillover sample we will request contact information and a review of the measure description to be used in the survey for three times the number of sampled projects. These additional projects are the initial backup for the spillover sample. The number requested corresponds to a minimum 33 percent response rate. If response rates are lower for the SO CATI than 33 percent in specific strata, we will request contact information for additional sites as needed.

We will not request project documentation for the entire spillover sample. Once we have identified the sites that require follow up engineering interviews we will request documentation for necessary sites and up to 20 additional sites beyond those that will receive follow up calls Based on prior experience we anticipate conducting follow up calls for approximately 10 percent of the original sample. Overall this staging of requests will reduce the amount of project documentation that the utilities need to provide, while ensuring efficient data collection and respondent confidentiality.

Backups for each sample will only be contacted if needed to meet targeted number of completes.

Once we have received the requested contact information, we will identify instances where a contact was involved in multiple projects, even across sites. While the projects are conducted at the site level, the decision maker, technical expert, or vendor may have been involved in projects at multiple sites. For example, multiple participating sites for the same retail chain may have one energy manager from the corporate office but the technical expert may be site specific. Using this contact information and taking into account cross-site involvement, we will assemble the CATI and the IDI sample frame.

Task 3: Data Collection

Data collection for the program includes interviews with program managers, staff and energy advisors; CATI surveys and IDIs with program participants; on site verification at participating customer sites; and IDIs with participating vendors. Interviews with program staff and energy advisors are for informational purposes only. CPSV, FR and SO results will be based on data collected directly from participating customers and vendors.

Table 20: Task 3 Subtasks and Completion Status

Key Tasks
☒ Task 1: Project Kickoff
☐ Task 2: Sample Design
☐ **Task 3: Data Collection**
☒ **Task 3.1: Program Managers and Staff Interviews**
☒ Union Gas Program Portfolio Management
☒ Enbridge Commercial Program Managers
☒ Enbridge Industrial Program Managers
☒ Enbridge RunitRight Program Managers
☐ **Task 3.2: Program Energy Advisor Interviews**
☐ Energy Advisor Interview Guide
☐ Up to 10 pre-survey interviews
☐ **Task 3.3: Program Participants**
☐ SO CATI survey Instrument
☐ Up to 502 CATI surveys completed
☐ FR IDI Instrument,
☐ Up to 280 FR IDIs completed
☐ CPSV Data Collection forms
☐ Up to 107 site visits completed
☐ Up to 62 TSERs completed
☐ Approx. 50 SO follow up IDIs completed
☐ **Task 3.4: Participating Vendors**
☐ In-Depth Interview Instrument
☐ Up to 80 IDIs completed
☐ Task 4: Data Analysis
☐ Task 5: Reporting
☐ Task 6: Project Management

Objectives

The objective of the data collection task is to collect

- Program manager, staff and energy advisor information on program services and influence on participants and vendors to inform other data collection efforts
- Participant information on timing, efficiency, and quantity to inform FR analysis
- Vendor information on timing, efficiency, and quantity to inform the FR analysis
- On-site and telephone data from participants about equipment and operations to inform the CPSV
- Participant information on energy saving projects undertaken outside of the program(s) and program influence thereof to inform the spillover analysis

Activities

Each of the data collection activities supports either understanding program influence on energy savings projects or verifying gross energy savings.

1. Group interviews with utility program managers, and staff informed the development of the scope of work. These interviews focused on how the programs are designed and operate to influence projects

directly and indirectly through incentives, technical assistance, vendor relationships and long term customer management.

2. Program energy advisor interviews will be scheduled after submission of the draft SOW. These interviews will focus on the specifics of program interactions with customers. The intent of the interviews is to ensure that the FR framing in the IDIs and CATI covers the range of program activities that may have influenced decisions to implement projects.
3. Program Participants are the primary source of data for the evaluation and verification.
   a. Spillover CATI surveys will be conducted to identify customers with potential spillover projects. The CATI will utilize the FR framing to aid customer recall of the original program measure and the program interactions associated with it. Then the CATI will ask the customer if any other energy saving actions have been taken since the original measure and, if so, whether these actions were influenced by the prior program participation.
   b. FR IDIs will be conducted to estimate the free ridership for the 2015 program. These IDIs will ask primarily open ended questions about program and other influences in a FR framing section and then will ask a series of questions to estimate free ridership for each measure. A subset of these IDIs will include gross savings verification questions (for the TSER sample) and a subset will also be asked SO questions (if they are also in the SO sample for another measure).
   c. On site visits will collect data to support verification of gross savings estimates (onsite sample). These visits will occur after the initial FR IDI for sites in the onsite sample.
   d. Engineering follow up IDIs will collect data to support spillover savings estimates and free ridership of the original program measure (where applicable)
4. Participating vendors will provide supplemental data for FR estimates for customers who indicate vendor influence on their decision to implement program measures.

Table 21 is a summary of the targeted completes by data collection type. For spillover the sample design targets 484 completed surveys. A portion of these surveys will be completed as a spillover module addressing 2013/14 projects at the end of the FR interview with 2015 participants who also participated in 2013/14. A more detailed breakdown of our target number of surveys and interviews is provided in the description of the methodology in Task 2: Sample Design.

Table 21: Target Number of Completed Surveys/Interviews

Target Group		Number of Interviews/Surveys		
		Enbridge	Union	Total
Program Manager Interviews		3	1	4
Energy Advisor Interviews		≤10	≤10	≤20
Spillover Only	Participant CATI Surveys	≤246	≤238	≤484
	Participant Follow up Interview	~25	~25	~50
FR/CPSV/Spillover	Total Participant IDIs	151	121	272
CPSV	Participant Site Visits	40	57	97
	Participant TSERs	38	22	60
FR	No CPSV	73	42	115
FR/Spillover	Participating Vendors	~30	~30	≤62

Shortly after this scope of work is provided to the EAC for review, DNV GL will contact the utilities to schedule interviews with program EAs to support prompt submittal of the draft interview guides and CATI surveys to the EAC for review.

A comment matrix will describe how comments or suggestions from reviewers were addressed in the final interview guides and survey instruments. While this review process is ongoing, we will also request contact information from the utilities to ensure that we are talking to the appropriate people, have the necessary contact information, and work with the utilities to prepare draft advance letters.

Deliverables

- Program participant Spillover CATI survey instrument (draft and final), including proposed scoring algorithm memo
- Program participant Free ridership IDI guide (draft and final), including proposed scoring algorithm memo
- Participating vendor IDI guide (draft and final), including proposed scoring algorithm memo
- Program manager and staff IDI guide (draft and final)
- Program Energy Advisor IDI guide (draft and final)
- CATI and IDI participation advance email & mail scripts

Task 3.1: Program Managers/Staff In-Depth Interviews

In order to better understand program logic, methods, execution, and intent, DNV GL conducted IDIs with program managers and then program staff. The interviews informed the development of the scope of work in the planning of data collection and analysis. These interviews focused on:

- Understanding how the program is designed
- Understanding how the program is implemented and marketed
- Understanding the program theory and logic
- Identifying key staff such as Energy Advisors and what roles they play

- Identifying how staff understand decisions are made by customers
- Identifying how communication among customers, program staff and vendors parties occurs.

DNV GL staff interviewed program staff from Enbridge and Union on the following dates:

Table 22: Program Manager Interviews

Date	Company	Program
1/22/2016	Union Gas	Program Management - Portfolio
1/25/2016	Enbridge	Commercial Programs Interview
1/29/2016	Enbridge	Industrial Programs Interview
1/29/2016	Enbridge	RunitRight Program Interview

Task 3.2: Program Energy Advisors

The evaluation will request interviews with ten Energy Advisors prior to submitting the final program participant survey/interview instruments, in order to better inform those instruments. Five will be interviewed from each of Enbridge and Union Gas (10 total interviews). For these initial, non-project specific interviews, we will ask the utilities to select the Energy Advisors who they feel will be most helpful to the evaluation in terms of how the program influences projects and works with vendors. These interviews will inform our participant data collection guides to ensure that they address the actions of each of the programs that this evaluation is addressing. The outline for the initial Energy Advisor interview is provided in Appendix F .

The evaluation will attempt to schedule an additional 10 energy advisor interviews will be scheduled prior to fielding the participant IDIs. Five will be interviewed from each of Enbridge and Union Gas (10 total interviews). The energy advisors will be those with the five largest projects in the Union and Enbridge programs respectively. We will discuss the two largest projects in the sample that are associated with each energy advisor selected. These interviews will consist of talking through the FR framing topics with the energy advisor regarding each project. Following the interviews project specific probes will be added to the specific project's interview guide as necessary. Added probes, with participant identifying information redacted, will be provided to the EAC prior to administering the participant IDI for transparent review to ensure that any probes added are "non-leading" and will not bias the FR results.

The outline for the project specific energy advisor interviews will parallel the FR Framing module in the participant IDI.

Task 3.3: Participant Data Collection

Participant data collection will be a combination of CATI surveys, in-depth-interviews and onsite visits. The combination of data collection approaches that will be used for a specific customer depends on which samples the customer has been selected for.

Figure 9 shows the populations and samples that a single customer may a part of. The figure shows how a customer may be included in as many as three samples or as few as none. The CPSV Onsite and TSER samples are mutually exclusive and a subset of the FR Sample. The NTG-Only sample is the portion of the FR sample that was not selected for the CPSV. The Spillover sample overlaps each of the Onsite, TSER and NTG-Only samples and includes many customers that are included in the 2015 samples.

Figure 9: Population and sample overlap

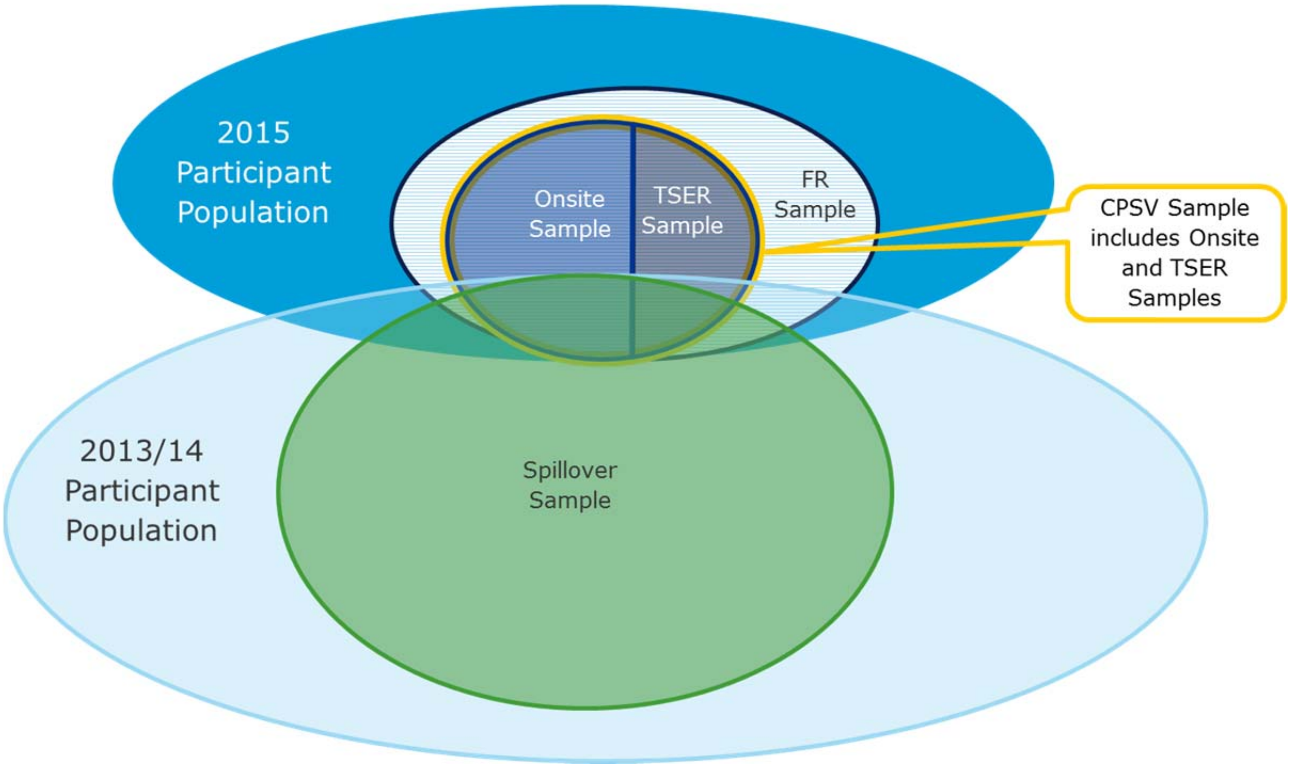


Table 23 shows the data collection efforts that will be attempted with each sample group.

- Advance letters will be sent to all of the customers selected for each sample and backup sample.
- CATI surveys will be conducted with customers sampled for spillover only.
- FR focused IDIs will be administered for any customer selected in the FR sample (made up of the Onsite, TSER and NTG-only samples).
- TSER interview modules will be included in the FR IDI for the TSER sample.
- Following the initial IDI, Onsite sample customers will receive a scheduling call to schedule an onsite visit.
- Spillover sample customers will receive a follow up IDI if the initial survey or interview indicates the potential for spillover at one of the customer’s sites.
- Vendors who worked with customers in the NTG sample will receive a project specific vendor NTG interview for projects where the customer indicates vendor influence.

Table 23: Data Collection for each Sample Group

2015 Participants	2013/14 Participants	Target Completes: Enbridge	Target Completes: Union	Target Completes: Total	Advance Letter	CATI	IDI	Onsite Sched & Visit	SO Follow up	Vendor Interview*
Onsite Sample	Spillover Sample	23	19	10	✓		✓	✓	✓	✓
	Not Sampled/Non-Part	17	38	97	✓		✓	✓		✓
TSER Sample	Spillover Sample	30	13	2	✓		✓		✓	✓
	Not Sampled/Non-Part	8	9	60	✓		✓			✓
NTG-Only Sample	Spillover Sample	64	15	2	✓		✓		✓	✓
	Not Sampled/Non-Part	9	27	109	✓		✓			✓
Not Sampled or Did Not Participate	Spillover Sample	≤246	≤238	≤484	✓	✓			✓	

*Vendor interviews are with participating vendors, not participating customers.

Figure 10 shows the data collection flow and assignments for the CPSV and FR sample projects. Primary responsibility for each task is colour coded by company in the shape "fill." Outlines of each shape indicate the company with secondary responsibility.

- Advance letters will be coordinated and sent to the sample population by DNV GL and the Gas Utilities.
- FR IDIs will be conducted by a qualified DNV GL or Itron interviewer for all customers selected in the Onsite and NTG-only samples.
- FR+TSER modules will be included in the TSER sample interviews and will be conducted by DNV GL evaluation engineers with experience administering NTG IDIs.
- Onsite sample customers will receive a scheduling call from a Stantec recruiter to schedule an onsite visit. Gas utilities will be asked to facilitate scheduling on a case-by-case basis. In order to avoid the appearance of bias, the gas utilities will not be asked to take the lead on scheduling onsite visits.
- Onsite verification will be carried out by qualified Stantec engineers. Depending on need, some of the most complex projects may have onsite verification completed by a DNV GL or Itron engineer. Gas utility representatives will be encouraged to facilitate and observe the onsite portion of the verification.
- Vendor IDIs will be administered by DNV GL or Itron interviewers for applicable projects.

Figure 10: Data collection flow for CPSV and FR Sample Projects

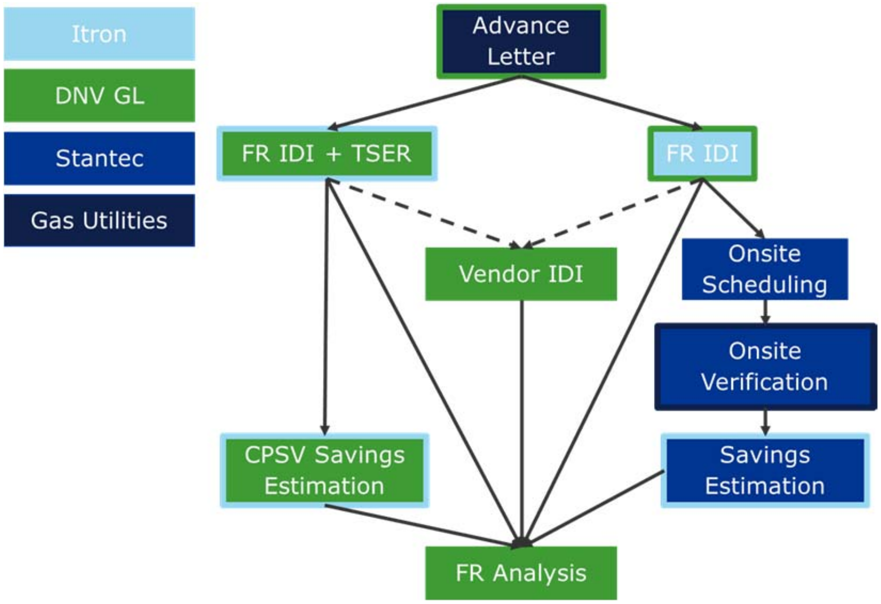
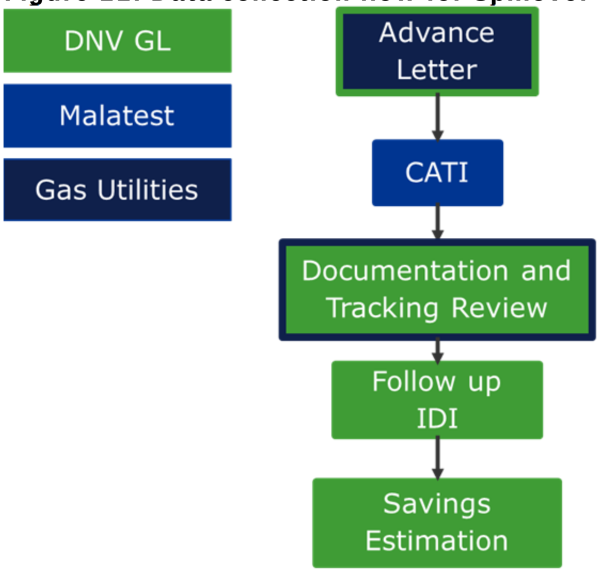


Figure 11 shows the data collection flow for the spillover sample projects. Primary responsibility for each task is colour coded by company in the shape "fill." Outlines of each shape indicate the company with secondary responsibility.

- Advance letters will be coordinated and sent to the sample population by DNV GL and the gas utilities.
- CATI Surveys will be administered by Malatest under direction from DNV GL. Not shown in the figure, a small number of customers selected for both the spillover and FR sample will have spillover modules administered as part of their FR IDI in lieu of the CATI.
- DNV GL will request project documentation and non-custom program tracking data for customers who report potential spillover projects in the CATI survey (plus additional customers in order to preserve respondent confidentiality)
- After reviewing project documentation, A DNV GL Engineer will conduct an IDI with customers who report potential spillover in the CATI survey.

Figure 11: Data collection flow for Spillover Sample Projects



As Table 23 indicates the success of the project will depend on having flexible instruments with different modules depending on the sample(s) that the customer is selected for. Table 24 shows how these modules will be distributed across the sampled customer types. Each module includes a framing section to aid customer recall and a section that will be scored. The determination of vendor influence will be done based on questions that are part of the framing in the FR module.

Table 24: Data Collection Modules by Sample Groups for Initial Customer Contact

		Initial Modules			
2015 Participants	**2013/14 Participants**	**Informed Respondent**	**CPSV**	**FR**	**SO**
Onsite Sample	Spillover Sample	✓		✓	✓
	Not Sampled/Non-Part	✓		✓	
TSER Sample	Spillover Sample	✓	✓	✓	✓
	Not Sampled/Non-Part	✓	✓	✓	
NTG-Only Sample	Spillover Sample	✓		✓	✓
	Not Sampled/Non-Part	✓		✓	
Not Sampled or Did Not Participate	Spillover Sample	✓			✓
	Not Sampled/Non-Part				

There is no spillover module for the 2015 projects because not enough time has elapsed for the large majority of these participants to have done a spillover project. It is possible that some customers may have done a spillover project in this short timeframe. As the table indicates, we will not be collecting free ridership information from the SO-only participants as part of the initial CATI or IDI. This information is required for our participant spillover methodology, but only for projects that have associated spillover. To reduce customer burden for the majority of customers, we will collect these data as part of the follow up spillover interviews.

Conducting IDIs of customers with large or complex projects is a standard method for DNV GL and Itron, with experienced and expert interviewers conducting all interviews.[28] These interviews are conducted with the 'decision maker' – an informed respondent who has at least some say in whether or not to proceed with a project and is aware of the project's impacts.

DNV GL and Itron staff will conduct IDIs with customers in the FR sample. FR for each project is certain to have an effect on the final net savings. The outline for Participant IDIs is provided in Appendix F .

CPSV Data collection

Data collection for the TSER sample will be completed via the IDI as described above. Prior to the TSER IDI the interviewing engineer will review project documents and calculations to identify the specific CPSV questions to include in the interview. Following the interview the engineer will complete the TSER verification report, embedded below. Verification reports completed by DNV GL engineers will be reviewed by an Itron engineer and verification reports completed by Itron engineers will be reviewed by a DNV GL engineer.

Onsite sample customers will not have engineering questions asked during the IDI. Instead these customers will be asked permission for a follow up site visit. Customers who agree to the site visit will receive a follow up call from Stantec to schedule the visit. Utility staff will be informed of the scheduled visit and invited to attend. Following the onsite visit, the Stantec engineer will complete the onsite verification report, embedded below. An Itron engineer will review the report.

Appendix F has the template forms that each of the data collection approaches will use for the CPSV.

Completed verification reports will be compiled into a draft report to be reviewed by the OEB and EAC. The steps in the CPSV review process are shown in Table 25.

[28] Names and CVs of specific interviewers and engineers will be provided after the SOW has been approved and the data collection schedule is more certain.

Table 25: CPSV Steps

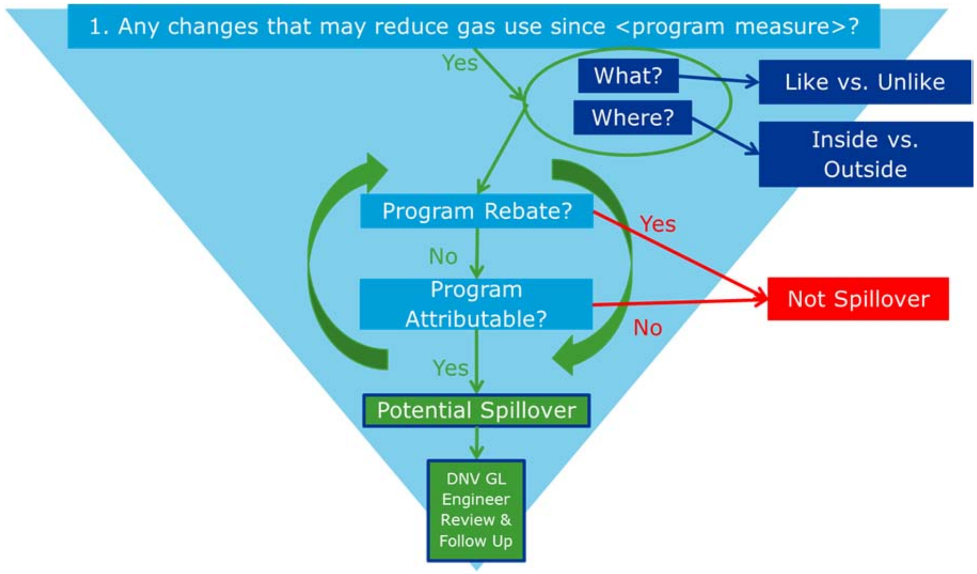
Step	Activity
1	NTG/CPSV Evaluation Team reviews project files provided by utilities ▪ Missing or incomplete documentation will be requested from utilities following review (final opportunity for utilities to provide new information).
2	NTG/CPSV Evaluation Team conducts IDI with customers ▪ Collects required CPSV data for TSER sample projects
3	NTG/CPSV Evaluation Team schedules site visits with onsite sample customers, informs utility
4	NTG/CPSV Evaluation Team conducts customer site visit ▪ Collects required CPSV data for Onsite sample projects
5	NTG/CPSV Evaluation Team drafts project verification reports ▪ Contacts utility staff/customer to clarify any site/operational details if needed.
6	EC Team conducts internal review of individual project verification reports ▪ Itron reviews projects verified by Stantec and DNV GL ▪ DNV GL reviews projects verified by Itron
7	EC Team shares draft report, including all site verification reports, with OEB for quality control, redacted as necessary.
8	EC Team (OEB team) shares final draft report with EAC, redacted as necessary
9	EAC provides written comments on final draft report
10	EC Team/OEB hold EAC meeting to discuss comments
11	EC Team finalizes report

Spillover Sample

Two of the challenges that SO presents for data collection are that many projects result in no spillover,[29] so evaluations need to contact a larger sample to achieve the desired 90/10 precision; and spillover can be hard to quantify since the program does not have the project documentation to calculate savings. To solve the first challenge, a large sample, we will use a CATI survey as our initial pass at identifying program spillover for most of the spillover sample. This will allow us to cast a wide net in our initial survey, contacting more customers. We will also be using a question sequence on these calls that seeks to start as wide as possible before narrowing down the potential spillover. Follow up IDIs will allow us to leverage evaluation engineer expertise to collect the data needed for savings estimates and to collect free ridership data for the original program measure. Figure 12 shows the high level approach that we will take in the CATI, with specific details provided in the spillover survey module and methodology memo.

[29] Unless the program is specifically designed to induce spillover.

Figure 12: High level approach to identifying potential spillover



Engineering Follow-Up Interviews for Spillover

For some projects, it will be necessary to follow up with an additional individual or individuals, aside from the ‘decision maker’. Engineering follow up calls are a specialized form of IDI that are conducted between a DNV GL engineer and an individual at the customer site that can speak to the specific engineering specifications of the equipment. DNV GL will ask specific questions that will allow for the calculation of energy savings.

These interviews will be individually tailored, depending on equipment installations, with the goal of gaining information to calculate energy savings.

For like spillover measures and the subset of unlike spillover measures to which it applies,[30] the spillover follow up interview will also include the FR module for the original program measure.

Task 3.4: Participating Vendors (In-Depth Interviews)

Vendors that worked with customers on sampled projects will be interviewed if the participant indicates high program FR and high vendor influence. The interviews will result in project specific vendor attribution scores that quantify the program’s influence on the vendor’s recommendations to the customer. Vendor attribution is an indirect program influence on the participant’s decision to implement energy saving measures. Where program influence on the vendor’s recommendations is greater than program influence on the participant directly, the vendor score will be used. We will complete IDIs with up to 80 of these vendors. The outline for Participating Vendor IDIs is provided in Appendix F .

[30] See Appendix D

Mitigation Strategies for Data Collection Risks

Several risks to the data collection efforts have been identified in earlier discussions with the TEC, EAC and OEB. The timing of data collection in the year, identifying informed respondents and the handling of optimization, operations and maintenance projects are concerns that have been singled out.

Timing

DNV GL recognizes the limitations of the calendar in conducting survey research. Holidays increase the difficulty in reaching individuals. DNV GL will take efforts to conduct the majority of data collection outside of peak summer and winter holiday periods. Typical survey protocol dictates that contact with a survey respondent should be attempted 6-8 times before being considered 'exhausted'; DNV GL will adapt survey protocols to ensure that contact with an individual is not attempted more than 2x in a given calendar week and 3x in any two weeks to ensure that holidays do not influence response rates. DNV GL will also consider implementing a data collection hiatus during the last week of the year should the evaluation remain in the field at that time.

Informed Respondent

For data collection efforts involving non-program staff (e.g., participant surveys, participant interviews, participant follow-up interviews, participating vendor interviews), DNV GL will include a question battery designed to ensure that only informed respondents are participating. For participating customer respondents, DNV GL will define informed respondents as interviewees who directly participated in the project(s) in question. For participating customer respondents, DNV GL will make every effort to reach informed respondents.

To ensure informed respondents we will provide the programs the opportunity to verify that the program tracking data an appropriate contact listed. A spreadsheet listing the sampled projects (and backups) will be provided and the utilities will be asked to identify a "decision making" contact (for NTG) and a "technical contact" (for CPSV). In some cases these will be the same person. For TSERS where separate contacts are listed for the two roles, we will complete the separate parts of the IDI with the appropriate contact for that part.

When we call each contact we will list the project(s) that we are asking about, providing a description of the measures, location and time frame of implementation. We will then ask "Are you familiar with your organization's decision to make these energy efficiency improvements?" if the respondent indicates "yes" we will follow up to ensure that the "yes" response applies to all of the projects we are asking about.

For any projects that the response is "no" we will ask for contact information for someone who is familiar. We will continue with the survey for the projects that the respondent indicates that they are familiar with.

Some companies with multiple projects and diverse decision makers may require multiple interviews. We will not administer surveys for projects where the informed respondents are not available.

Response Rates

Survey response rates have been in decline over the past decade. This is especially true for residential surveys, where cell-phone only households have made surveying difficult, but there has also been erosion of response rates for business surveys. In order to achieve increased response rates, DNV GL will prompt program participants with both advance emails and advance letters, informing them of the survey and requesting participation. Advance letters, sent through traditional postal mail, are generally better received (and read) when sent by the recognized energy provider and should be sent on utility letterhead, if possible.

All communications with program participants will adhere to each of the respective utility's protocols for customer communication.

In order to execute the mailings, it is critical that DNV GL be provided with accurate contact information for the correct informed respondent. This will include, but is not limited to, the correct individual's:

- Full Name
- Role
- Mailing Address
- Email Address
- Direct Business Phone Number

DNV GL will send the above-mentioned emails and letters to all program participants included in the primary and backup samples of each data collection effort. For IDIs, there is an additional opportunity to improve response rates – providing respondents with the opportunity to schedule their own interview time. DNV GL will accomplish this with either an invitation to email DNV GL directly about preferred times or will utilize an online scheduling service where individuals may choose their own preferred times.

Secondary Attribution

Optimization, operational and maintenance projects (Actions) will be separated from equipment installation in the sample design and require special consideration for data collection as well. Maintenance projects in particular are by their nature recurring, while equipment optimization and operational improvements are behavioural and can be undone. The question of how to credit the program for maintenance this year when the customer participated in the past is complex. DNV GL and the TEC considered this issue while finalizing the contract and decided that the primary objective of the free ridership estimation will be to capture the effect of the program(s) on the current project. The effect on the current project of prior and indirect program experience will be captured in a secondary, less rigorous question sequence.

The primary attribution questions will be framed by questions that ask about decision making for the current project alone so that the scored attribution sequence will capture the effect of the program on the current project. After the scored section of the survey is complete we will capture the indirect, longer term attribution effect by asking:

- "Now, without *any* utility assistance for *any* projects in the past, what is the percent likelihood that you would have <taken this EE Action>?

The maximum of the primary attribution and this score will provide us with an idea of how much higher attribution would be if a longer term view were taken.

To limit customer burden and ensure the validity of our spillover analysis we will limit the investigation of secondary attribution to:

- *Measures with less than 100 percent primary attribution*: if primary attribution is 100 percent, then secondary attribution is as well. Put another way, the long term effect of the program (secondary attribution) is inclusive of short term (primary attribution), so by definition, the long term effect cannot be less than the short term and it is unnecessary to ask the secondary attribution question.

- *2015 participants*: 2015 participants are the only participants that will be asked attribution questions comprehensively. 2013/14 participants will be asked the attribution questions only if they indicate potential spillover has occurred (potential spillover is a project that the participant reports as possibly reducing gas usage, not-incentivized and attributable to previous program participation.

Secondary attribution will be captured for all measure types, but was a specific concern for maintenance and other "Action" measures.

Spillover Concerns

Key challenges to providing convincing quantified evidence of spillover for a particular customer include:

- Determining that a particular subsequent action was due to the influence of the program
- Confirming that the action was not taken as part of the original or another program, hence already counted by the program
- Quantifying the savings associated with confirmed spillover actions.

DNV GL's approach provides a high level of rigor to address each of these issues.

- We determine program influence using participant surveys that start with the framing used for our free ridership questions. This framing helps ensure more meaningful responses to questions of the influence of the experience with the program in implementing the original measure on subsequent actions. As for the free rider surveys, obtaining the right respondents is also essential to obtaining meaningful responses to these questions.
- We confirm that the actions tentatively identified as spillover were not already counted by another program by cross-checking tracking data bases. Also critical to separation of spillover from program-claimed savings is understanding what savings if any are claimed by the programs for facilitation support such as opportunity identification, feasibility studies, audits, and related continuous improvement program engagement.
- We quantify the savings for confirmed spillover actions by collecting engineering specifications and calculating associated savings. This approach gives more accurate results than asking customers to estimate the magnitude of spillover savings relative to the original measure.

Thus, our participant spillover methodology addresses the following key issues:

- *Locating the right decision-maker* - Large commercial and industrial companies have multiple decision-makers and it is often difficult to find someone who is familiar with both the tracked program-influenced measure and the spillover measure. Employee turnover can also complicate this. Our approaches to ensure appropriate respondents are discussed above.
- *Avoiding double-counting* – Companies that received financial incentives from an energy efficiency program for one measure are likely to seek these incentives for future measures. Hence it is important to get the program's latest tracking data to make sure that a potential participant spillover measure did not receive program support.
- *Estimating program attribution for potential spillover measures* - A common way of assessing participant spillover is to ask how much the participant's experience with the tracked program-influenced measure influenced their decision to implement measures that are candidates for spillover attribution. It is difficult to turn this "fuzzy" assessment of program influence into a more concrete attribution factor necessary for attributing a certain quantity of m^3 from the spillover measure to the program.
- *Estimating the energy savings for the participant spillover measures.* Because spillover measures occurred outside the program, evaluators do not have access to the same information about the size, type, and quantity of the implemented energy-efficient measures that they would find in a program tracking database.

Task 4: Data Analysis

The data analysis task takes the data collected in Task 3 and combines it into adjustment factors that represent the population of implemented projects. Those adjustment factors are then applied to the program-level savings to produce verified gross savings and net savings. Table 26 shows the sub-tasks and their completion status for Task 4.

Table 26: Task 4 Subtasks and Completion Status

Key Tasks
☒ **Task 1: Project Kickoff**
☐ **Task 2: Sample Design**
☐ **Task 3: Data Collection**
☐ **Task 4: Data Analysis**
☐ **Task 4.1: Analyze Survey and Interview Data**
☐ Sample frame data transformation
☐ Sampling weight
☐ **Task 4.2 Calculate estimates**
☐ Verified Gross Savings
☐ Free Ridership (attribution)
☐ Secondary Attribution
☐ Spillover
☐ Gross 2015 program savings
☐ Net 2015 program savings
☐ **Task 5: Reporting**
☐ **Task 6: Project Management**

The objectives of this task are to:

- Determine the population-weighted adjustment factors related to verified gross savings, FR, spillover, and NTG
- Apply the adjustment factors to the appropriate program-reported savings estimates
- Produce the overall verified gross and net savings
- Produce the overall spillover adjustment factor

This task will begin with preliminary (incomplete) data collected in Task 3. The preliminary data will be used to establish the analysis methodology, which will be implemented once the data collection is complete. Each activity will be discussed in greater detail below.

Task 4.1: Analyze survey and interview data

The analysis flow after data collection begins with transforming the collected data back to the level of the unit of analysis. This translation depends on the number and grouping of program measures or projects asked about for an individual customer, and whether subsampling was required.

The survey will collect attribution information on each measure type. We apply the free ridership and spillover “scoring” methods to determine the free rider and spillover factors for each measure type. We then apply these factors to the associated gross savings to produce net-of-free riders and spillover savings for each measure type. Data collected from a single customer will be treated as a single cluster in error estimates.

We will use the sampling weights created during the sample design process to expand the customer sample in each sampling cell (stratum) to represent the full participant population in that cell. Targeted cells for which we are unable to obtain any responses will either be treated as not represented by the sample, or will be collapsed with other cells for sample expansion.

The application of attribution and spillover algorithms that convert survey and interview data into energy savings values ready for expansion involves consistency checks for each respondent. These checks utilize both questions directly used in the algorithms and verbatim responses that contain information on the reasoning of the respondent’s responses.

Task 4.2: Calculate Estimates

The 2015 combined evaluation will result in verified gross savings and free ridership that are calculated for each evaluated unit of analysis and expanded to the population using the statistical technique of ratio estimation.

Verified savings will be estimated by evaluation engineers while free ridership estimates will be calculated using the survey data collected. Free ridership will be calculated using the LCNS method by scoring survey responses as described in this section.

The 2016 spillover estimates will be calculated by a combination of evaluation engineer estimation and scored survey responses. Spillover will be captured using an approach that will capture inside, outside, like and unlike spillover. Separate estimates for each of the four categories will be produced as a ratio of spillover to gross savings.

More detail on this task is provided in Appendix D and Appendix E .

Task 5: Reporting

The reporting task encompasses the formal communication between the DNV GL team and the OEB and other stakeholders. Reporting includes status and update reports as well as the draft and final reports, which take the results of the analysis from Task 4 and presents them to the OEB, EAC, and other interested stakeholders. Table 27 shows the sub-tasks and their completion status for Task 5.

Table 27: Task 5 Subtasks and Completion Status

Key Tasks
☒ Task 1: Project Kickoff
☐ Task 2: Sample Design
☐ Task 3: Data Collection
☐ Task 4: Data Analysis
☐ Task 5: Reporting
☐ **Task 5.1: Reporting**
☐ **Task 5.1: Monthly Status Reports**
☐ **Task 5.2: Bi-Monthly Updates**
☐ **Task 5.4: Draft Deliverables**
☐ 2015 CPSV and FR Report
☐ Participant Spillover Report
☐ 2015 Verified and Net Savings Memo
☐ **Task 5.5: Final reports and presentation**
☐ Final reports addressing comments on draft report
☐ In-person presentation
☐ Task 6: Project Management

The objectives of this task are to:

- Provide clear and timely reports on project progress and evaluation activities
- Distribute and document results
- Document methodology
- Make recommendations for program improvements

Task 5.1: Monthly Status Reports

Every month the DNV GL project manager will submit a status report to the OEB, via email, which will summarize the past month's activities, notify of the next month's activities, and report on how closely the evaluation is adhering to the original schedule. However, if there are methodological questions or delays in responses to data requests that could put the evaluation off schedule, the program manager will notify the OEB of these issues immediately for proposed resolution so that the evaluation schedule is not compromised.

Task 5.2: Bi-monthly Status Updates

The DNV GL project manager will provide the OEB with study updates via teleconference on a bi-monthly basis in alignment with scheduled EAC meetings. These bi-monthly study updates will provide similar information as in the monthly emailed status reports, although the more interactive format of the teleconference should allow for greater discussion and quicker resolution of any key issues.

Task 5.3: Draft Reports

At the conclusion of the evaluation, DNV GL will submit to the OEB two draft reports and one draft memo that will present all the information in the research objectives. Each of the draft reports and the memo will have separate results sections for each utility with common methodology sections. This will allow for streamlined review of sections that apply to both utilities, while facilitating a potential separation of each deliverable into utility-specific final deliverables.

The first report (2015 CPSV/FR Report) will include

- Verification rates by market sectors, programs and domains of interest with associated precision estimates for both the Enbridge and Union Gas' 2015 programs
- Free ridership factors by market sectors, programs and domains of interest with associated precision estimates for both the Enbridge and Union Gas' 2015 programs
- Along with these key findings, we will also show how these estimates were derived and what data from the IDIs and onsites were used to inform these estimates, including any qualitative findings regarding non-incentive based utility services.

The second report (Spillover Report) will include

- Estimates of participant inside and outside, like and unlike spillover[31] by market sectors, programs and domains of interest with associated precision estimates for both the Enbridge and Union Gas' programs
- Guidance on the development of a strategy for applying spillover data collected on previous program participation to forward looking DSM program activity
- Along with these key findings, we will also show how these estimates were derived and what data from the CATI survey and follow up IDIs were used to inform these estimates, including any qualitative findings regarding non-incentive based utility services.

The memo (2015 Verified and Net Savings Memo) will include

- Verified and net savings (including spillover) for Enbridge and Union Gas' 2015 Custom programs and RunitRight.

Task 5.4: Final Report and Presentation

After receiving comments on the draft reports from the OEB and EAC, DNV GL will produce final reports (possibly separate final reports for each utility, depending on filing requirements) which address all these comments along with a comment matrix that shows how we addressed them and why. We also plan to deliver an in-person presentation of the results to the OEB and EAC.

[31] Potential electric and/or water spillover savings will not be reported in kWh, but descriptively, as electric spillover is outside the specific scope of this evaluation.

Task 6: Project Management

The project management task is an ongoing task to ensure proper implementation of the project, including the schedule, budget, and scope. Table 28 shows the sub-tasks and their completion status for Task 6.

Table 28: Task 6 Subtasks and Completion Status

Key Tasks
☒ Task 1: Project Kickoff
☐ Task 2: Sample Design
☐ Task 3: Data Collection
☐ Task 4: Data Analysis
☐ Task 5: Reporting
☐ **Task 6: Project Management**
Task 6.1: Complete evaluation on time, on budget and within scope.
Task 6.2: Keep client informed

The objectives of this task are to:

- Ensure timely and on-budget deliverables
- Keep clients informed of project progress

This task is ongoing over the course of the project, and includes budget and workflow tracking, communication among DNV GL team members and partner firms, and invoicing. The subsequent sections discuss the project timeline and risks to effective project implementation.

Project Timeline

Our current schedule has the project completion as May 25, 2017. This schedule includes four extra weeks for data collection to accommodate the winter holiday season. EAC review periods are assumed to be 1-2 weeks depending on the specific deliverable. Utility delivery of data is assumed to require two weeks following request.[32]

[32] With the exception of project files and contact information spreadsheets, which are being delivered a bin per week for four weeks for the CPSV/NTG and Spillover CATI contact information being provided in early January.

Table 29: Schedule of Deliverables

Task	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
SOW										
Final Prep										
Sample Design										
Review Process										
Surveys / Interview Planning										
Development (4 Guides, 4 Methods)										
Review Process										
Training/Coordination										
Documentation Request										
Contact Information Request										
Data collection										
Spillover Advance Letters										
Spillover CATI										
Spillover Follow up IDI										
CPSV & FR Advance Letters										
Energy Advisor Interviews										
CPSV & FR Interviews										
Vendor Interviews										
On-site Recruiting										
On-site Visits										
Analysis										
CPSV Site Report Development										
CPSV Site Report Review										
CPSV & NTG Analysis										
Spillover Engineering Calculations										
Spillover Analysis										
Reporting										
2015 CPSV & FR Report						D	F			
Spillover Report									D	F
2015 Net Savings Memo									D	F
Project Management										

Risks and Contingencies

The tables in this section document the risks to project schedule, finances, and quality and the contingencies DNV GL has in place to handle them.

Table 30: Schedule Risks

Schedule Risks	Explanation	Contingency
Data Reception	Timing Controlled by Union/Enbridge.	1) The data required and will be requested once spillover CATI's are completed.
Documentation Reception	Timing Controlled by Union/Enbridge	1) Send formal documentation request with explicit, agreed upon deadline for documents needed.
Contact information Reception	Timing Controlled by Union/Enbridge	1) send worksheet for contact information request 2) include clear directions for worksheet completion, including context of what we are attempting to learn from the interviews. 3) ensure the worksheet is simple and easy to complete.
Contact information processing	Contact information may be incomplete or come in hard to use format	1) Clear directions for the request 2) use experienced analyst to prepare data for survey
Resourcing	Having the right resources available at the right time is a challenge with projects that have experienced delays	1) reserve necessary resources for project in DNV GL's internal systems. 2) keep project on schedule to avoid conflicts with other project needs. 3) keep project sponsor aware of needs and championing project
Survey House Availability	Availability at the right time is a challenge with projects that have experienced delays	1) Malatest has been contracted for the work
Review Periods	Dependent upon OEB/EAC priorities	1) establish clear and explicit deadlines for reviews
Decision Making	Dependent upon OEB/EAC priorities	1) schedule meetings with clear agendas that have key decisions up front.
Response Rates	Response rates on surveys have been declining, which can extend the time required for data collection	1) IDI rather than CATI for the CPSV and FR portions of the study 2) email participants prior to call to ask for cooperation 3) send advance letter to participants prior to call to ask for cooperation

Table 31: Financial Risks

Financial Risks	Explanation	Contingency
Currency Exchange Rates	USD/CAD rates have been highly variable	Fix prices in USD and/or CAD have adjustment process in the contract.
Resourcing	Planned resources have been promoted since project scoped and now cost more. Planned resources have left company	1) substitute with acceptable alternatives. Provide OEB/EAC with CVs once resources are finalized.
Timeline	Longer timeline tends to use project funds more than shorter timeline	1) seek to reduce schedule delays 2) Ensure efficiency or delay non-critical work when critical path is delayed to avoid additional expense

Table 32: Quality Risks

Quality Risks	Explanation	Contingency
Response Rates	Response rates on surveys have been declining, which can reduce sample sizes, introduce uncertainty about bias and make it hard to get data from large customers who have a large effect on final result	1) attempt a census so that call order does not matter. 2) IDI rather than CATI for the most complex and large projects 3) email participants prior to call to ask for cooperation 4) send advance letter to participants prior to call to ask for cooperation
Informed Respondents	Multiple people in a business are often involved in the decision to purchase capital equipment or spend money on optimizing or maintaining existing equipment. For consistency and cost reasons a single respondent from a company is preferable to interviewing multiple people at a business about the decision. Ensuring we have a respondent who knows enough about the decision to complete the project and the influence of the program on that decision is the crucial challenge of the data collection effort	1) Clear guidelines and screening questions to determine an informed respondent 2) removal from study of un-informed respondents 3) single interview for a project may require contacting multiple people at the site to determine an informed respondent.
Engineering Estimates	Spillover estimates will be based on engineer estimates of savings for projects that were not part of a program. We expect that these projects will not have the typical amount of documentation that we see for program incentivized projects. The engineering estimates will be based on respondent provided information, and in some cases may not include specific sizes or operating characteristics.	1) Engineers will be required to thoroughly document information collected from the respondents and from third party sources. Justification for savings estimates will be provided, along with values and sources of key assumptions and calculation methods. 2) A senior engineer (Tammy) will review all estimates. 3) transparently provide documentation of project savings (within confidentiality limits) in appendix of report

APPENDIX A SAMPLING PROCESS

This appendix provides detail on the

1. high level process used in sampling
2. exploration of tracking data
3. definition of the unit of analysis
4. stratification decisions
5. 2015 FR and CPSV sample design
6. 2013/14 Spillover Sample design
7. Sample and backup sample selection

High Level Process

A sample is a collection of data items such as those collected through surveys, metering or onsite observation. A sample design is required when a sample does not include the entire target population. Most sample designs are driven by cost constraints (including schedule constraints), desired precision or both. The sampling process described here ensures that all bases are covered, ensuring optimal precision around estimates of interest for the data collected. The process we followed was:

1. **Identify Goals, Methods and Constraints**: for sampling, the goals consist of identifying the primary and secondary estimates of interest: what quantitative results are most important. Defining the data collection methodology –the process used to gather the data for the analysis – and the estimation method – the approach used to calculate the primary estimate of interest – is critical for defining elements of the design. Cost and schedule constraints surrounding the data collection and analysis then determine an upper bound for the sample size.

   - **Goals**: For this study the primary estimate of interest is the NTG ratio for each program. The NTG ratio is the parameter that we are targeting for 90/10 precision for each program.

     As will be described later in the methodology memo, we calculate the NTG ratio as

     NTG = (1-FR)*(1+SO).

     Since spillover tends to be small, this formulation is mathematically very close to the simpler formula indicated in the recent Ontario evaluations

     NTG = 1-FR + SO.

     We prefer the multiplicative formula as a more complete expression of the relationship between free ridership and spillover.

     Previous work in Ontario indicates that free ridership is on the order of 10% to 60% across program segments, 50% overall on a savings-weighted basis. Spillover is on the order of 5%. Because spillover is generally small, the precision of the full NTG will in most cases be close to that of the net-of-free rider factor, even with a modest spillover sample size.

   - **Methods and Constraints:** We are using two data collection methods, each of which have different costs associated. Due to cost constraints we must limit our use of on-sites to those projects where it will make the most difference in the estimate. These will be deployed on the largest and most complex projects as identified based on tracking data descriptions. TSERs will be used to collect the balance of the data that we do not have the funds to collect with Onsites. For smaller and simpler projects where the decisions made are more straight forward, TSER verification provides accurate data at a reasonable cost.

2. **Define the unit of analysis**: The unit of analysis is the level at which final estimates will be made. Some studies have multiple units of analysis: process evaluation results may be based on respondent level estimates, while impact evaluation results may be based on measure or project level estimates. Sampling units do not need to be the same as the unit of analysis, but identifying both early is crucial.

   We are using the same definition for our sampling unit. Most customers have no more than three projects in a given year, and most projects are of only one or two measure types, so that we will be able to inquire about all of these in a single survey or interview of reasonable length.

   We plan to ask each sampled customer about attribution for all of the customer's measures. Only a handful of customers have more than three (unit of analysis level) measures in 2016, with a maximum of six.

   For customers with large numbers of projects and measures, we will ask about groups of measures or projects. The groupings will depend on details of the types of measures and savings magnitudes.

3. **Identify the target population:** The target population is the universe of items that inferences and estimates are desired for. In the initial scope of the NTG study, the primary target population was defined as future programs of the same type. Having future program years as the target population has two implications for the sample design. First, the applicable error associated with our estimates is the non-finite population corrected error (described in our discussion of sample size below) which requires larger sample sizes for a given precision. Second, analysis by sub-domains such as measure types within the programs becomes more important. The measure mix in programs changes from year to year and typically NTG varies more across measure types than within. For more accurate estimates of net savings for future program years, applying measure type NTG ratios will be preferred to program as a whole NTG ratios. At this time the question of prospective vs. retrospective application of NTG results is unresolved. The final sample design is expected to result in precision levels sufficient for either application of the results.

4. **Establish the Sample Frame:** The sample frame refers to the list or mechanism from which the sample is drawn. A perfect frame will match the target population exactly.

   Since the target populations of this study are the future programs, we will not have a perfect sample frame; however, if the program designs remain relatively stable, using past program participants as the sample frame will provide a good list from which to draw our sample.

5. **Determine sample size:** Sample size refers to the number of items that are selected from the sample frame in order to draw inferences and create estimates about the target population. In stratified designs, sample sizes are determined for each stratum.

   Critical to the sample size determination is the error ratio for each sampling cell with respect to the ratio to the estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean. Our experience with conducting similar NTG studies of commercial-industrial customers is that the error ratio for the free rider rate is between 0.7 and 0.8 within reasonably defined sampling cells.

   In determining these sample sizes, the number of customers in the full population is also important for two reasons. First, if we are trying to estimate a parameter for a finite population, the sample size required is reduced by the Finite Population Correction or FPC. Second, we need to consider the number of completed surveys we can realistically complete given likely response rates.

Use of the FPC is appropriate when the parameter of interest represents a particular population. This situation applies when we are determining the free ridership factor or spillover rate for a particular program and time frame. When we determine these factors for all future theoretical projects, it is arguably more appropriate to treat the sample drawn from recent participants as coming from an essentially infinite population. Thus, for projection to future years we generally recommend against applying the FPC.

6. **Stratification:** Stratification is the partitioning of a target population. Stratification is discussed in depth in the sample design section in the body of the Scope of Work.

7. **Sample Selection:** Sample selection refers to the process of obtaining the sample of units from the sample frame. If all units on the sample frame are selected then the design is referred to as a census or certainty sample. Otherwise units may be selected either randomly or non-randomly, depending on the evaluation goals, constraints and amount of acceptable bias. The sample selection process is a critical feature of the sample design and has a direct impact on the expected precision and bias of estimates. The optimal sample selection process for a particular project can vary greatly.

8. **Unit and Item non-response** Unit and item nonresponse are potential sources of bias, depending on the nonresponse mechanism and the level of nonresponse encountered. Unit nonresponse refers to the absence of information from an entire sampled unit. Item nonresponse refers to the situation where some data are collected, but not all, from a sampled unit. The nonresponse mechanism refers to the process that is causing the nonresponse. If the probability of responding depends on the data items being sought then the nonresponse mechanism is said to be non-ignorable. Otherwise it is called an ignorable nonresponse mechanism. Nonresponse bias tends to be greater when the nonresponse mechanism is non-ignorable and as levels of item nonresponse increase.

   There are various ways to address nonresponse in a sample. For example, weight adjustments are often used to account for unit nonresponse and item imputation techniques are often used to account for item nonresponse.

   If nonresponse levels are low and the response mechanism is thought to be ignorable then one could ignore nonresponse and simply create estimates among the respondents.

   We recommend treating unit nonresponse as ignorable for this study since it does not depend on the data items being sought. Instead, it depends on the willingness of the decision maker at the participating business agreeing to respond to the survey.

   For item nonresponse in the scored portion of the surveys we recommend treating the nonresponse as non-ignorable if all three of the T, E, Q portions of the free ridership sequence contain non-response. Otherwise we plan to treat the item nonresponse as ignorable and will impute the average response for the missing item from among scored units of the same measure type and utility. The exception to this rule is when we find conflicting responses in our QC of the data collection that indicates the nonresponse is non-ignorable. For non-ignorable item nonresponse we will drop the unit from the analysis.

9. **Expansion** Sample expansion refers to the process of extrapolating results from a sample back to the target population of interest. Often times this is done using a sample weight. The weight is a numeric quantity associated with each responding unit and conceptually represents the amount of the target population the responding unit represents during the analysis. The sample weight is some function of the total number of units on the sample frame.

   The sample weight for our analysis will be built from the inverse probability of selection, incorporating additional adjustment factors to account for nonresponse and coverage errors. The sample weight will be utilized along with the "size" of the unit (energy savings) to expand results using ratio estimation, as described in the ratio estimation appendix of this work plan.

10. **Domains of interest:** Often times, estimates for an entire target population are of interest, but so are estimates for various subgroups. Subgroups may or may not overlap. Identifying the population domains of interest is another critically important design feature because it affects the decisions being made about other design features, such as the desired sample size, stratification variables and primary and secondary estimates of interest.

Explore the Tracking Data

We explored the tracking data provided by Union and Enbridge to determine data availability, the number and types of measures installed, and the size and quantity of projects. We explored the Union and Enbridge datasets separately.

Enbridge Custom Participant Data

The custom program participant data files provided by Enbridge included custom C&I energy efficiency projects claimed during the 2013-2015 program years and custom Low Income Multi-Family projects claimed in 2015 (Table 11). The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. There are 124 accounts that appear in both the 2015 program year and the 2013/14 program years.

Table 33: Enbridge Custom C&I and Multi-Residential Program Participation Metrics by Year

Program Year	Accounts	Gas Savings (m^3)
2013	680	53,030,333
2014	573	46,195,015
2015	706	51,330,067

The Enbridge custom project tracking data includes measure level savings specific to a measure, site and date. As part of defining the unit of analysis, we used the tracking data variables *Market Type*, *load type name*, *end use*, and *technology* to categorize measures into measure types that would be meaningful for data collection and expansion, shown in Table 34.

Table 34: Enbridge Participation Metrics by Measure, 2013-2015

Measure Type	2013-2014 (SO)		2015 (CPSV/FR)	
	Accounts	Gas Savings (m^3)	Accounts	Gas Savings (m^3)
HVAC	636	32,807,840	380	19,105,965
Controls	337	17,821,495	175	13,868,059
Other Equipment	121	25,151,192	10	2,153,339
Operational Improvements	119	9,672,787	55	7,811,661
Heat Recovery	16	1,092,519	29	4,398,419
Steam and Hot Water	175	3,376,999	86	1,825,048
Process Heat	14	4,786,413	3	73,078
Building Shell	38	1,833,941	89	1,794,104
Greenhouse	10	2,682,162	3	300,394

Enbridge RunitRight Participation Data

For RunitRight, the program tracking data includes projects claimed in the 2014-2015 program years. These projects were all completed in 2013-2014; savings for a project in the program do not get claimed until after one year of site metering is complete.

Table 35: Enbridge RunitRight Program Participation Metrics by Year Claimed

Program Year	Accounts	Gas Savings (m^3)
2014	45	625,088
2015	28	542,442

The RunitRight program has only one measure type. It also has several projects with negative savings. Negative savings (increases in energy use) are possible results from retro-commissioning projects, sometimes due to calculation method (billing analysis based savings without weather, occupancy adjustment or production adjustment) or due to actual increases in energy use. Negative saving measures need to be handled carefully in ratio estimation: high FR on large negative savings projects can result in overall program FR <0, which is not a valid result.[33] Our recommended approach to the problem is to produce and apply ratios with separate domains for positive and negative savings projects.

Union Custom Participant Data

The participant data files provided by Union included energy efficiency projects claimed during the 2013-2015 program years. The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. There are 67 accounts that appear in both the 2015 program year and the 2013/14 program years.

Table 36: Union Participation Metrics by Year

Program Year	Accounts	Gas Savings (m^3)
2013	352	369,438,742
2014	392	285,752,549
2015	462	201,620,726

[33] Free ridership on negative savings results in more program savings, rather than less.

We used the *project type*, *equipment type*, and *project category* variables in the tracking data to categorize measures. Our first step was to distill the combined information from the three fields into measure types that would be meaningful for data collection and expansion, shown in Table 37. The largest measure types (by cumulative savings) were maintenance, steam and hot water, and optimization.

Table 37: Union Participation Metrics by Measure, 2013-2015

Measure Type	2013-2014		2015	
	Accounts	Gas Savings (m^3)	Accounts	Gas Savings (m^3)
Maintenance	222	255,847,232	79	37,181,863
Steam and Hot Water	161	119,657,223	91	39,229,635
Optimization	91	94,790,733	28	16,936,421
Ag and Greenhouse	149	64,895,560	73	31,875,980
Heat Recovery	86	38,174,741	52	19,797,904
Other Equipment	56	27,104,377	13	20,653,141
Controls	78	16,785,704	128	13,267,526
HVAC	48	14,885,291	49	8,829,742
Process Heat	25	13,242,538	10	4,536,172
Building Shell	152	5,599,318	68	3,597,883
New Construction	19	3,714,489	5	4,589,777
Cogeneration	4	494,085	1	1,124,682

Define the Unit of Analysis

Following data exploration, we defined the *unit of analysis*, which established the level at which data will be analyzed but not the level at which it will be collected, which is the *sampling unit*. We further discuss this distinction and how the sampling unit is defined in the Task 2.5 section.

The definition of the unit of analysis is one of the most important and least discussed aspects of DSM program evaluation. Consider the following four dimensions: end -use, measure type, equipment or "action," and calculation approach. The program tracking databases include the first three dimensions and do not have an identifier for the fourth (though there may be a way to proxy it). Our example assumes that calculation type can be defined at a high level with reasonable accuracy based on existing database fields for the 2015 program year. Table 38 shows six measures performed at a site in a year through a program. Each of these categories could be considered a possible unit of analysis.

Table 38: Example dimensions used to define a unit of analysis

Measure ID	Enduse	Measure Type	Equipment or Action	Calc Type
M1	Process Heat	Boiler	Action	Complex
M2	Process Heat	Boiler	Equipment	Complex
M3	Space Heat	Boiler	Action	Simple
M4	Space Heat	Boiler	Equipment	Simple
M5	Space Heat	Furnace	Action	Simple
M6	Space Heat	Furnace	Equipment	Simple

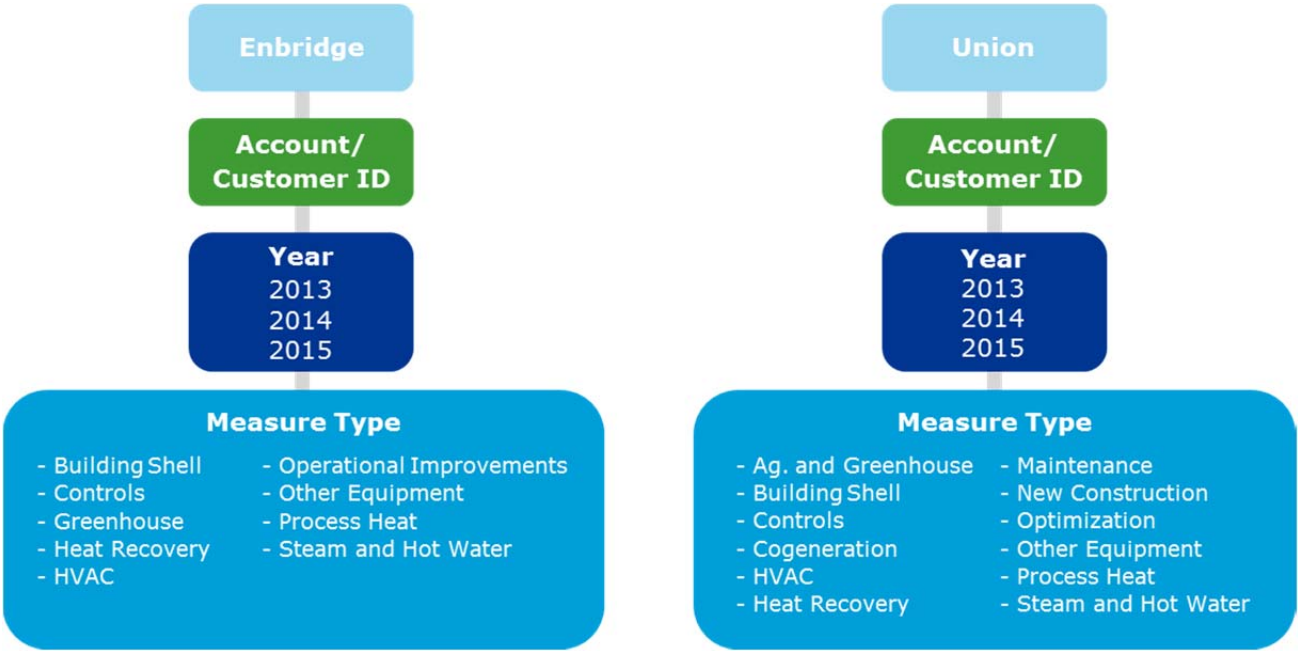
- The **end use** can be important in decision making because lowering the cost per unit produced is a different decision than lowering the cost of heating a facility or office, for example. It can also be used as a proxy for the complexity of the calculation, as process-related end uses tend to have more complex and site-specific calculation approaches. End use can be used in surveys by listing the measure types that fall into the category; however, this is not ideal for NTG as the program's influence on decision making may differ by measure type, affecting the attribution response.
- **Measure type** is important for surveys to aid participant recall by providing a concrete, simple description of what equipment was altered or installed. This aggregation is less appropriate for CPSV where the calculation method may differ.
- **Equipment or Action** is a very important distinction for NTG. Continuous improvement actions, such as maintenance, operations, and optimization, have fewer barriers to implementation than equipment purchases due to lower total cost, shorter term planning horizons and often fewer approvals. Businesses typically have separate budgets for capital and operating expenses. Purchases of new or replacement equipment falls under a capital budget, while actions are usually part of the operating budget or performed by salaried employees. Capital budgets typically have long term planning and allocation, while an operating budget is by nature more flexible to conditions in a given year. The ability of programs to affect equipment and action decision making is necessarily different as well. For the unit of analysis, actions were put into three categories: maintenance, operational improvement, and optimization.
- **Calculation type** is important for CPSV. Simple, commonly implemented measures in custom programs do not require the same depth of data collection to verify calculations and inputs as more complex measures. Simple measures also use standardized calculation approaches that reduce variance. Evaluators tend to find fewer adjustments and, even when adjustments are found, the adjustment often affects all measures of a calculation approach similarly.

In the example shown in Table 38, aggregating across any of the four listed dimensions is a trade-off of accuracy for increased precision, reduced customer burden and reduced evaluation costs. Not aggregating makes the same trade-off, but in reverse.

We aggregated across elements that are likely to have a lesser effect on decision making (such as type of insulation) and did not aggregate across distinctions that are likely to play a larger role in how decisions were made (such as process vs space heat).

The unit of analysis for the evaluation, presented in Figure 4, aggregates the data to the utility, account, year, and measure type. For Union, aggregating the tracking data to the unit of analysis reduced the number of records from 744 to 597 records for 2015 and from 1,468 to 1,091 records for 2013 to 2014. For Enbridge, the number of records for 2015 decreased from 955 to 858 records and for 2013 to 2014 decreased from 1,648 to 1,511 records.

Figure 13: Unit of Analysis



For this evaluation, the unit of analysis and the sampling units are defined differently. While a unit of analysis separates units of different accounts/sites, program years or measure types, the sampling unit is specific to the customer. As an example, one Enbridge customer may have installed a new boiler in 2013 and insulation in 2014, which is two different units of analysis. Since they were installed by the same customer, however, they belong to one sampling unit. In the analysis phase, weights will be developed for each unit of analysis (account-measure type-year), but for the standard error calculation, data collected from a single customer (sample unit) will be a treated as a cluster rather than evaluated as if they are independent observations.

Once aggregated to the unit of analysis, Union had an average of 1.5 units of analysis per account in 2013 and 2014 and 1.3 units per account in 2015[34] while Enbridge has an average of 1.2 units per account in 2013, 2014, and in 2015. In general, Union accounts tended to have more units of analysis per account than Enbridge accounts. Only 26 Union accounts have 5 units and none had more than 5. For Enbridge, 9 accounts have 4 units and no accounts have more than 4. This will facilitate data collection, since it's reasonable to ask about 3-4 units.

At this time we are unable to comment on the number of units per customer, because some customers will likely have multiple accounts. Customers will be defined by their contact information which will be requested along with the documentation request following submission of the scope of work.

[34] We are assuming a 1:1 account to customer ratio for sampling. For the analysis, customer will be defined by contact information (phone number primarily), which is not included in the provided tracking data.

Stratify the NTG and CPSV Data

There is a balance between having too many and too few strata.[35] In sample designs, more strata allow the design to control representativeness and estimated precision along more dimensions. Having more strata does not hurt overall precision, but it can increase the sample sizes required. Each stratification level serves to improve efficiency, improve representativeness, or both.

There are four populations across which the evaluation findings will be completely separate from one another.[36] These populations are defined by having separate program designs. The divisions between these populations are hard lines; none of the reported ratio results will include a mix of information across these populations. We can think of this as four evaluations using a common methodology and data collection effort.

5. Union Large Volume
6. Union Custom C&I
7. Enbridge Custom C&I
8. Enbridge RunitRight

Within the stratification segments (see Table 10) we categorize measures to improve the efficiency and representativeness of the sample. [37] The stratification for the 2015 data collection effort balances the needs of two studies, with the CPSV sample a subset of the NTG sample. Each has differing measure categorization priorities. [38]

- For NTG the measure categorization most predictive of free ridership rates is whether the project is installation of efficient equipment or whether the project was an action taken with existing equipment, regardless of whether that action is maintenance or an optimization that leads to energy savings.
- For CPSV the measure categorization most predictive of verification rates is a simple calculation versus one that is complex. Simple projects that follow consistent approaches and vary less from site to site typically have verification rates with lower variance than more complex projects that require more site specific knowledge and truly custom calculations. Stratifying by rigour allows us to assign a lower ER (0.3) to the simple project strata and higher to the more complex strata (0.4 ER) which provides better sample allocation. Simple strata projects will receive a TSER verification, while complex strata projects will receive an onsite verification.

The final stratification level segments projects by the magnitude of energy savings resulting from that project. Large projects represent a greater portion of the population, so sampling them at increased rates will result in greater precision with fewer verification visits or calls. Smaller projects must also be sampled to ensure representativeness. DNV GL used annual savings as a measure of size; cumulative savings were

[35] DNV GL agrees with the approaches described in "Sampling Methodology for Custom C&I Programs" which was prepared by Navigant for the TEC in 2012 and used to inform previous CPSV sample designs. Our sample design approach is consistent with the approaches recommended and follows the recommended seven step process (pages 17-23).
Dan Violette, Ph.D. & Brad Rogers, M.S., MBA, Navigant Consulting, Inc. "A Sampling Methodology for Custom C&I Programs," Prepared for: Sub-Committee of the Technical Evaluation Committee. November 12, 2012 (Revised October 28, 2014).

[36] For the CPSV, LI MF will be reported with MR MF either together with Custom C&I or as a separate Multi-Family domain, depending on final sample sizes and precisions.

[37] Page 14 in the Navigant report provides an explanation of the rationale for stratification.

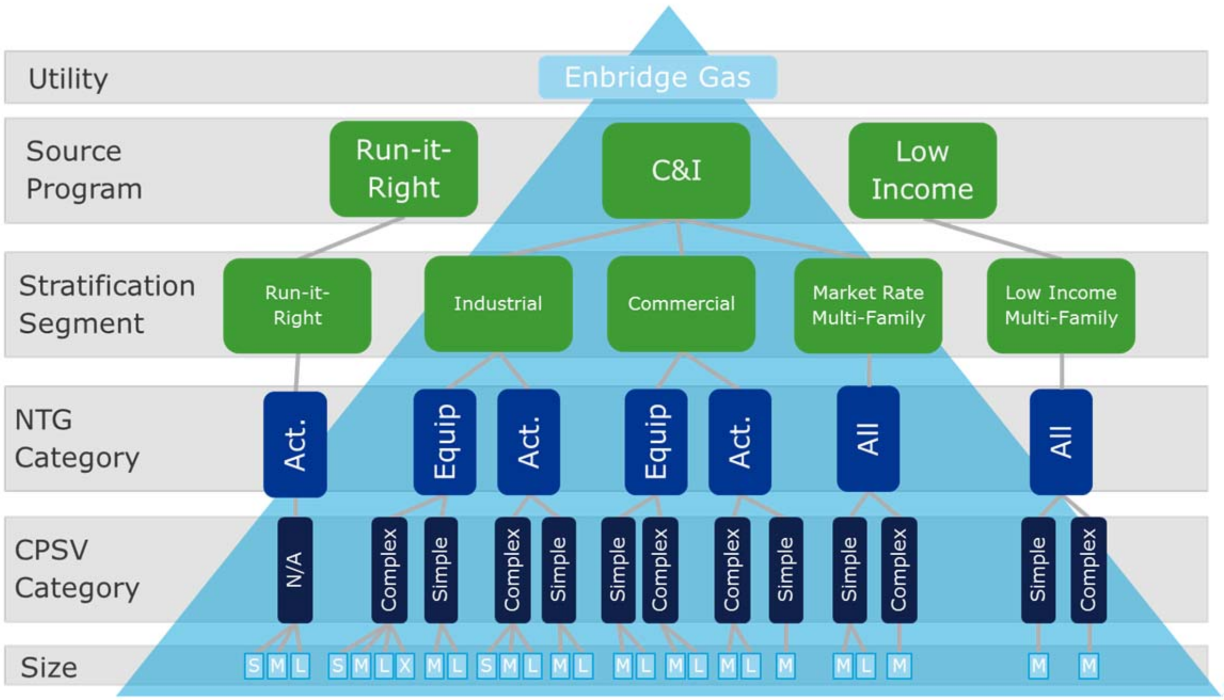
[38] The current stratification plan has more aggregated program segment categories than were described in the original proposal. When developing the proposal sample design we did not have access to the data or savings amounts specific to measure types.

not provided for all years and programs included in the study.[39] In terms of sample allocation, using annual savings will select longer life measures at a lower rate than would occur if cumulative savings are used.

It is important to note that the stratification used for sampling and expansion does not need to correspond directly to the level of reporting. For example, while we have chosen to use broad categories of customer segments in our stratification, this does not preclude reporting by more disaggregate customer segments.

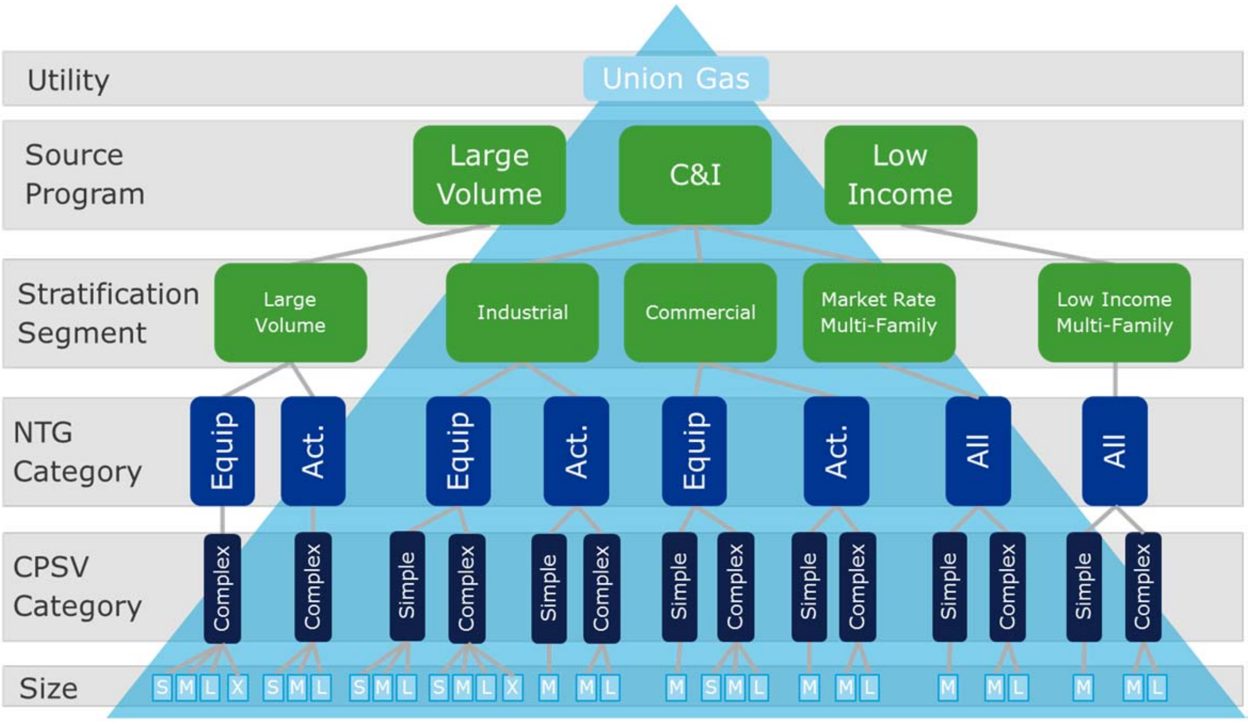
Figure 5 and Figure 6 show the CPSV and NTG stratification for Enbridge and Union respectively.

Figure 14: Enbridge Stratification



[39] The August 4, 2016 data provided by Enbridge included cumulative savings for 2015, but not 2013 and 2014.

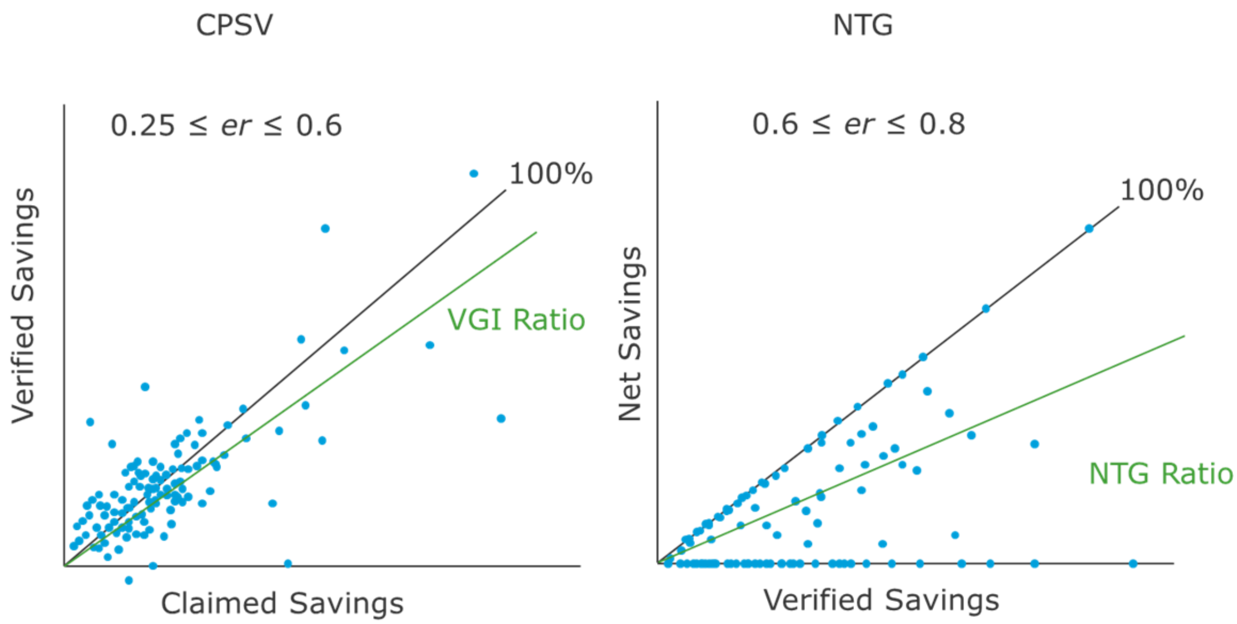
Figure 15: Union Stratification



Design the 2015 Samples

Critical to the sample size determination is the error ratio for each sampling cell with respect to the ratio to be estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean. Free ridership is measured as a percentage between 0 and 100%, with clustering of responses on the extremes. The clustering of responses at 0 and 100% means that the error ratio for NTG studies is generally higher than that for engineering verification, where most of the estimates cluster reasonably close to the tracking savings estimates. Figure 13 shows the expected clustering of results for the two study types.

Figure 16: Error Ratio Example plots



Our experience with conducting similar studies of commercial-industrial customers is that the error ratio for NTG factors is between 0.6 and 0.8 within reasonably defined sampling cells. SO typically has an error ratio higher than that of FR. Our sample design assumes an ER of 0.6 for FR and 0.8 for SO.

Including the Equipment vs. Action level of stratification allows us to use a 0.6 ER assumption for FR, rather than the 0.7 ER assumption that we would use without.

The CPSV sample of the 2015 program year will target a subset of sites selected for the FR portion of the study. CPSV error ratios are typically lower than those for FR. We are using error ratios ranging from 0.3 to 0.4 for the CPSV portion of the study. Including a stratification level based on assumed complexity allows us to vary these ERs to better allocate our sample. Specifically, we used an error ratio of 0.4 for "complex" Commercial and Industrial strata, 0.35 for "complex" Multi-Family strata, and 0.3 for the less complex TSER strata.

The error ratios for CPSV are based on previous CPSV efforts for the utilities that have achieved or come close to achieving 90/10 precision at the program level using an error ratio assumption of 0.35. Using an error ratio from a study performed by a different firm working for different clients (even though they are the same programs) is a risk. We are mitigating this risk by using a unit of analysis smaller than site-level in our sample design, but collecting data on all projects at the site from the same program year. This approach provides an additional margin of error for the evaluation by collecting more data than is projected by the sample design approach.[40] The cost of the additional data collection is low since engineers will already be on the phone or onsite with the customer.

[40] Sampling at the sub-site level allows us to use measure characteristics more effectively in sampling and expansion. Over-collected data (units of analysis that were not selected randomly) will be given a weight of one (representing themselves alone) to ensure the final results are not biased by collecting additional data from multiple measure sites.

2015 Enbridge Stratification

The 2015 Enbridge stratification is presented in Figure 7. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total there are 26 Strata.

Table 14 shows the 2015 Enbridge sample design in table form with the expected relative precisions and sample for targeted programs shown for each portion of the study. Data collection for FR will be completed through IDI, while the CPSV group indicates strata that will have onsite data collection (complex) or TSER (simple) for gross savings verification.

Table 39: 2015 Enbridge CPSV and FR Sample Design

Stratification Segment	NTG Group	CPSV Group	Size Strata	Sample Frame		FR Sample Design		CPSV Sample Design	
				N	m3	n	Rel. Prec.	n	Rel. Prec.
Industrial	Action	Complex	3	18	3,839,353	8	9 %	7	9 %
		Simple	2	8	992,833	4		4	
	Equipment	Complex	4	66	15,781,190	24		14	
		Simple	2	26	2,193,173	5		5	
Commercial	Action	Complex	2	4	2,148,182	4	9 %	4	9 %
		Simple	1	24	824,845	4		4	
	Equipment	Complex	2	93	5,909,721	22		9	
		Simple	2	255	9,216,164	34		10	
Market Rate Multi-Family	All	Complex	1	55	2,139,551	8		5	
		Simple	2	182	5,224,012	19		8	
Low Income	All	Complex	1	6	297,979	0	N / A	2	
		Simple	1	93	2,763,064	0		6	
RunitRight	Optimization	IDI	3	28	542,442	18	10 %	0	N / A
Total				**858**		**150**		**78**	

Table 15 shows the anticipated relative precisions for less aggregated program segments. We expect that the final relative precisions will be close to 90/10 for these segments as well as the targeted programs above.

Table 40: Enbridge Expected Precisions by Program Segment

Stratification Segment	Sample Frame		NTG		CPSV	
	N	Savings	n	Rel Prec.	n	Rel Prec.
Industrial	118	22,806,549	41	9%	30	9%
Commercial	376	18,098,912	64	10%	27	12%
MR MF + LI MF	336	10,424,606			21	13%
MR MF	237	7,363,563	27	20%		
RunitRight	28	542,442	18	10%		

Table 41 Provides the detailed sample design.

Table 41: Detailed 2015 Enbridge CPSV and FR Sample Design

Strata	Utility	Program	NTG Category	CPSV Category	Measures in Frame	FR Measure Target	CPSV Measure Target	Cumulative Gas Savings in Frame (m3)	Fraction of Frame Total Reported Cumulative Savings (m3)
211101	Enbridge	Industrial	Action	Complex	8	4	3	2,231,087	0.3%
211102	Enbridge	Industrial	Action	Complex	4	3	3	3,678,905	0.4%
211103	Enbridge	Industrial	Action	Complex	1	1	1	12,988,135	1.5%
211201	Enbridge	Industrial	Action	Simple	7	3	3	2,028,590	0.2%
211202	Enbridge	Industrial	Action	Simple	1	1	1	2,935,575	0.3%
212101	Enbridge	Industrial	Equipment	Complex	47	7	4	44,621,995	5.1%
212102	Enbridge	Industrial	Equipment	Complex	13	7	4	52,578,105	6.0%
212103	Enbridge	Industrial	Equipment	Complex	7	7	4	76,310,125	8.7%
212104	Enbridge	Industrial	Equipment	Complex	3	3	3	103,059,720	11.7%
212201	Enbridge	Industrial	Equipment	Simple	24	5	5	23,332,790	2.7%
212202	Enbridge	Industrial	Equipment	Simple	1	1	1	20,592,275	2.3%
221101	Enbridge	Commercial	Action	Complex	2	2	2	774,895	<0.1%
221102	Enbridge	Commercial	Action	Complex	1	1	1	10,213,885	1.2%
221201	Enbridge	Commercial	Action	Simple	24	4	4	3,875,430	0.4%
222101	Enbridge	Commercial	Equipment	Complex	50	13	4	20,106,586	2.3%
222102	Enbridge	Commercial	Equipment	Complex	8	8	4	31,966,255	3.6%
222103	Enbridge	Commercial	Equipment	Complex	1	1	1	9,501,060	1.1%
222201	Enbridge	Commercial	Equipment	Simple	265	17	5	88,190,023	10.1%
222202	Enbridge	Commercial	Equipment	Simple	28	17	5	148,466,935	16.9%
224101	Enbridge	Commercial	Multi-Residential	Complex	53	8	5	23,584,650	2.7%
224201	Enbridge	Commercial	Multi-Residential	Simple	139	10	4	53,999,911	6.2%
224202	Enbridge	Commercial	Multi-Residential	Simple	36	9	4	75,569,018	8.6%
241301	Enbridge	Run-it-right	Action	N/A	19	8	0	373,925	<0.1%
241302	Enbridge	Run-it-right	Action	N/A	5	5	0	923,845	0.1%
241303	Enbridge	Run-it-right	Action	N/A	4	4	0	1,414,440	0.2%
254101	Enbridge	Low Income	N/A	Complex	6	0	2	5,125,020	0.6%
254201	Enbridge	Low Income	N/A	Simple	104	0	6	58,676,555	6.7%

2015 Union Stratification

The Union stratification is shown in Figure 8. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total there are 30 strata.

Table 16 shows the 2015 Union sample design in table form with the expected relative precisions and sample for targeted programs shown for each portion of the study. Data collection for FR will all be completed through IDI, while the CPSV group indicates strata that will be have onsite data collection (complex) or TSER (simple) for gross savings verification.

Table 42: 2015 Union CPSV and FR Sample Design

Stratification Segment	NTG Group	CPSV Group	Size Strata	Sample Frame		FR Sample Design		CPSV Sample Design	
				N	m3	n	Rel. Prec.	n	Rel. Prec.
Industrial	Action	Complex	2	34	9,139,331	7	10%	7	9%
		Simple	1	26	4,882,678	4		3	
	Equipment	Complex	4	139	52,501,738	40		19	
		Simple	3	111	11,513,970	10		9	
Commercial	Action	Complex	2	5	6,776,934	5	10%	4	
		Simple	1	11	1,491,487	6		3	
	Equipment	Complex	3	113	6,850,571	17		8	
		Simple	1	42	1,013,521	5		4	
Market Rate Multi-Family	All	Complex	2	6	392,276	4		3	
		Simple	1	1	2,213	1		1	
Low Income Multi-Family	All	Complex	2	3	63,468	0	N/A	2	
		Simple	1	34	272,988	0		5	
Large Volume	Action	Complex	3	31	31,827,854	9	10%	8	10%
	Equipment	Complex	4	41	74,891,697	22		15	
Total				**597**		**130**		**91**	

Table 17 shows the anticipated relative precisions for less aggregated program segments. We expect that the final relative precisions will be close to 90/10 for these segments as well as the targeted programs above.

Table 43: 2015 Anticipated Precisions by Program Segment

Program Segment	Sample Frame		NTG		CPSV	
	N	Savings	n	Rel Prec.	n	Rel Prec.
Industrial	310	78,037,717	61	10%	38	10%
Commercial	171	16,132,513	33	10%	19	11%
Large Volume	72	106,719,551	31	10%	23	10%
MR MF+LI MF	44	730,945			11	13%
MR MF	7	394,489	5	18%		

Table 44 provides the detailed sample design.

Table 44: Detailed 2015 Union CPSV and FR Sample Design

Strata	Utility	Program	NTG Category	CPSV Category	Measures in Frame	FR Measure Target	CPSV Measure Target	Cumulative Gas Savings in Frame (m3)	Fraction of Frame Total Reported Cumulative Savings (m3)
111101	Union	Industrial	Action	Complex	21	7	6	75,487,148	2.8%
111201	Union	Industrial	Action	Simple	44	4	3	102,200,503	3.7%
112101	Union	Industrial	Equipment	Complex	104	13	6	183,932,142	6.7%
112102	Union	Industrial	Equipment	Complex	22	12	5	242,844,358	8.9%
112103	Union	Industrial	Equipment	Complex	9	9	5	347,468,949	12.7%
112104	Union	Industrial	Equipment	Complex	1	1	1	88,336,980	3.2%
112201	Union	Industrial	Equipment	Simple	91	5	4	50,638,424	1.9%
112202	Union	Industrial	Equipment	Simple	19	4	4	73,398,020	2.7%
112203	Union	Industrial	Equipment	Simple	1	1	1	41,029,840	1.5%
121101	Union	Commercial	Action	Complex	7	4	3	50,040,503	1.8%
121102	Union	Commercial	Action	Complex	1	1	1	31,595,400	1.2%
121201	Union	Commercial	Action	Simple	13	6	3	22,029,892	0.8%
122101	Union	Commercial	Equipment	Complex	104	9	3	20,998,185	0.8%
122102	Union	Commercial	Equipment	Complex	4	4	3	44,746,640	1.6%
122103	Union	Commercial	Equipment	Complex	1	1	1	76,886,900	2.8%
122201	Union	Commercial	Equipment	Simple	42	5	3	14,831,059	0.5%
123101	Union	Commercial	Multi-family	Complex	5	2	1	2,316,375	<0.1%
123102	Union	Commercial	Multi-family	Complex	1	1	1	5,093,140	0.2%
123201	Union	Commercial	Multi-family	Simple	1	1	1	44,260	<0.1%
131101	Union	Large Volume	Action	Complex	28	5	4	126,323,149	4.6%
131102	Union	Large Volume	Action	Complex	6	4	3	215,015,820	7.9%
131103	Union	Large Volume	Action	Complex	1	1	1	63,059,180	2.3%
132101	Union	Large Volume	Equipment	Complex	25	10	4	114,682,330	4.2%
132102	Union	Large Volume	Equipment	Complex	5	5	3	137,740,059	5.0%
132103	Union	Large Volume	Equipment	Complex	4	4	3	200,140,680	7.3%
132104	Union	Large Volume	Equipment	Complex	3	3	3	393,918,480	14.4%
153101	Union	Low Income	N/A	Complex	1	0	1	20,865	<0.1%
153102	Union	Low Income	N/A	Complex	1	0	1	1,433,430	<0.1%
153201	Union	Low Income	N/A	Simple	35	0	3	4,466,365	0.2%

Design the Spillover Samples

The sample design for spillover omits the CPSV category, but is otherwise consistent with the sample design for the 2015 FR and CPSV evaluation task. For spillover the ER used was 0.8; 90/10 precision was targeted.

2013/14 Enbridge Stratification

The 2013/14 Enbridge stratification is presented in Figure 7. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total there are 28 strata.

Figure 17: 2013/14 Enbridge Stratification

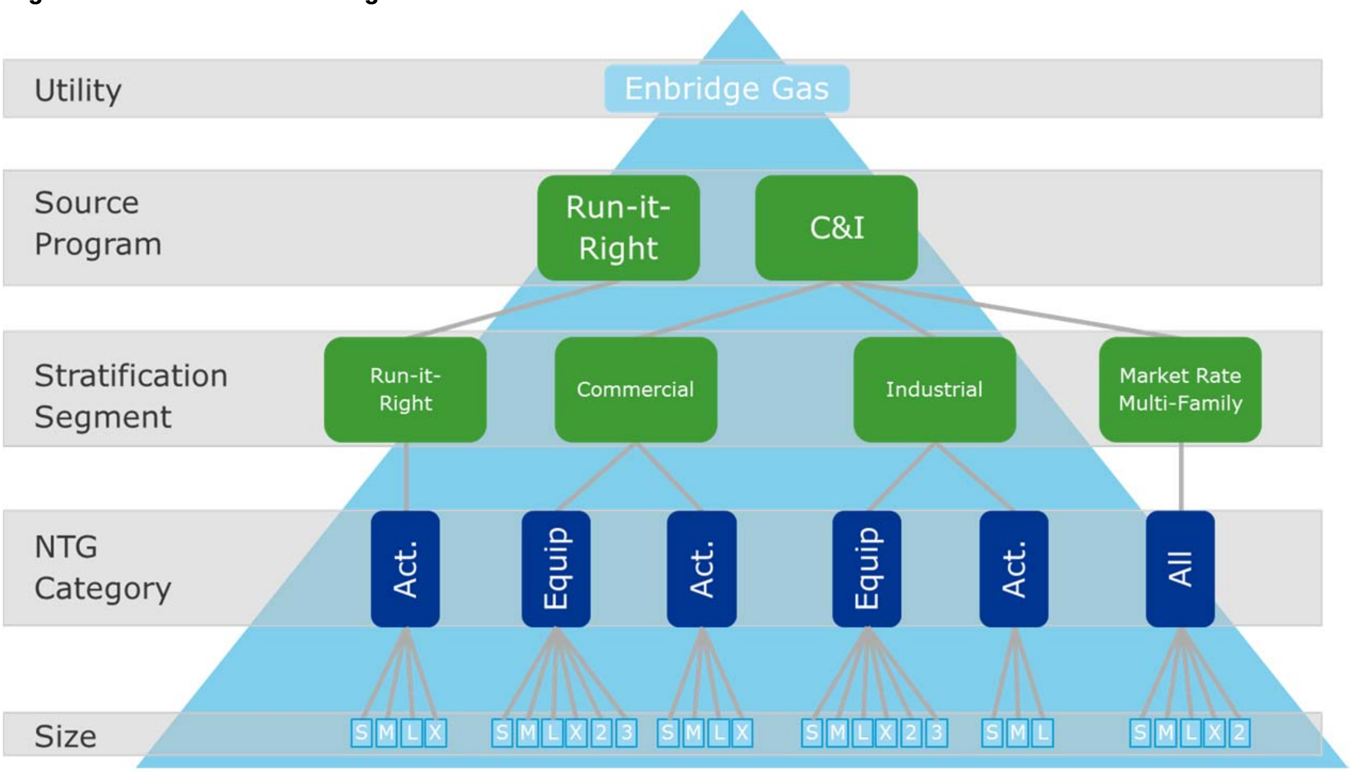


Table 18 shows the number of accounts and savings in the sample frame and the targeted spillover sample size for each grouping.

Table 45: 2013/14 Enbridge Spillover Sample Design

Stratification Segment	NTG Group	Size Strata	Sample Frame		SO Sample Design	
			N	m3	n	Rel. Prec.
Industrial	Action	3	40	5,067,923	20	10%
	Equipment	6	191	41,899,589	50	
Commercial	Action	4	79	4,604,864	25	10%
	Equipment	6	603	27,240,429	60	
MR MF	All	5	553	20,412,543	65	
RunitRight	Action	4	45	625,088	26	10%
Total			**1,511**		**246**	

2013/14 Union Stratification

The Union stratification is presented in Figure 8. In total there are 35 strata.

Figure 18: 2013/14 Union Stratification

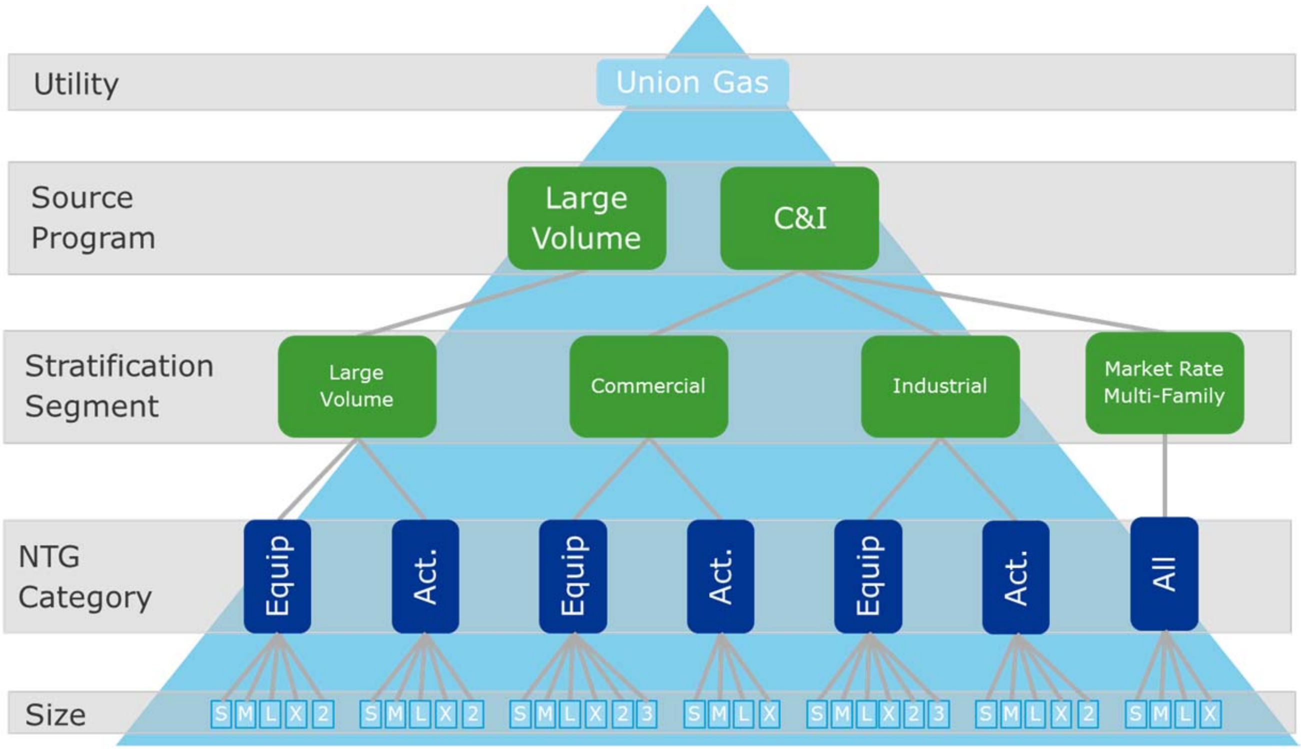


Table 19 shows the number of accounts and savings in the sample frame and the targeted spillover sample size for each grouping.

Table 46: Union Spillover Sample Design

Utility	Stratification Segment	NTG Group	Size Strata	Sample Frame		SO Sample Design	
				N	m3	n	Rel. Prec.
Union	Industrial	Action	5	167	64,448,800	38	10%
		Equipment	6	412	107,347,726	57	
	Commercial	Action	4	74	9,687,715	24	10%
		Equipment	5	190	15,744,760	40	
	MR MF	All	2	38	564,428	8	
	Large Volume	Action	5	130	317,638,812	38	10%
		Equipment	5	94	139,759,050	33	
	Total			**1,105**		**238**	

Prepare the Sample and Backup Sample

Once we have completed the final sample design, we will submit a data request to the utilities. The specific types of information we will be requesting are outlined in Table 47. The decision maker may not necessarily be located at the site where the project occurred and may be the same for multiple projects at multiple sites.

The technical expert is someone who will be able to answer questions regarding the specific engineering specifications of the equipment. Program energy advisors are the primary Account Manager or Energy Solutions Consultant that worked with the customer on the sampled projects. Vendors are the third party firms that were involved in the sale or design of the equipment, or the sale and performance of the O&M services.

Table 47: Information to Be Requested

Requested Information	Project Year	
	2013/14	2015
Site Address	√	√
Project Documentation	√	√
Decision Maker Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√
Technical Expert Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√
Program Energy Advisor Information: ▪ Full Name ▪ Email Address ▪ Direct Business Phone Number		√
Vendor Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√

For the 2015 NTG sample we will request documentation and contact information for 50 percent more projects that are in the primary sample. This corresponds to a minimum 66 percent response rate. If response rates are lower than 66 percent in specific stratum, we will request documentation and contact information for additional projects in the stratum.

For the 2013/14 spillover sample we will request contact information for three times the number of sampled projects. This corresponds to a minimum 33 percent response rate. We will not request project documentation for the spillover sample until we have identified the sites that require follow up engineering interviews. To protect respondent confidentiality we will request documentation for more sites than will receive follow up calls. Overall this staging of requests will reduce the amount of project documentation that the utilities need to provide, while ensuring efficient data collection.

Backup sample will only be contacted if needed to meet targeted number of completes.

Once we have received the requested contact information, we will identify instances where a contact was involved in multiple projects, even across sites. While the projects are conducted at the site level, the decision maker, technical expert, or vendor may have been involved in projects at multiple sites. For example, multiple participating sites for the same retail chain may have one energy manager from the corporate office but the technical expert may be site specific. Using this contact information and taking into account cross-site involvement, we will assemble the CATI and the IDI sample frame.

APPENDIX B LCNS METHODOLOGY

Life Cycle Net Savings (LCNS) is a methodology for determining the FR component of NTG by estimating program effect over the life of the program measure. In this appendix, the terms FR and attribution are used interchangeably as complements of one another. This appendix does not include spillover.

Notation:

VGS_S = Verified Gross Savings based on standard efficiency equipment baseline (annual)

VGS_E = Verified Gross Savings based on pre-existing equipment baseline (annual)

VGS_L = Verified Gross Lifetime Savings

Y_L = Verified Estimated Useful Life (Years) of installed efficient equipment

Y_A = Years Accelerated

Y_R = Remaining Useful Life of pre-existing equipment

A_E = Efficiency Attribution

A_Q = Quantity (size) Attribution

F_E = Efficiency free ridership

F_Q = Quantity (size) free ridership

SPA = Simple Program Attribution (function of efficiency and quantity free ridership, not timing)

NS_L = Net Lifetime Savings

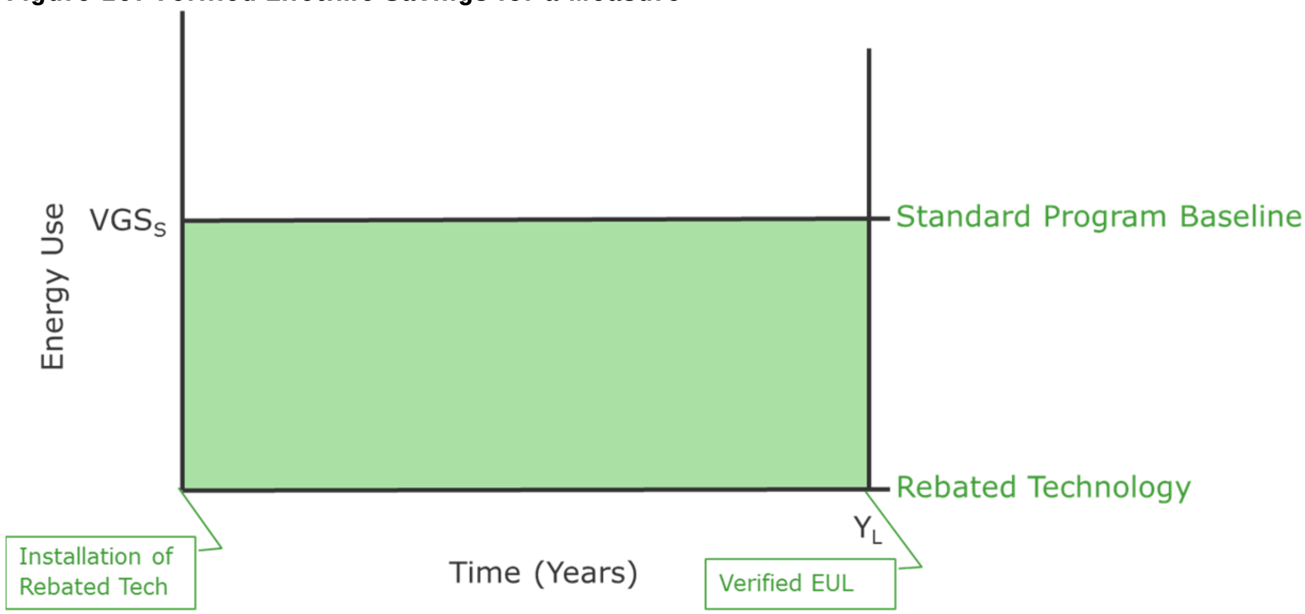
NS_A = Net Acceleration Period Savings

NS_P = Net Post-Acceleration Period Savings

Verified Lifetime Savings

First we consider the verified savings that make up the denominator in the NTG ratio. Figure 19 shows the verified lifetime savings for a measure.

Figure 19: Verified Lifetime Savings for a Measure



Verified lifetime savings are calculated as the difference in energy use of the incentivized measure and the energy use of a standard program baseline measure for the (verified) life of the measure.

$$VGS_L = VGS_A \times Y_L$$

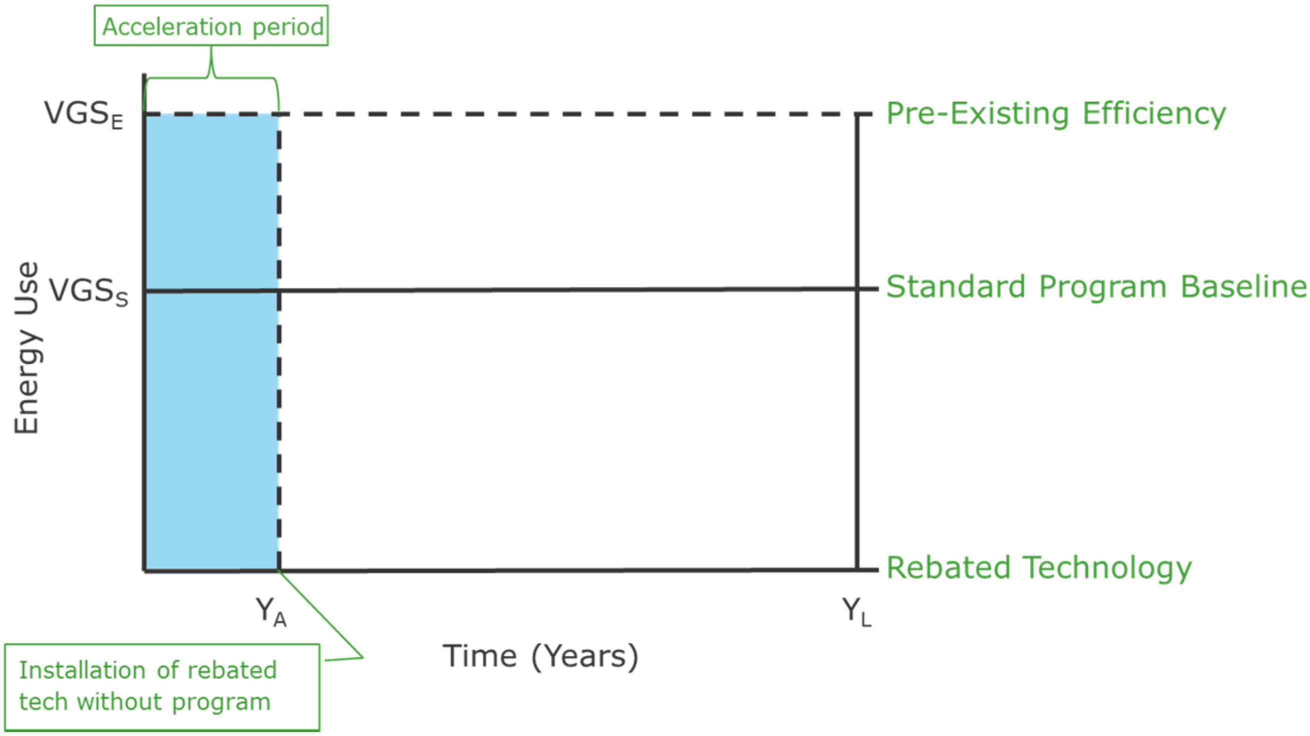
Timing

The treatment of timing is how LCNS differs from other estimation approaches for attribution. In LCNS the response to the question "when would you have performed the measure without the program" defines the number of years that the program accelerated (advanced) the measure. This period is referred to as the "acceleration period" and shown as the distance from the origin to Y_A along the x-axis.

During the acceleration period, the customer would not have installed a new measure (efficient or standard). Instead the appropriate baseline equipment for this time period is the pre-existing equipment that they had been using. This section shows how this difference in baseline affects the net savings estimate for the measure relative to the gross savings.

During the acceleration period (Y_A), the attributable savings are calculated as the difference in energy use of the incentivized equipment and the energy use of the replaced equipment (a pre-existing efficiency baseline). As a result, during the acceleration period the net savings (blue box up to VGS_E) may be higher than the verified gross savings (VGS_s) if the efficiency of the pre-existing equipment was less than the standard program baseline. Savings during the acceleration period are, by definition, attributable. Figure 20 shows the attributable savings in the acceleration period for an accelerated measure.

Figure 20: Acceleration Period Savings



Acceleration period savings are calculated as:

$$NS_A = VGS_E \times Y_A$$

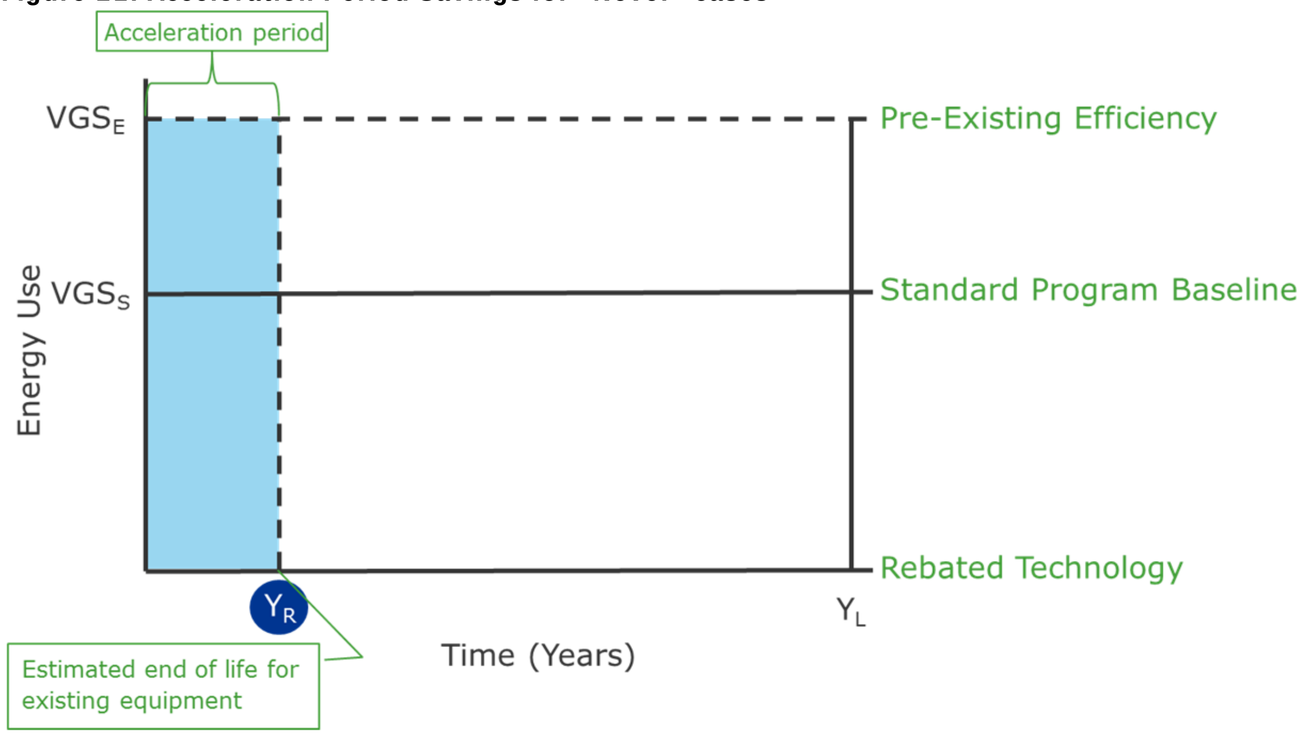
Special Case: "Never"

Some respondents will indicate that they would "never" have replaced the existing equipment. A customer "Never" would have installed the project if they:

1. respond to initial timing question by saying they never would have installed it without the program
2. respond to second timing question by saying they would have installed it more than four years later without the program
3. respond to the initial quantity question by saying they would not have replaced any of the units without the program

For these measures, the acceleration period is defined by the remaining useful life of the pre-existing measure (Y_R) and the applicable baseline is versus pre-existing efficiency (VGS_E) as shown in Figure 21.

Figure 21: Acceleration Period Savings for "Never" cases



Acceleration period savings for "Never" would have installed measures are calculated as:

$$NS_A = VGS_E \times Y_R$$

Efficiency and Quantity

In the post-acceleration period attribution is based on the program effect on the efficiency and quantity of what was installed.

Efficiency attribution, A_E, measures the effect the program had on the *efficiency* of the equipment installed. The efficiency attribution measures the proportion of savings attributable to the program for increasing the efficiency of the equipment above what would have been installed otherwise.

Quantity attribution, A_Q, measures the effect the program had on the *size or amount* of the equipment installed. The quantity attribution measures the proportion of savings attributable to the program for increasing or decreasing the quantity of equipment above or below what would have been installed otherwise.

The Simple Program Attribution (SPA) is the fraction of annual verified gross savings that are attributable to the program and is a function of the efficiency free-ridership (f_E) and the quantity free-ridership (f_Q).

The free-ridership values for efficiency and quantity are calculated from the attribution factors. The complement of attribution is free-ridership. Attribution measures the portion of the savings that result because of the actions of the program. Free-ridership measures the portion of the savings that would have happened in the absence of the program. The free-ridership equivalents of the attribution factors are used to determine program net savings.

$$f_E = 1 - A_E$$

$$f_Q = 1 - A_Q$$

The fraction of verified gross savings that would have occurred without the program is the product of the fraction of units that would have been installed without the program, and the fractional unit savings that these units would have had without the program.

$$f_{QE} = f_Q f_E$$

For example, if two-thirds as many units would have been installed without the program (f_Q = 2/3), and the savings per unit would have been only half as much (f_E = 1/2), the portion of the savings that would have occurred without the program would be

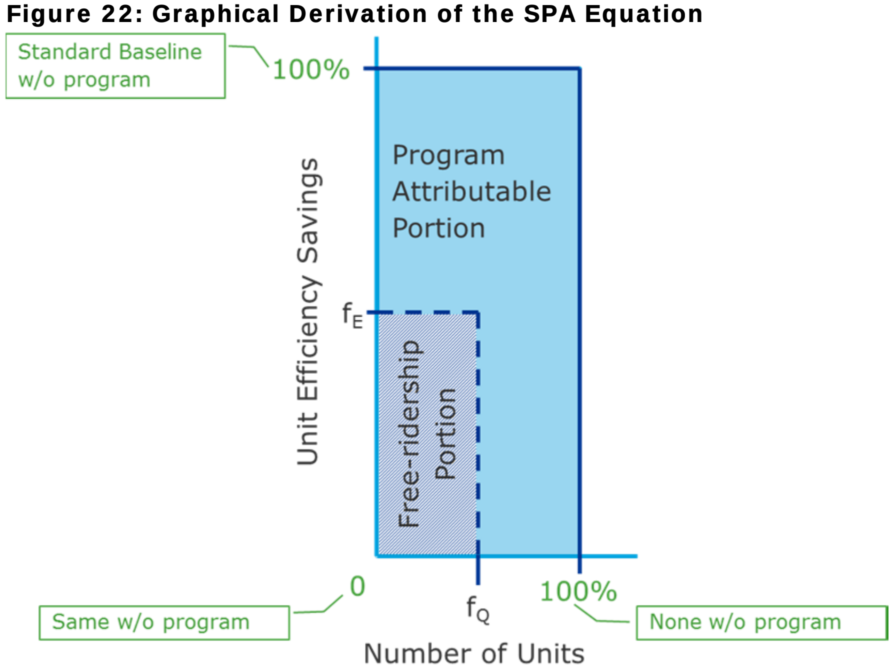
$$f_{QE} = (2/3) \times (1/2) = 1/3.$$

The SPA is the complement of this free rider portion.

$$SPA = 1 - f_{QE} = 1 - f_Q f_E$$

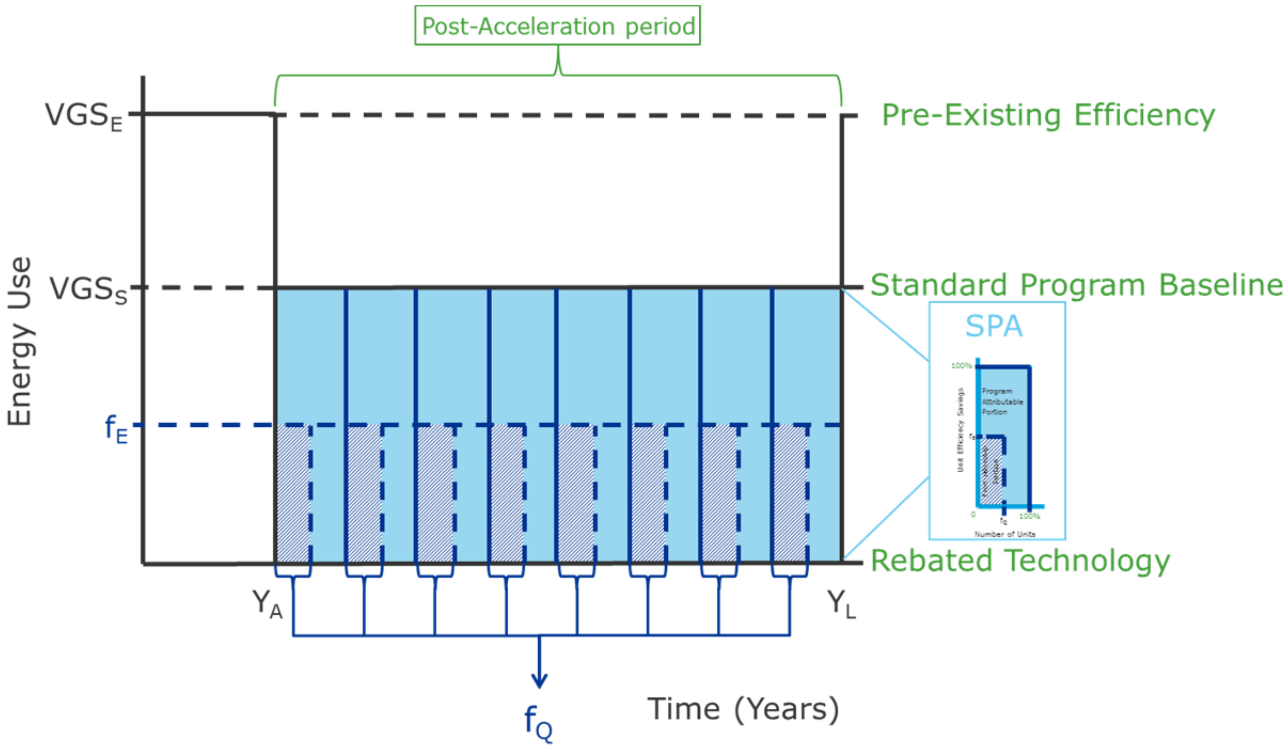
The relationship is illustrated in Figure 22.

Figure 22: Graphical Derivation of the SPA Equation



SPA is the attribution of each year savings in the post-acceleration period. Figure 23 shows the program attributable and free-ridership portions of each year's savings in the post-acceleration period. The blue rectangles represent SPA as discussed and shown from above. The height of the SPA box is equivalent to the baseline used for verified savings. The grey "missing pieces" are the free ridership for each year's savings. Because attribution is three dimensional and this is a two dimensional document, we are representing both years and quantity on the x-axis. Years are denoted by the dark blue vertical lines, while the quantity FR (f_Q) is shown as the width of the grey box.

Figure 23: Post-Acceleration Period Attributable Savings



The net savings in the post-acceleration period are calculated as:

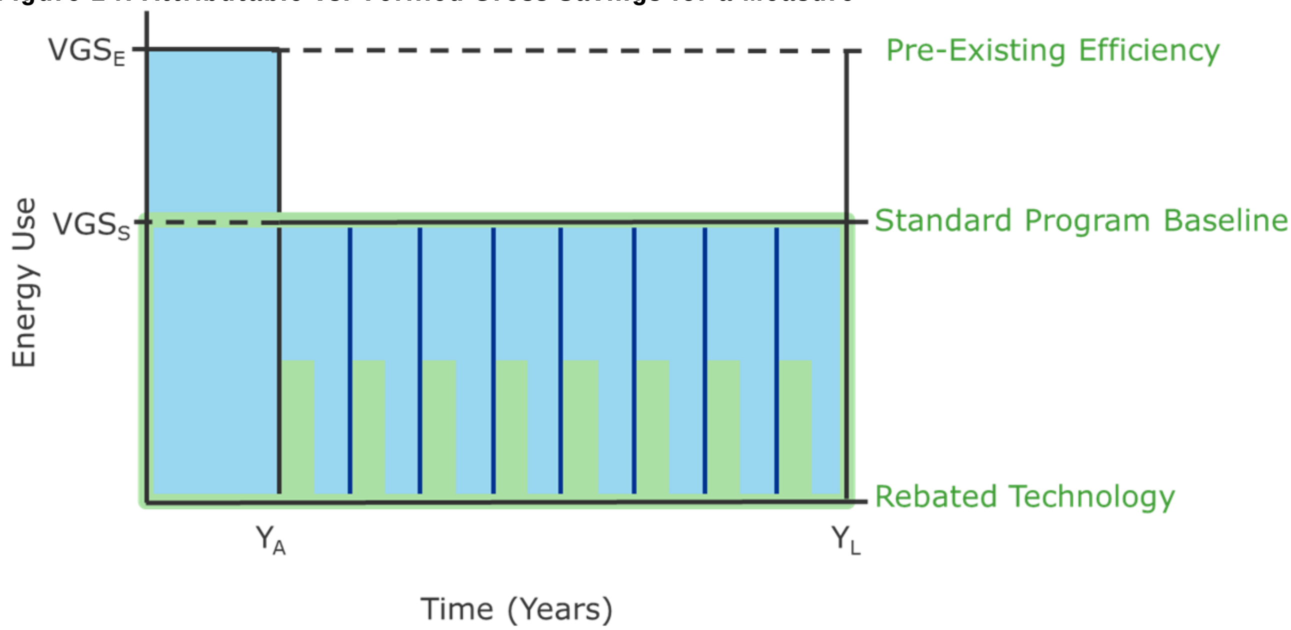
$$NS_P = VGS_S \times SPA \times (Y_L - Y_A)$$

Note that for the special case discussed relating to acceleration period savings, "Never", SPA= 100%.

Calculating Attribution

Figure 24 shows the attributable savings across the lifetime of the measure NS_L (blue) overlaid on the verified gross lifetime savings VGS_L (green). The figure shows that with the effect of the dual baseline verification included in the net savings estimate and not in the verified savings estimate, some accelerated measures may have greater attributable savings than verified gross savings.

Figure 24: Attributable vs. Verified Gross Savings for a Measure



The formula for each individual measure's estimate of lifetime net savings is:

$$NS_L = NS_A + NS_P$$

or

$$NS_L = VGS_E \times Y_A + VGS_S \times (SPA) \times (Y_L - Y_A)$$

The formula for each individual measure's attribution is:

$$Attr = \frac{NS_L}{VGS_L}$$

$$Attr = \frac{VGS_E \times Y_A + VGS_S \times (SPA) \times (Y_L - Y_A)}{VGS_S \times Y_L}$$

Four years is the time horizon beyond which we assume the respondent cannot answer with certainty. Anything beyond four years (Y_A>=4) is treated as a "never would have installed" response (100% attributable), rather than an accelerated measure.

Special Case: FR Sampled Projects not sampled for CPSV

The sample for the CPSV portion of the study is a subset of the free ridership sample. This means that for projects included in the FR study, but not included in CPSV we will not be calculating verified savings. For expansion of the NTG ratio and for calculating post-acceleration period savings we will use the final ratio application domain level Gross RR to estimate verified savings for measures not in the CPSV.

For acceleration period savings we will use the A/P ratio of accelerated projects in the CPSV to estimate the pre-existing baseline savings. The A/P ratio refers to the ratio between the annual Acceleration Period Savings and the annual Post-Acceleration Period Net Savings. It is always one or larger. Like the application of Gross RR the A/P ratio will be estimated at the application domain level for use in estimating net savings for the FR-only sampled measures.

APPENDIX C DETERMINING ATTRIBUTION PARAMETERS

The attribution factors defined in the previous section are determined from the participant responses gathered during the survey. This section provides an overview of the survey data and how it is used to determine each attribution factor. It also includes more detailed sections for each factor that show exactly how all survey responses are handled.

General procedure

This section provides an overview of the attribution factors and how they are determined.

- Timing attribution, A_T: The timing attribution is determined from the acceleration period, Y_A, which is in turn provided directly by the respondent and the verified savings versus existing equipment provided by the evaluation engineers. There is no timing attribution effect for values of Y_A greater than four; in those instances we assume that the measure would never have been installed without the influence of the program.
- Efficiency attribution, A_E: The efficiency attribution is based on the answers to questions DAT2a and DAT2b which ask about the efficiency level that would have been installed in absence of the program. Respondents who indicate that they would have installed a lesser-efficient piece of equipment in the absence of the program are asked what efficiency they would have installed instead. An efficiency attribution value is assigned based on the response. Standard efficiency based on program definitions will be used to bracket the finer cut as defined in the project documentation provided by the utilities.
- Quantity attribution, A_Q: The quantity attribution is based on the percentage change in quantity caused by the program, ΔQ, which is in turn provided directly by the respondent. **Error! Reference source not found.** shows the attribution assignment based on responses to DAT3a and DAT3b.

The next few sections deal with determining the timing, efficiency, and quantity attributions on a more detailed level.

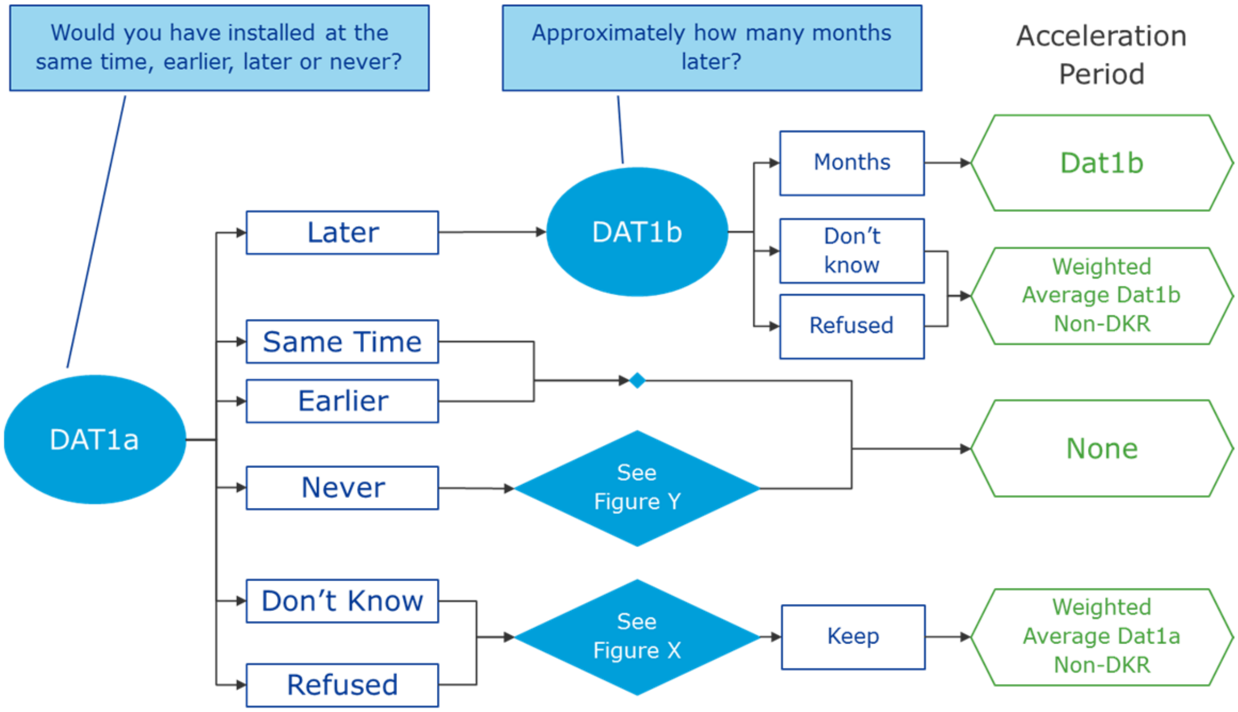
Timing

The timing attribution, A_T, is determined from the first set of attribution survey questions. These questions are used to determine whether or not the program accelerated implementation of a measure or caused it to be implemented before it would have been without the program. The two relevant questions are labelled DAT1a and DAT1b.

- DAT1a: "Without < the program>, would you have <installed, preformed> <measure> at the same time, earlier, later, or never?"
    - o DAT1a_O: "Why do you say that?"
- DAT1b: "Approximately how many months later?" (DAT1b is only asked if DAT1a is "Later.")

Note that these questions ask about the timing of installing equipment, not installation of efficient equipment in particular. For example, if the measure was replacement of a high-efficiency boiler, the question asks when the boiler would have been replaced without the program. Engineers conducting the interviews are trained to ensure clarity for these questions. **Error! Reference source not found.** shows a decision tree for DAT1a and DAT1b.

Figure 25: Decision Tree for the Acceleration Period



The measure is considered accelerated if the respondent indicates that the measure would have been installed less than four years later without the influence of the program. The acceleration period is determined based on the answer to DAT1b. If the respondent is unable to answer DAT1b, the measure is assigned the average acceleration period across all accelerated measures in the same measure group.

If the respondent answers DAT1a with Earlier or Same Time then there is no acceleration period. If the respondent answers DAT1a with Never and the Quantity and Efficiency sections apply to the measure then the survey skips to the next section and there is no acceleration period. If the respondent answers DAT1a with Don't Know or Refused but does provide answers to inform the Quantity and Efficiency Attributions then the measure is assigned the average Acceleration Attribution for all measures in the same primary domain.[41]

[41] The primary domain is the domain that the attribution factor will be applied to in calculating the final net savings for the programs.

Table 48: Timing Attribution Assignments

Coarse Cut (DAT1a) (Would you have implemented the measure at the same time absent the program)	Finer Cut (DAT1b)	Acceleration period
Same time	NA	None
Earlier	NA	None
Later	0 < years <4	A_T=DAT1b Acceleration period equals response to DAT1b
	4<= years	Equivalent to "Never" $A_T=A_R$ Acceleration period equals remaining useful life of replaced equipment, SPA=100%
	Don't know/refused	Weighted average of "later" cases for primary domain, 0 < years <4
Never	NA	$A_T=A_R$ Acceleration period equals remaining useful life of replaced equipment, SPA=100%
Don't know/refused	NA	Weighted average of all respondents for primary domain

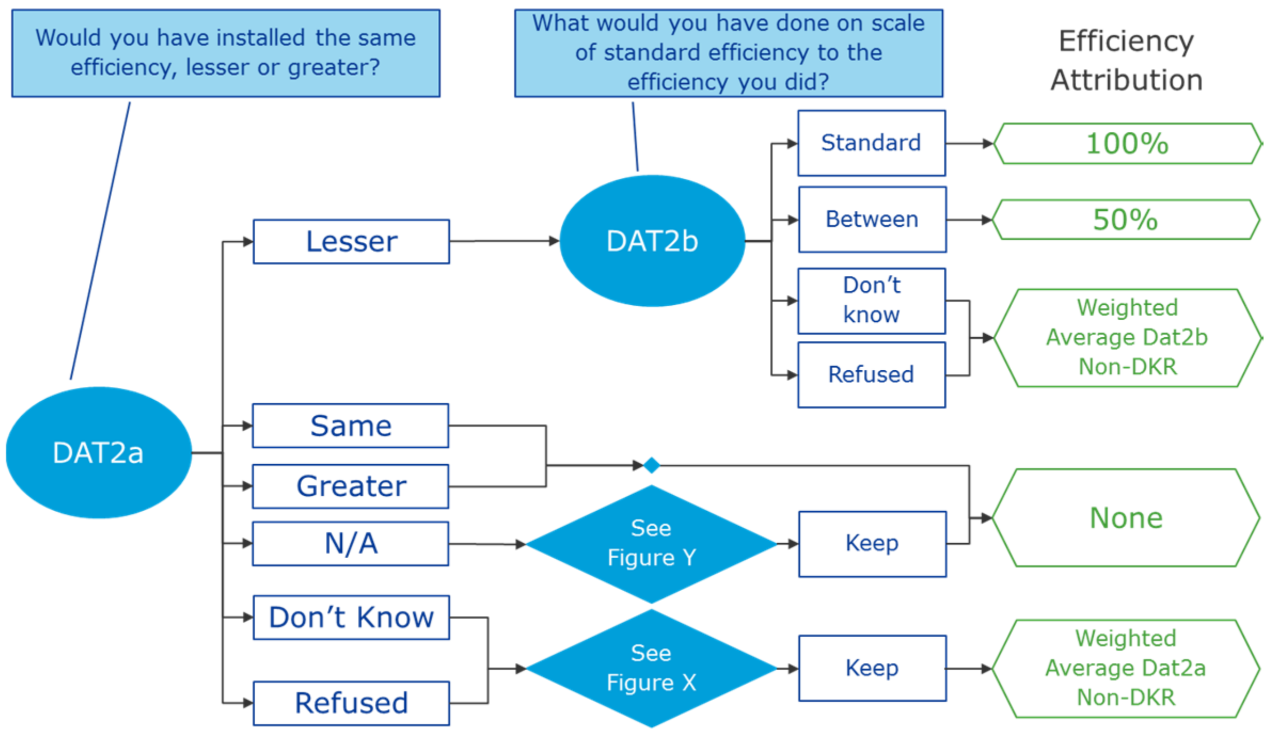
Efficiency

Efficiency Attribution, A_E, gives the program credit for increasing the efficiency of a measure above what would have been installed in the absence of the program. The two relevant questions are DAT2a and DAT2b.

- DAT2a: "Without <the program>, would you have installed the same efficiency as what you installed, lower efficiency, or higher efficiency?"
- DAT2b: "Without <the program>, would you have installed <measure> that was "standard efficiency on the market at that time," or "between standard efficiency and the efficiency that you installed?" (DAT2b is only asked if DAT2a is "Lesser.")

The program receives nonzero Efficiency Attribution if the respondent indicates that they would have installed a less efficient measure without the influence of the program. The magnitude of the Efficiency Attribution is determined based on the answer to DAT2b, as shown in **Error! Reference source not found.**. **Error! Reference source not found.** shows the corresponding decision tree for DAT2a and DAT2b.

Figure 26: Decision Tree for Efficiency Attribution



If the respondent answers DAT2a with Greater or Same then the survey skips to the next section and there is zero Efficiency Attribution. If efficiency is not applicable to this measure but quantity is applicable and the measure would have been installed anyway then the survey skips to the next section and the Efficiency Attribution will not affect the Simple Program Attribution. If the respondent answers DAT2a with Don't Know or Refused but does provide answers to inform the Quantity Attribution and Acceleration Period then the measure is assigned the average Efficiency Attribution for all measures in the same measure group.

Table 49: Efficiency Attribution Assignments

Coarse Cut (DAT2a) (what efficiency would have been implemented absent the program)	Finer Cut (DAT2b)	Efficiency Attribution
Same	NA	0%
Lower	Standard efficiency or according to code	100%
	Between standard efficiency and the efficiency that was installed	50%
	Don't know/refused	Weighted average of above cases for primary domain
Greater	NA	0%
Don't know/refused	NA	Weighted average of all respondents for primary domain

Quantity

Quantity Attribution, A_Q, gives the program credit for increasing the quantity of a measure above what would have been installed in the absence of the program. The two relevant questions are DAT3a and DAT3b.

- DAT3a: "Without <the program>, how different would the <number/size> of the <equipment type> have been? Would you say you would have installed the same amount, less, more, or not have installed anything?"
- DAT3b: "By what percentage did you change the amount of <equipment type> installed because of <the program>?" (DAT3b is only asked if DAT3a is "Less" or "More.")

The program receives nonzero Quantity Attribution if the respondent indicates that they would have installed less of the measure or a smaller measure without the influence of the program (for example: "I would have replaced as many doors"_. The program also receives nonzero Quantity Attribution if the respondent indicates that they would have installed more of the measure or a larger measure without the influence of the program (for example: "I would have installed a bigger furnace, but I through the program I learned it was unnecessary"). The latter case covers situations where the program effect was in "right sizing" the measure. The magnitude of the Quantity Attribution is determined based on the answer to DAT3b, as shown in **Error! Reference source not found.**. **Error! Reference source not found.** shows a decision tree for DAT3a and DAT3b.

Figure 27: Decision Tree for Quantity Attribution

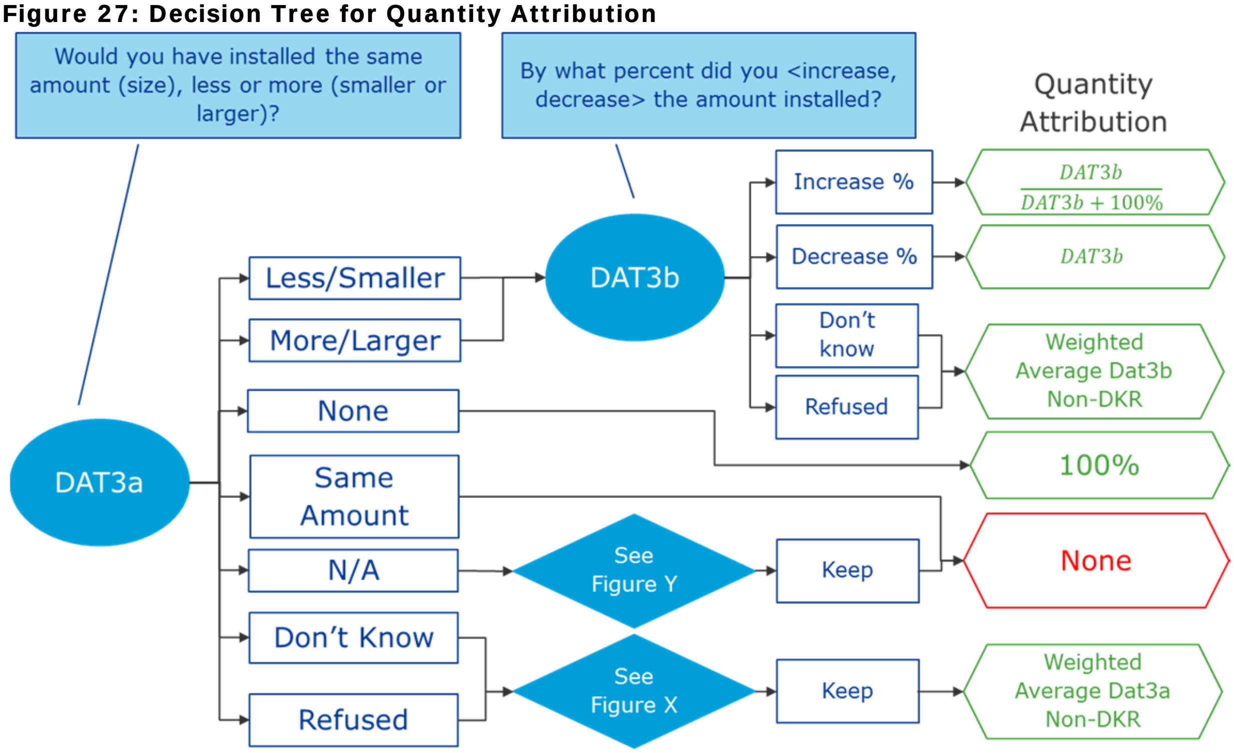


Table 50: Quantity Attribution Assignments

Coarse Cut (DAT3a) (How much equipment would have been replaced absent the program)	Finer Cut (DAT3b)	Quantity Attribution
Same	N/A	0%
Less/Smaller	ΔQ	AQ = ΔQ / (ΔQ + 100%)
	Don't know/refused	Weighted average of "less" cases for primary domain
More/Larger (right sizing)	ΔQ	AQ = ΔQ
	Don't know/refused	Weighted average of "more" cases for primary domain
None	N/A	100%
Don't know/refused	N/A	Weighted average of all respondents for primary domain

If the respondent would have installed a smaller measure without the program then the Quantity Attribution is calculated as:

A_Q = Inc / (Inc + 100%)

where

Inc = percentage change in quantity because of the program.

If the respondent would have installed a larger measure without the program, then the Quantity Attribution is calculated as:

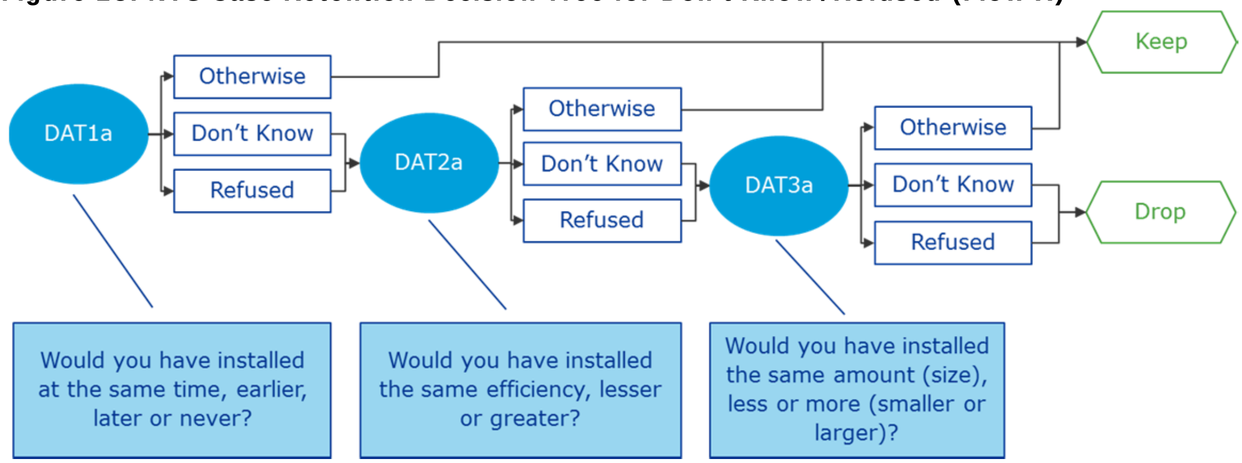
A_Q = Inc.

If the respondent answers DAT3a with Same Amount or None then the survey skips to the next section and there is zero Quantity Attribution. If quantity is not applicable to this measure but efficiency is applicable and the measure would have been installed anyway then the survey skips to the next section and the Quantity Attribution will not affect the Simple Program Attribution. If the respondent answers DAT3a or DAT3b with Don't Know or Refused but does provide answers to inform the Efficiency Attribution and Acceleration Period then the measure is assigned the average Quantity Effect for all measures in the same measure group.

What if they "Don't Know" or "Refuse?"

Some respondents are unable or unwilling to answer the relevant questions in the survey attribution sequence. If a participant is unable or unwilling to answer *all* of the attribution questions then the participant is dropped from the attribution analysis. However, the respondent information will still be included as part of the installation rate and the VGI. **Error! Reference source not found.** shows a decision tree that indicates the relationship between the question responses and how they affect the attribution. If a measure goes to the "Keep" decision then the ultimate resolution of each effect is shown in **Error! Reference source not found.**.

Figure 28: NTG Case Retention Decision Tree for Don't Know / Refused (Flow X)

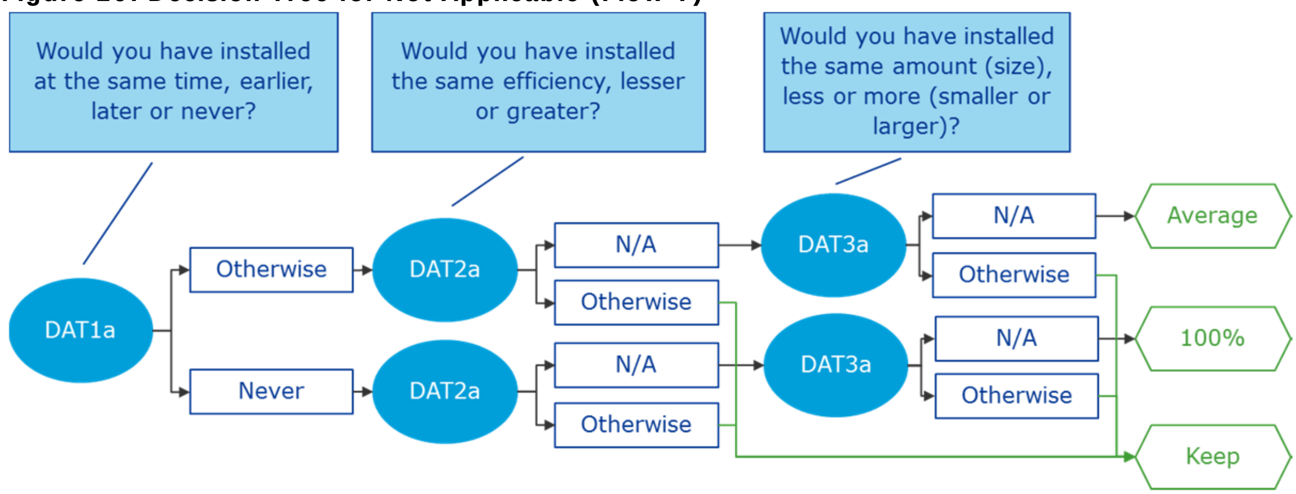


When Efficiency and Quantity Don't Apply

Quantity and efficiency questions do not apply to all measures. Efficiency questions do not apply if the equipment type is inherently an efficiency improvement; that is, the "standard efficiency" baseline would be not to install anything. Variable frequency drives (VFDs) or heat recovery systems are examples. Quantity questions do not apply when varying quantity or size does not make sense in the context of the measure.

Error! Reference source not found. shows a decision tree that indicates the relationship between the question responses and how they affect attribution. If a respondent indicates that a measure would never have been installed without the program and the DAT2a and DAT3a questions do not apply then the attribution is 100%. If the respondent would have installed the project at the same time, earlier, or later and the DAT2a and DAT3a questions do not apply then the measure is assigned the average savings-weighted attribution across all measures in that measure group.

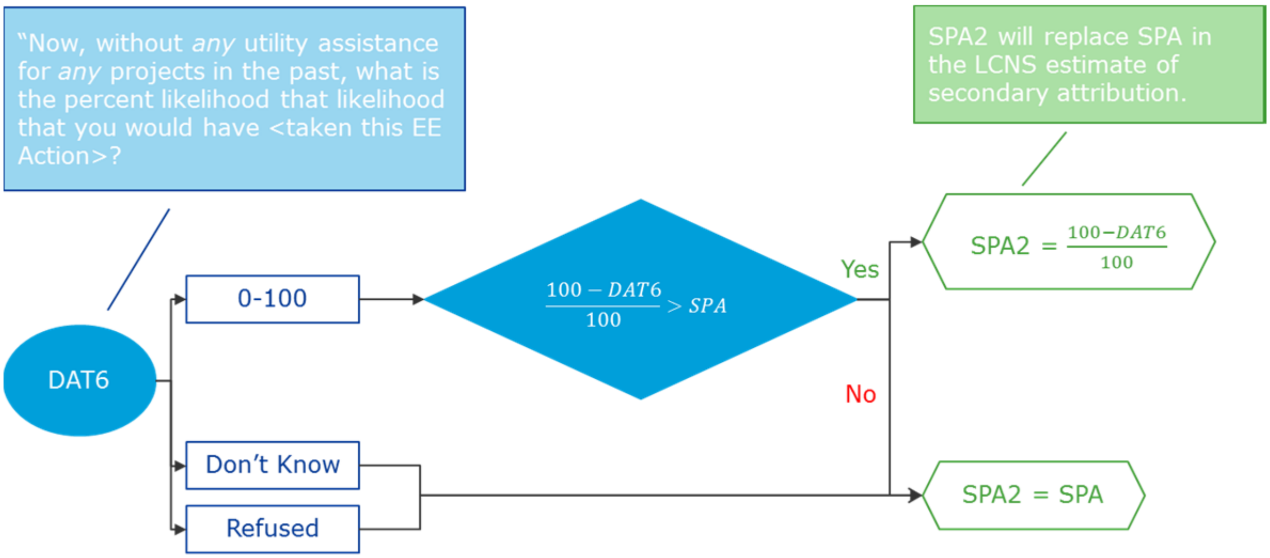
Figure 29: Decision Tree for Not Applicable (Flow Y)



Secondary Attribution

Secondary attribution, the longer-term effect of the program on participant decision making will be assessed based on a single question. That asks the respondent about the likelihood of the project given all program assistance for all projects since the programs were started. The greater of this score and the primary SPA will be used as SPA in calculating the LCNS based on all program efforts, not just those focused on this project.

Figure 30: Secondary Attribution Scoring



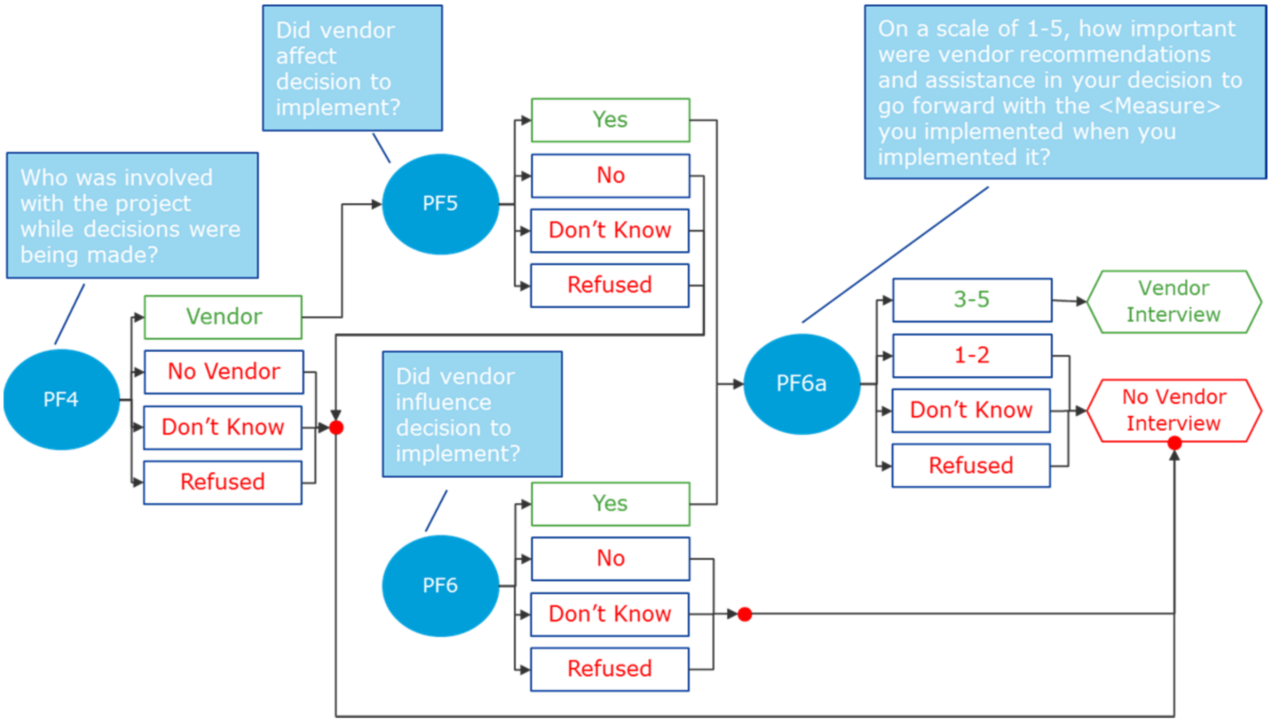
Incorporating Vendor Effect

DNV GL will take two steps to determine when a vendor survey is necessary to supplement the participant survey. They are:

1. When we request project documentation and site contact information for each sampled project we will also ask the utilities to provide vendor contact information for projects with vendor involvement.

2. Each survey completed with a participant is reviewed to determine the effect the supplier had on the participant's decision to install a given measure relative to the program's effect. If a participant indicates that the program did not influence their decision to install high efficiency equipment but the vendor did have substantial influence, then we will complete a survey with the vendor. The decision tree is shown in **Error! Reference source not found.**.

Figure 31. Decision Tree to Trigger Vendor Interview



For measures with both participant surveys and vendor surveys, the analysis will produce two separate attribution values. The first reflects the influence that the program had on the participant's decision to install the measure. The second reflects the influence that the program had on the vendor's business practices and therefore their ability to sell the measure. We choose the higher of the two values as the final program attribution for that measure. That is, if either the vendor or the customer indicates that the program influenced the decision to install the measure, we conclude that the program influenced the decision. In the event that a vendor interview is triggered, but is either not completed or results in an inconclusive vendor score, vendor attribution for the measure will be the average attribution of all completed vendors within the evaluation program.

The vendor attribution scoring method will be included with the vender interview guide.

Quality control by interviewers and analysts

Each of the components of attribution, Timing (DAT1a/ DAT1a_O/DAT1b), Efficiency (DAT2a/DAT2a_O/DAT2b) and Quantity (DAT3a/ DAT3a_O/DAT3b), have a question sequence that follows the same pattern:

DATXa.	What would you have done without the program?
DATXa_O.	Why do you say that?
DATXb.	<If DATXa=program effect> How different would the project have been?

Quality control for each component of attribution consists of comparing the final component attribution score (t, e, q) to the open ended response for the "DATXa_O. Why do you say that?" question.

1. Interviewers are trained to probe if the response to the open ended question is inconsistent with the scored response to DATXa.
2. During the analysis phase, the analyst will put measures into three bins: full attribution, partial attribution and full free rider for each component. The analyst works bin at a time to compare each verbatim open ended response to the score for the attribution component. Assessing verbatim responses by bin reduces analyst error and speeds the review. If an open ended response appears inconsistent with the score received, the case is elevated to PM review.

Overall attribution scores are compared to the DAT0 score and assesses for consistency. A high attribution score from the TEQ questions should correspond to a "somewhat unlikely" or" very unlikely" to implement response to DAT0. Inconsistent scores are referred to PM review.

Overall attribution scores are also assessed for consistency with the DAT4 verbatim, by bins as described for the QC of the component scores. Inconsistent scores are referred to PM (Ben Jones) review.

Non-Zero attribution scores are also assessed for consistency with the responses to PF8 and PF9. Any non-zero score that also has a response of "after making decision" or "after installing" is considered inconsistent and referred to PM (Ben Jones) review.

The overall attribution score will also be compared to DAT6 (the secondary attribution question). In theory, DAT6 should be equal to or greater to the overall attribution score for all measures, but because the question is a scalar 1-10 and the primary attribution is scored by asking about influence on specific aspects of the project inconsistencies are expected. For QC, all instances where the secondary attribution is more than 20% lower than overall primary attribution will trigger a PM review of.

Quality control PM Review

Analysts are instructed to have a low bar ("when in doubt flag for review"), most of the measures flagged for PM review result in no change. For each site that has a measure flagged for PM review, the PM (Ben Jones) will review the full survey, including all measures and responses. The PM may also follow up with the interviewer to better understand the combination of responses. If the PM determines that the flagged score (whether of a component or overall) is not clearly contradicted by the overall story told by the respondent throughout the interview, the PM makes no change. If the flagged score is clearly contradicted (approximately one percent of cases in DNV GL's experience), the PM decides among three options:

1. drop the measure from the sample (for very muddled responses, much more common with CATI than IDI)
2. replace the inconsistent response with a "Don't Know" (effectively using the average if it is clear that there should be some attribution for the component, but unclear how much)
3. adjust the flagged score to more accurately reflect the intent of the respondent (employed in cases where there is overwhelming evidence of intent, for instance the open-ended response says clearly what the score should be)

For all adjusted scores, project sponsor (Tammy Kuiken) approval is required.

An appendix in the FR report will provide information on the QC process including:

1. (anonymized) verbatim responses by attribution bin for each component (DATXa_O) and overall (DAT4)
2. how many scores were adjusted and how
3. cross-tabs of
    a. DAT0 response versus overall attribution bin
    b. DAT6 response versus overall attribution bin
    c. PF8 responses by overall attribution bin
    d. PF9 responses by overall attribution bin

APPENDIX D SPILLOVER METHODOLOGY

The spillover analysis will provide separate estimates of spillover for inside-like, inside-unlike, outside-like, and outside-unlike spillover. Each of the estimates will be generated based on ratio estimation relative to the program measure savings.

Spillover "refers to effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program."[42] As in many jurisdictions, Ontario's Demand-Side Management Guidelines recognize the importance of spillover in determining program benefits, and also require "comprehensive and convincing empirical evidence" to support any program spillover claim.

Key challenges to providing convincing quantified evidence of spillover for a particular customer include:

- Determining that a particular subsequent action was due to the influence of the program
- Confirming that the action was not taken as part of the original or another program, hence already counted by the program
- Quantifying the savings associated with confirmed spillover actions.

DNV GL's proposed approach provides a high level of rigor to address each of these issues.

- We determine program influence using participant surveys that start with the framing used for our free ridership questions. This framing helps ensure more meaningful responses to questions of the influence of the experience with the program in implementing the original measure on subsequent actions. As for the free rider surveys, obtaining the right respondents is also essential to obtaining meaningful responses to these questions.

- We confirm that the actions tentatively identified as spillover were not already counted by another program by cross-checking tracking data bases. Also critical to separation of spillover from program-claimed savings is understanding what savings if any are claimed by the programs for facilitation support such as opportunity identification, feasibility studies, audits, and related continuous improvement program engagement.

- We quantify the savings for confirmed spillover actions by collecting engineering specifications and calculating associated savings. This approach gives more accurate results than asking customers to estimate the magnitude of spillover savings relative to the original measure.

Thus, our participant spillover methodology addresses the following key issues:

- *Locating the right decision-maker* - Large commercial and industrial companies have multiple decision-makers and it is often difficult to find someone who is familiar with both the tracked program-influenced measure and the spillover measure. Employee turnover can also complicate this. Our approaches to ensure appropriate respondents are discussed above.

- *Avoiding double-counting* – Companies that received financial incentives from an energy efficiency program for one measure are likely to seek these incentives for future measures. Hence it is important to get the program's latest tracking data to make sure that a potential participant spillover measure did not receive program support.

[42] Ontario Energy Board *Demand Side Management Guidelines For Natural Gas Utilities*, EB-2008-0346, June 2011, Chapter 7.

- *Estimating program attribution for potential spillover measures* - A common way of assessing participant spillover is to ask how much the participant's experience with the tracked program-influenced measure influenced their decision to implement measures that are candidates for spillover attribution. It is difficult to turn this "fuzzy" assessment of program influence into a more concrete attribution factor necessary for attributing a certain quantity of m^3 from the spillover measure to the program.

- *Estimating the energy savings for the participant spillover measures.* Because spillover measures occurred outside the program, evaluators do not have access to the same information about the size, type, and quantity of the implemented energy-efficient measures that they would find in a program tracking database.

Our approach to these issues is described in more detail below. This approach is based on one we used successfully in Wisconsin C&I programs over many years.

Understanding Energy-Related Standard Practices

The first objective of the survey will be to find out whether the participant's company or organization had installed any energy-efficient equipment or made any energy-efficient changes in operation or maintenance (O&M) procedures after the implementation of the tracked project. But before doing that we will collect some information about the company or organization's energy-related decision-making process. We will ask the participants a series of questions about:

- Who in their company makes decisions about equipment replacement and retrofit projects;
- What information sources are used in making these decisions; and
- Possible barriers to energy efficiency implementation.

This information will be valuable for a number of different reasons. First, it should help program implementers devise strategies for increasing program awareness and mitigating barriers to project implementation, especially for participants who did not identify any subsequent energy-efficient projects after the tracked project. Second, by shedding light on the project decision-making process, it should help the evaluators make better judgments about assigning program attribution to a given project. Finally, it should make the survey appear less peremptory for those who did not report any new energy-efficient projects after the tracked projects, since otherwise their survey would be terminated fairly quickly.

After we collect this information about participant energy practices, we will ask the participants whether their company/organization had installed any energy-efficient projects after the installation of the tracked project. If the participants report no subsequent actions, we will terminate the survey since there is no participant spillover to be measured. If they do identify subsequent projects, then we will collect some basic information about the project including:

- The approximate year of the project;
- The geographic location of the project (e.g. city);
- The types of energy-efficient measures installed or energy-efficient O&M practices implemented; and
- Whether the tracked project and the subsequent project were in the same facility or not (needed for the calculation of inside vs. outside spillover).

Because this information will be collected by CATI program surveyors who do not have an energy background, we will not ask them to try to collect too detailed information about the energy-efficient project.

It just needs to be detailed enough to allow the evaluators to make a reasonable match with any projects in the program tracking data.

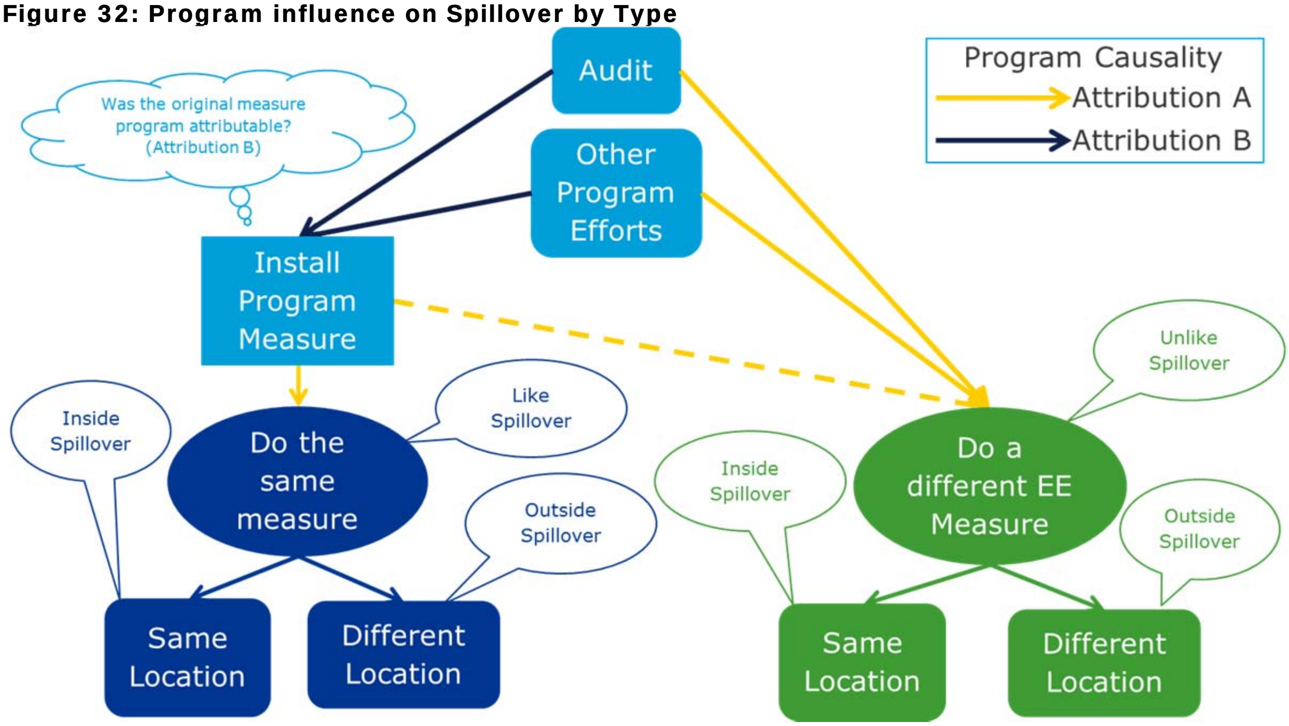
Calculating Program Attribution for Candidate Spillover Actions

The next stage of the survey will focus on program attribution. Our method only awards spillover energy savings if two criteria are met:

1. The potential spillover project is at least partially attributable to the participant's experience with the program in implementing the earlier tracked project (Attribution Factor A).
2. For like spillover, the original tracked project is at least partially attributable to the program (Attribution Factor B). For unlike spillover, Attribution B will apply if the respondent indicates that the original program measure (separate from other program efforts) was a factor in their decision.

Figure 32 shows how program causality ties to different types of spillover. Attribution B applies to like spillover in all cases, while for unlike spillover attribution B applies to the spillover only if the original program measure was part of the program influence that led to the spillover measure being implemented.

Figure 32: Program influence on Spillover by Type



If a measure met these two criteria, we assign it spillover savings according to the following formula.

(Spillover Savings) = (the measure's savings) X (Attribution Factor A) X (Attribution Factor B).

We apply both Attribution Factor A and Attribution Factor B because if the program had no influence on the original tracked project, the program should not get credit for any additional measure installations resulting from that tracked project. To reduce respondent fatigue, Attribution Factor A will be asked in the CATI survey, while Attribution B will only be asked in the Engineering follow up IDI. If Attribution A is zero we will not

To determine attribution factor B we will use the FR question battery already described in this SOW. For Attribution factor A we will use a scoring method that will be triggered off the question, "If you had not made the earlier energy-efficiency improvements I just listed, how likely would you have been to make this additional energy efficiency improvement?" The scoring method, which we used in Wisconsin for many years, is shown in Table 51. If the participant said they were very likely to have made the additional energy efficiency improvement without the program, then we will terminate the survey since there will be no participant spillover to be measured. If the subsequent measure is fully or partially attributable, then for unlike spillover a follow up question will be administered to assess whether Attribution B is applicable.

Table 51: Program Attribution for Subsequent Measures

If had not made tracked program-influenced energy efficiency improvement, reported likelihood of making subsequent energy efficiency improvement		Assigned Attribution Factor A
1	Not likely at all	1.00
2	Not very likely	0.90
3	Somewhat likely	0.55
4	Very likely	0.00

The reason we use a different method for Attribution Factor A than for Attribution Factor B is that the character of influence is different. For the program's influence on the tracked project (Attribution Factor B) financial incentives usually account for much of the influence in terms of reducing payback periods and therefore we want to measure things like acceleration effects. However, with participant spillover the influence is less tangible and more likely to be general positive experience with a new energy-efficient technology and the energy savings it produces. We believe that using a Likert scale question will better capture the less tangible character of this type of influence.

Avoiding Double Counting of Energy Savings

Once a participant has identified a subsequent project that is attributable – e.g. one where Attribution Factor A and Attribution Factor B are both greater than zero -- then we will conduct some additional checks to insure that the subsequent project is not also a tracked project. Some of these checks will occur in the survey itself. For example, we will ask the participants if they recall receiving financial incentives from an energy efficiency program for the subsequent projects. We will also examine the program tracking data to make sure that the subsequent project is not in the tracking program data for future years. For example, if we interview a 2013 participant and they identify a subsequent project in 2014 we will look at the 2014-2015 program tracking data (we will look at both program years in case their memory of the project timing was faulty) to see if we can find that project. If we do find the subsequent project in program tracking data, then we will remove that project as a candidate for spillover energy savings since the savings for that project has already been claimed by the program.

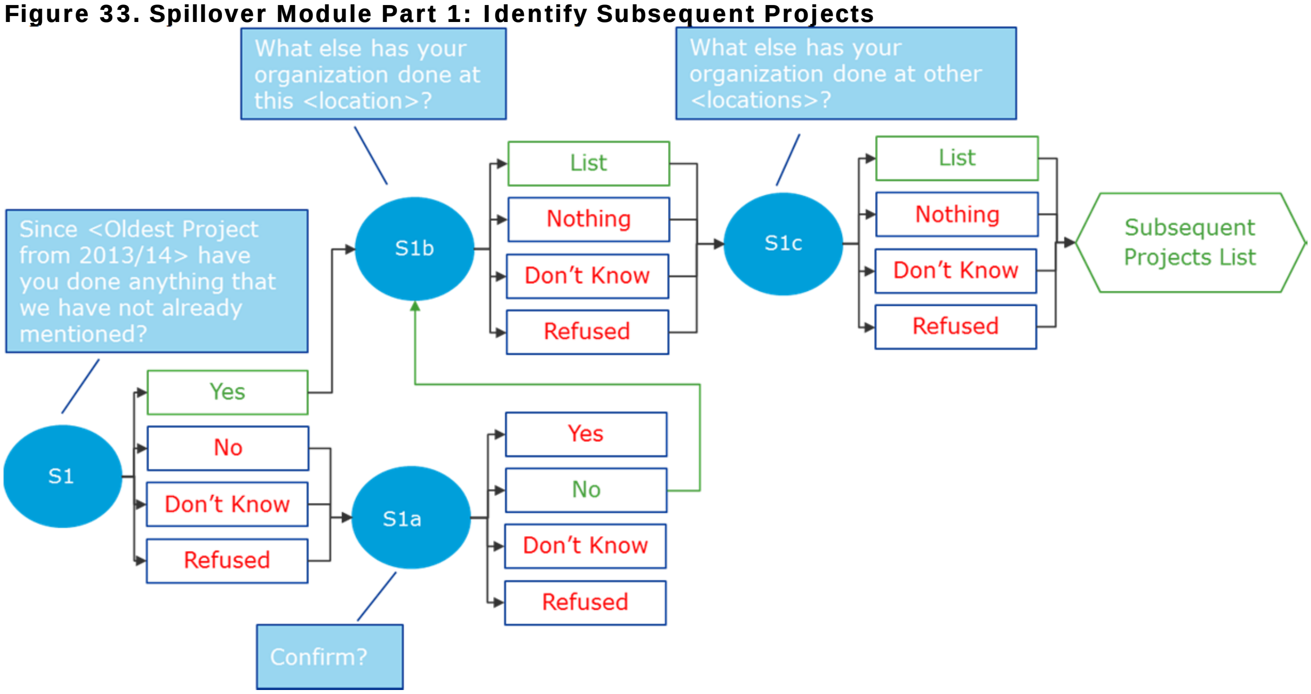
Estimating Energy Savings for Participant Spillover Measures

Once a project has been identified as having spillover energy savings (it is program attributable and we could not locate it in the program tracking data) the final step will be to estimate its energy savings. To estimate the annual energy savings for participant spillover measures, we plan to have engineers conduct follow-up interviews with the persons identified in the CATI surveys as being most familiar with the spillover projects. The engineers will have some basic project information collected from the CATI survey as well as some information about deemed savings algorithms for that measure which will allow them to prepare ahead of time the types of questions they will need to ask (e.g., about baseline measures, hours-of-use, etc.). Once they have conducted the interview and collected the necessary information they will calculate the first year savings and EUL for the measure. If a deemed savings algorithm exists for that measure they will use that as a default. If none exists then they will use their best professional judgment to estimate the energy savings. This process will work equally well for both like and unlike spillover.

Spillover Decision Trees

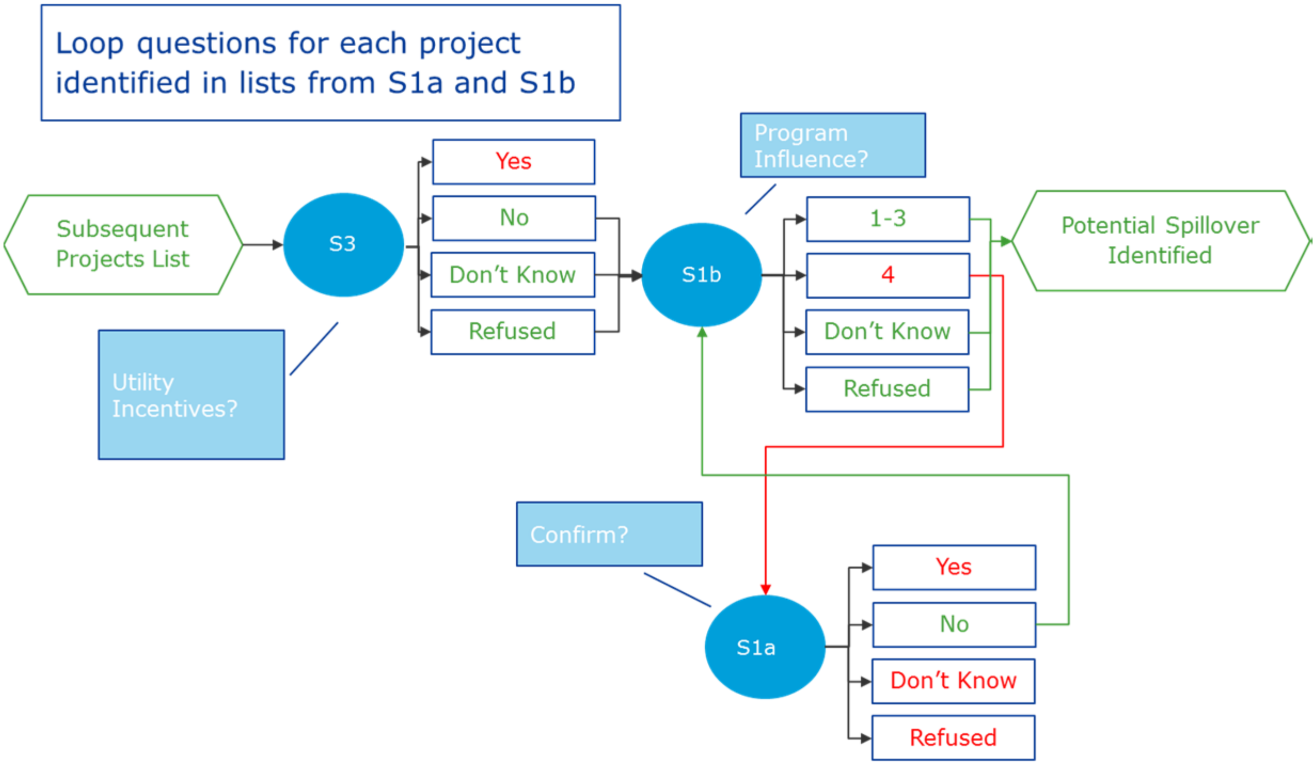
The initial participant IDI and participant CATI each include a spillover module that produces a list of potential spillover projects for each participant. The first part of the module (Figure 33) generates a list of changes to energy using equipment at the same location as the original measure and another list of changes to equipment at other locations.

Figure 33. Spillover Module Part 1: Identify Subsequent Projects



The second part of the module (Figure 34) loops through the list of subsequent projects to eliminate projects that received utility incentives and to establish program influence. The projects identified that were program influenced are referred to as potential spillover and will receive a follow up engineering interview to quantify savings.

Figure 34. Spillover Module Part 2: Subsequent Project loop



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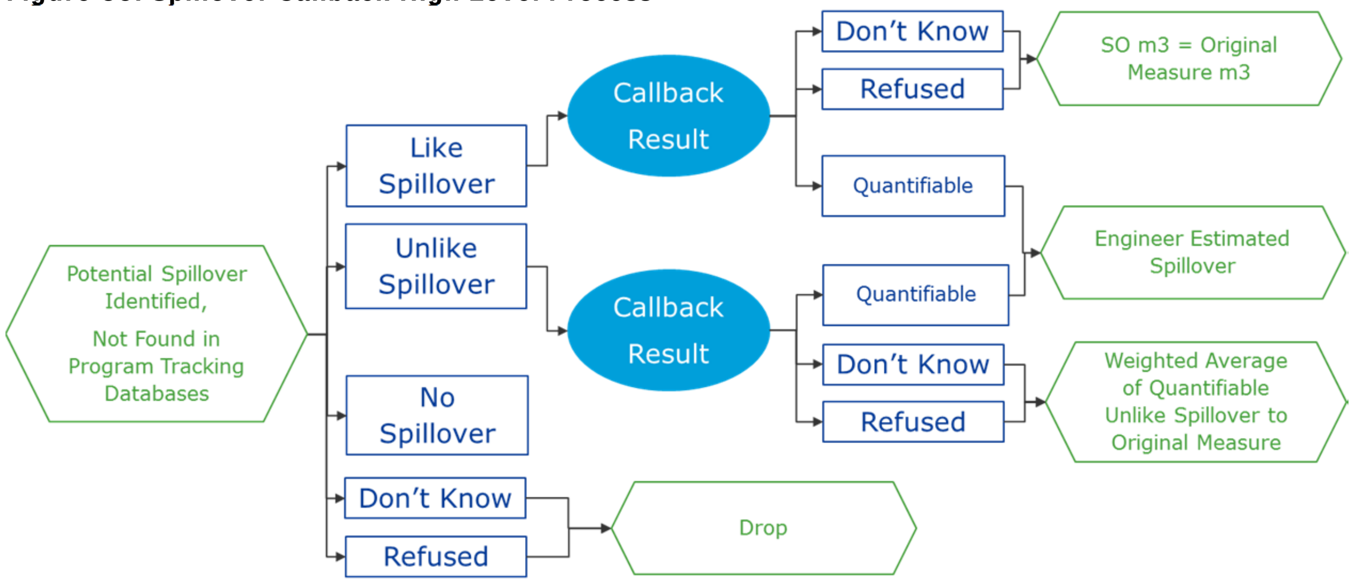
Potential spillover projects that are not found in program tracking databases will receive a call from a DNV GL engineer. If the customer refuses the interview or the evaluation engineer is not able to find a contact who can answer technical questions, the spillover will be quantified in one of two ways (Figure 35). If the project is like spillover we will use the savings of the original program measure as the basis for the savings estimate. If the project is unlike spillover we will use the average of other sites with unlike spillover for the estimate.

Figure 35. Spillover Callback High Level Process



APPENDIX E SAMPLE EXPANSION AND RATIO ESTIMATION

Sample Weights

This appendix describes how we calculate the sample weights for each stratum. In lay terms the weight is simply the number of units in the sample frame (N) divided by the number of completed units in the sample (n). The interpretation of the weight is that each completed sample unit represents N/n units in the population (sample frame).

Notation:

N_x = number of units of analysis in stratum X

n_x = number of completed sample units of analysis in stratum X

The weight W_x is calculated as

$$W_x = N_x / n_x$$

We can understand the weight as meaning the response for one sampled unit in stratum X is representative of W_x units in the population. Table 2 shows a simple example. In the example we completed 2 surveys with participants in the "North" and 10 surveys with participants in the "South." The weight for the "Northerners" is greater than that of the "Southerners," but because we completed more surveys with "Southerners" the combined weight of the "South" will be in proportion to its share of the population (both the population and sum of weights is 20).

Table 2: Example Sample Weights

Stratum Definition	Sample Frame (N)	Sample Completes (n)	Weight (W)	Interpretation
North	10	2	5 = 10/2	Each response represents 5 Northern participants
South	20	10	2 = 20/10	Each response represents 2 Southern participants

Without sample weights, the data collected from the "North" would be 17 percent (2/12) of the final result, while with weights, the "North" is 33 percent (10/30). The un-weighted result would be less accurate than the weighted result if the measured value differs along North/South lines. For example if the "North" is more conservative than the "South" then political surveys without sample weights would end up with inaccurate results. If responding to surveys is negatively correlated with conservatism, then the weights help correct for the systemic bias in response rates.

The sample weight associated with an observation is consistent regardless of the segmentation of the data that we report by (reporting domains). This means that we can segment the data multiple ways in the report, with the final overall results consistent no matter the domain.

Special Cases

There are some special cases where the sample weight for a project needs to be set to 1 in order to use the data collected without biasing the result. Our sample design targets measures within a site and sample weights are developed at that level as well. When we collect data from a customer we will collect data on all of a customer's measures in a single IDI or site visit. This maximizes the data collected on each customer contact, but requires special handling to ensure that extra data collected does not bias the sample. To eliminate the potential bias of over representing multiple measure sites, we first identify units that were completed as an add-on when another measure was selected for a site.

For each stratum in our sample design the units are randomly ordered for selection in a list. If seven units are targeted for the stratum then the first seven units on the list are the primary sample and the rest of the list comprises the full backup sample (when we request project documentation we will restrict the backup sample for the request in order to reduce burden on utility staff). If a site has two measures in different strata and one is selected in the primary sample, we will request documents on both measures and ask about both, regardless of whether the second measure is in the primary or backup sample in its stratum. After collecting data on both measures we will assess whether the second measure was selected in its stratum based on how far down the list we had to go to complete our target. If the second measure's spot on the list was selected, then the measure will be counted as a normal complete and included in the stratum's N/n weight calculation. If the measure's spot on the list did not come up, the data collected for the measure will be used, but the measure will not be included in the N/n weight for its strata. Instead it will be given a weight of 1 so that it represents itself and no other measures. For variance estimates, the measure will remain in its sampled stratum.

Table 52 provides an example. Both site A and Site B were had measures in Stratum X selected in the sample. Each responded to our interview. Both sites also had a measure in Stratum Y. The evaluation completed data collection for both measures for each site. Due to where each of the sites' second measures were on the original priority list in stratum Y, the second measure for each site received different weights despite being in the same stratum.

Table 52: Determining non-randomly selected measures

Strata	Priority	Site	Measure	Survey Disposition	Selection Type	Weight
X	1	**A**	**A1**	**Complete**	**Random**	**3 / 2**
X	2	**B**	**B1**	**Complete**	**Random**	**3 / 2**
X	3	C	C1	live		
Y	1	D	D1	Complete	Random	8/3
Y	2	E	E1	Refused		
Y	3	**A**	**A2**	**Complete**	**Random**	**8 / 3**
Y	4	F	F1	Complete	Random	8/3
Y	5	G	G1	live		
Y	6	**B**	**B2**	**Complete**	**Not Random**	**1 / 1**
Y	7	H	H1	live		
Y	8	I	I1	live		
Y	9	J	J1	live		

The measures in Stratum X each were selected randomly. Measure A1 was first on the priority list and measure B1 was second. Because both A1 and B1 were completed and the target was 2 for the strata, site C was not called. Because site C was not called, measure C1 had a final survey disposition of "live." In the case of stratum X, there were 3 measures and 2 were completed. This resulted in a sample weight of 3/2 for each of the two completed measures.

In stratum Y four measures were completed. In this example the target for the stratum was achieved prior to calling site G. The evaluation attempted data collection for the first 4 measures on the list. Site E refused the survey or otherwise did not respond. Sites D, A, F and G completed the survey, but B did not come up in the priority list until after site G (the first "live" site in the list). In this case measure B2 was not selected randomly and needs to be treated as a special case. Measure B2 is removed from the stratum Y weight calculation, so the three measures that were completed receive a weight of 8/3 (once measure B3 is removed there are eight measures in the frame, and 3 completed measures). Measure B2 receives a weight of 1.

Ratio Estimation

The calculation of the adjustment factors for tracking system gross and net savings uses appropriate case weights corresponding to the sampling rate as discussed above. The energy saving estimates (tracking savings, installed savings, verified savings or net savings) of the sampled units (measures, projects, sites) are present in both the numerator and the denominator of the ratios, when combined with the sample weights the ratio estimation method produces unbiased, savings weighted adjustment factors.

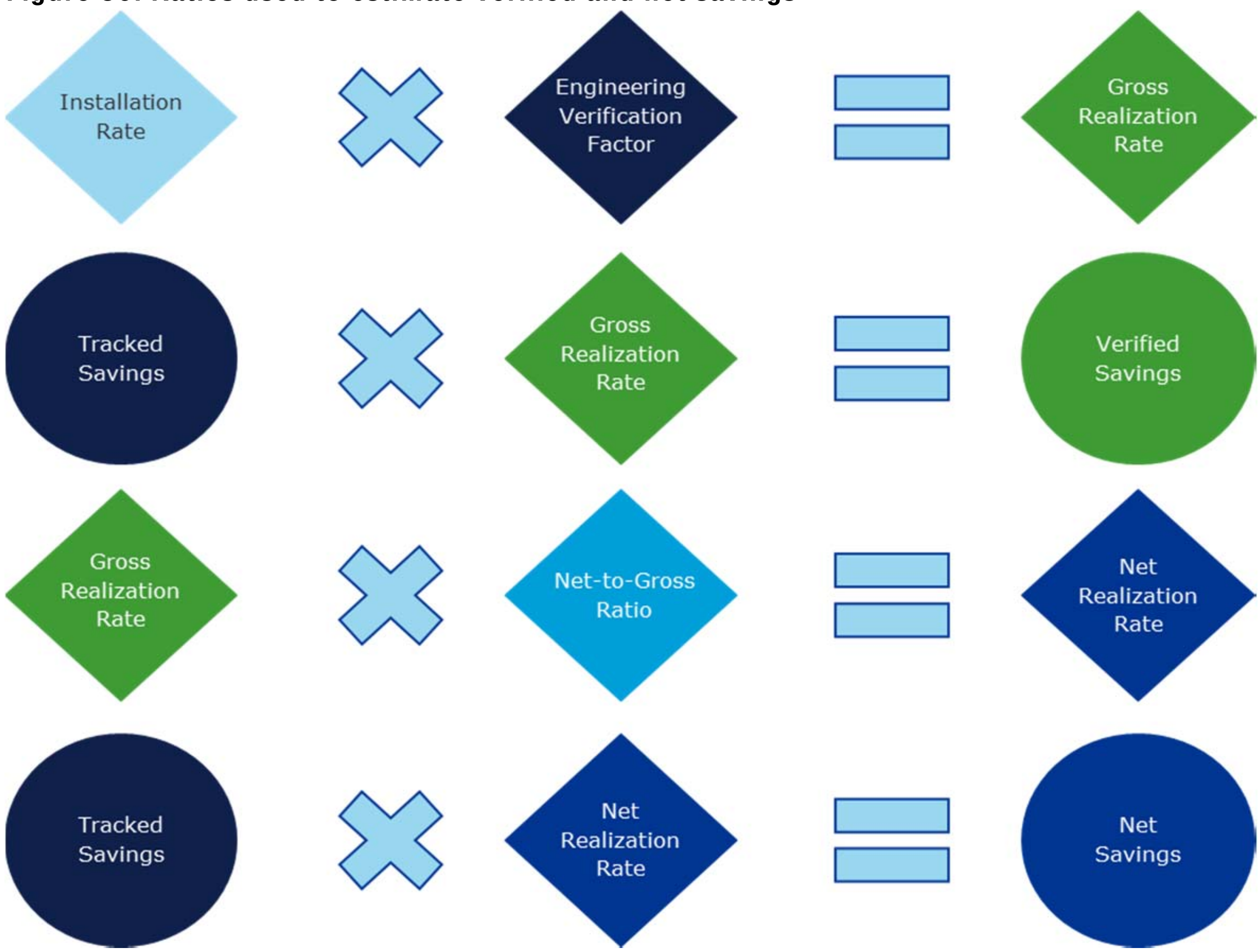
Collecting data on verified and net savings for the same set of measures provides a more accurate estimate of net savings. Integrating the two allows the evaluation to calculate net savings for a measure as a function of verified savings rather than tracking savings. This means that projects carry the weight of their specific verified savings in the net-to-gross ratio rather than tracking savings or a broader estimate of verified savings. Large verification adjustments can have a large effect on the relative weight of specific projects in the NTG.

For an individual measure:

- Installed savings are a function of the tracking savings. When the measure is installed the installed savings equal tracking savings and when the measure is not installed, then installed savings are zero.
- Verified savings are calculated independent of the tracking savings by evaluation engineers using the best available methods and information.
- Net savings are a function of verified savings. Attribution for the measure multiplied times verified savings plus spillover savings associated with the measure.

Individual measure results are expanded to the estimate population savings (circles) using ratios (diamonds), as shown in **Error! Reference source not found.**. Ratios are applied for each of the primary reporting domains and then summed to calculate the total for the program overall.

Figure 36: Ratios used to estimate verified and net savings



Two general ratio calculation approaches are employed: directly calculated and combined. The description of the process is easiest to understand through an example. The example below has three directly calculated adjustment factors: the installation rate, the engineering adjustment, and the net-to-gross factor. Each of these is calculated as a ratio estimator over the sample of interest (Cochran, 1977, p.165). The formulas for these factors are given below.

Notation: The following terms are used in calculating the adjustment factors:

G_{Tj} = tracking estimate of gross savings for measure *j*

G_{Ij} = tracking estimate of gross savings for measure *j*, adjusted for non-installation

G_{Vj} = engineer verified estimate of gross savings for measure *j*,

N_{Vj} = Net verified estimate of gross savings for measure *j*,

W_{Vj} = weighting factor for measure j used to expand the CPSV sample to the full population

W_{Nj} = weighting factor for measure j used to expand the FR sample to the full population

The installation rate R_I is calculated using the CPSV sample as

$$R_I = \frac{\sum_{j\varepsilon A} G_{Ij} w_{Vj}}{\sum_{j\varepsilon A} G_{Tj} w_{Vj}}$$

The Engineering Adjustment R_E is calculated from the CPSV sample as

$$R_E = \frac{\sum_{j\varepsilon V} G_{Ej} w_{Vj}}{\sum_{j\varepsilon V} G_{Ij} w_{Vj}}$$

The Attribution ratio R_A is calculated from the FR sample as[43]

$$R_A = \frac{\sum_{j\varepsilon N} N_{Vj} w_{Nj}}{\sum_{j\varepsilon N} G_{Vj} w_{Nj}}$$

The procedure used for calculating ratio estimation by domains provides the correct standard error of the estimate for each domain and overall. The procedure also takes into account defined clusters of observations (customers) and stratification. The standard error is calculated using two methods.

The first method recognizes the sample as drawn from a finite population: the measures completed within the analysis period with associated energy impacts in the program-tracking database. This calculation uses the Finite Population Correction (FPC) factor. This factor is a reduction to the calculated variance that accounts for the fact that a relatively large fraction of the population of interest has been observed directly and is not subject to uncertainty. It is appropriate to apply precision statistics, such as confidence intervals, based on the standard error calculated in this manner when quantifying the results of the program during the study period only. The FPC factor reduces the calculated sampling error around the estimate more for smaller populations than for large.

The second calculation treats the population of interest as essentially infinite. Thus, the measures completed to date and the sample selected from them is regarded as random instances of a virtually infinite number of measures that could have been completed under the program. In this case, the FPC is not included. It is appropriate to apply standard errors calculated in this manner when applying the verification factors developed from this study to tracked savings from other years to estimate verified savings in those years.

The Gross RR, $R_{V,}$ is calculated by chaining together the installation rate and the calculation adjustment:

$$R_V = R_I R_E = \left[\frac{\sum_{j\varepsilon V} G_{Ij} w_{Vj}}{\sum_{j\varepsilon V} G_{Tj} w_{Vj}}\right]\left[\frac{\sum_{j\varepsilon V} G_{Cj} w_{Vj}}{\sum_{j\varepsilon V} G_{Ij} w_{Vj}}\right]$$

This is an example of a chained ratio estimator using a nested sample. The standard error for the chained ratio is approximated by the formula:

$$SE(AB) \cong AB\sqrt{\left[\left(\frac{SE(A)}{A}\right)^2 + \left(\frac{SE(B)}{B}\right)^2\right]}$$

(This formula overstates the standard error, because it ignores the correlation between the numerator of R_I and the denominator of R_E, which reduces the variance of the product.)

[43] For the net-to-gross ratio, the verified gross savings for measures in the FR only sample (G_{Vj}) were estimated based on the gross RRs found for measures of the same measure type in the CPSV sample.

Likewise, the Net RR, R_N, is calculated by chaining together the gross realization rate and the net-to-gross ratio:

$$R_N = R_V R_A$$

The same standard error approximation formula allows (an over-estimate of) the standard errors of each of the realization rates to be calculated from the two separate standard errors.

Ratio Estimation Example

This section provides an example of the ratio estimation procedure. The results in this section are for explanatory purposes only.

The installed savings, and engineering verified savings, are calculated at the measure level and summed to the Measure Type level for each customer in the sample that completed a survey. Attribution is collected at the measure type level and is a function of the verified measure type savings for the customer. The sample weights are applied to the measure type level savings which is the unit of analysis. Table 53 shows the reported, installed and verified savings and NTG for Example Customer A's four measures reported in the program tracking database.

Table 53: Example Customer A in CPSV and NTG Sample

Measures	Measure Type	Reported m3	Installed m3	Verified m3	NTG
Space Heat Boiler 1	Space Heat	80,000	80,000	100,000	100%
Space Heat Boiler 2	Space Heat	56,000	56,000	55,000	
Process Heat	Process Heat	150,000	150,000	120,000	80%
Steam Trap Repair	Maintenance	12,000	12,000	14,000	20%

DNV GL engineers confirmed the customer installed all of the measures that were reported by the program; therefore installed savings are equal to the reported savings. If a measure was initially reported as not installed, a second DNV GL engineer would contact the customer to verify this result. The engineering review produced adjustments to the installed savings for the first three of Customer A's reported measures, resulting in differences between the verified gross savings and installed savings for those measures.

The attribution rate is calculated for each measure type using the customer and supplier survey, if applicable, for Example Customer A using the methods that will be provided with the survey instruments. The measure type level attribution rates are then applied to the aggregated measure type level verified gross savings to estimate measure level net savings. Example Customer A received 100 percent attribution for the two space heat measures, 80 percent attribution for the process heat measure, and 20 percent attribution for the maintenance measure. Table 54 shows the verified gross and net savings for Example Customer A.

Table 54: Example Customer A Net Savings

Measure Type	Verified m3	NTG	Net m3
Space Heat	155,000	100%	155,000
Process Heat	120,000	80%	96,000
Maintenance	14,000	20%	2,800

Similar estimates are created for each customer in the sample. For this example we assume Example Customers A to F comprise the Industrial Sector sample. Table 55 shows the un-weighted customer and commercial sector savings results.

Table 55: Example Industrial Sector Measure Type Level Sample

Customer	Measure Type	Reported m3	Installed m3	Verified m3	Net m3
A	Space Heat	136,000	136,000	155,000	155,000
A	Process Heat	150,000	150,000	120,000	96,000
A	Maintenance	12,000	12,000	14,000	2,800
B	Process Heat	250,000	250,000	180,000	180,000
B	Maintenance	20,000	20,000	14,000	0
C	Space Heat	150,000	150,000	140,000	35,000
D	Process Heat	80,000	80,000	81,000	81,000
E	Space Heat	70,000	70,000	70,000	0
F	Space Heat	14,000	14,000	13,000	0

Each customer in the sample frame is assigned to a sampling stratum as described in the sampling plan. Each customer in the sample is assigned a sampling weight based on the sample design and the number of completed sample points in each stratum. Assume that Example Customers A and C each have a space heat measure in a stratum that has four measures in the sample frame. The sampling weight for the space heat measures for Customers A and C is equal to the number of customers in the sample frame stratum divided by the number of stratum customers in the sample, or 4/2 = 2. The weighted savings for each customer is equal to the weight times the savings value. Table 4 shows the weights and savings (un-weighted and weighted) for each customer in the Example Industrial Sector if we assume the measure type weights shown.

Table 56: Example Industrial Sector Measure Type Level Weighted Savings

			Reported m3		Installed m3		Verified m3		Net m3	
Customer	Measure Type	Weight	unweighted	weighted	unweighted	weighted	unweighted	weighted	unweighted	weighted
A	Space Heat	2	136,000	272,000	136,000	272,000	155,000	310,000	155,000	310,000
A	Process Heat	3.5	150,000	525,000	150,000	525,000	120,000	420,000	96,000	336,000
A	Maintenance	20	12,000	240,000	12,000	240,000	14,000	280,000	2,800	56,000
B	Process Heat	1	250,000	250,000	250,000	250,000	180,000	180,000	180,000	180,000
B	Maintenance	18	20,000	360,000	20,000	360,000	14,000	252,000	0	0
C	Space Heat	2	150,000	300,000	150,000	300,000	140,000	280,000	35,000	70,000
D	Process Heat	3.5	80,000	280,000	80,000	280,000	81,000	283,500	81,000	283,500
E	Space Heat	15	70,000	1,050,000	70,000	1,050,000	70,000	1,050,000	0	0
F	Space Heat	25	14,000	350,000	14,000	350,000	13,000	325,000	0	0

The next step is to determine program overall adjustment factors. For kWh the Industrial Sector the installation rate, engineering verification factor, and attribution adjustment factor are:

3,627,000 weighted installed m^3 / 3,627,000 weighted reported m^3 = 100% installation rate

3,380,500 weighted verified gross m^3 / 3,627,000 weighted installed m^3= 93.2% eng. verification factor

1,235,500 weighted net m^3 / 3,380,500 weighted verified gross m^3 = 36.5% attribution adjustment.

The verified gross RR is the product of the installation rate and the engineering verification factor, or 100 percent times 93.2percent = 93.2 percent for this example. The net RR is the product of the verified gross RR and the attribution adjustment, or 93.2 percent times 36.5 percent = 36.5 percent for this example.

The same principle can be applied to each Measure Type to get the Measure Type level adjustment factors. With the unit of analysis remaining the same (at the measure type level), the same process can be used to produce adjustment factors for any domain that we are able to define for the whole sample.

Applying Ratios to Domains

Ration application refers to multiplying the gross RR and net RR times the program tracking savings to produce the total verified and net savings results for a program.

The general formula for total verified gross savings is:

The general formula for total net savings is:

The body of the report discusses how to calculate the population adjustment factors, which are based on a finite, fixed distribution of projects. You can also calculate for subsets, called domains. Viewing domain-level results allows for insights into program performance that can lead to program improvements. Domain-level ratios can also be used to apply ratios and calculate overall program savings totals. The ratio results will be generated for each of the domains of interest (subsets of the population that stakeholders agree are important) and overall for each of the utilities' programs.

The level at which one applies the ratios has an effect on the overall verified and net savings estimate for each program. There are two basic approaches that we take. The first is to apply the overall program ratio. This is appropriate to retrospective evaluation where the population that the applied ratio is the same as the population of study and is static.

The second is to apply the ratio at the domain level. This is appropriate for all uses and recommended for estimating savings for programs or program years that are not the same as the population of study. Another approach is to apply the ratio at the stratum level. This is really a subset of the domain application approach where the domain used is the sample strata.

We recommend applying ratios by domains in most cases in order to improve accuracy. Assuming a sufficient sample size in each domain, domain-level precisions are usually sufficient for the approach. While

90/10 relative precision is typically the threshold targeted for an overall result, precisions usually have lower threshold for domain-level application as the resulting precision of the overall result will be better than the component parts.

If one domain has an extreme adjustment, the accuracy of the overall result is improved if domain level ratios are applied to the domain level savings. Table 57 shows an example where we apply the gross RR and net RR directly and by domains. The sample weighted savings in the example closely match the population savings: one domain, process heat, is 3.2 percent different, while the other domains are each within 3 percent and overall the difference is less than 1 percent. The ratios and resulting savings are also similar, within one percent of one another. Though the results in the example are similar, the final net savings are more accurate when calculated by domains. In the example, both space heat and maintenance measures had very different attributions from process heat and each were slightly over-represented in the weighted sample savings, which resulted in lower net savings when we applied the overall ratio directly.

Table 57: Example of Ratios Applied Overall vs. by Domains

	A	B	C	D		
Measure Type	Population m3	Sample Weighted m3	Gross RR	Net RR	Verified Gross Savings (A*C)	Net Savings (A*D)
Space Heat	1,950,000	1,972,000	99.6%	19.3%	1,943,078	375,761
Process Heat	1,090,000	1,055,000	83.7%	75.8%	912,810	826,024
Maintenance	585,000	600,000	88.7%	9.3%	518,700	54,600
Overall - Ratios Applied Directly	3,625,000	3,627,000	93.2%	34.1%	3,378,636	1,234,819
Overall - Ratios Applied by Domains and Summed	3,625,000		93.1%	34.7%	3,374,589	1,256,384
Difference			0.1%	-0.6%	4,047	-21,566

Neither applying the overall ratio directly nor by domains has an inherent systemic bias, but when the differences among the domain ratios are significant, applying by domains results in improved accuracy.

The choice between how to apply the ratios does not affect whether or which domains are reported. There is a large inherent value in looking at program results by multiple domains in order to better understand where the program is doing well and what areas have room for improvement.

Criteria for selecting domains for reporting and application

DNV GL will select the domains that are reported and those that will be applied to estimate gross and net savings for the programs.

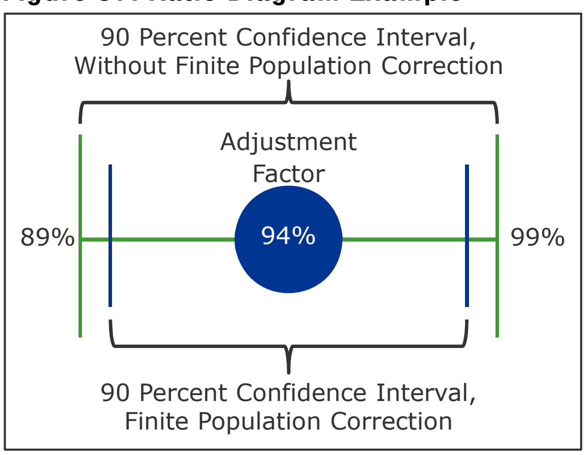
Table 58: Relevant statistics.

Term	Definition
Ratio/Adjustment factor	A point estimate of the evaluation findings expressed as a percent.
+/- or Absolute Precision	If the evaluation were repeated several times selecting samples from the same population, 90%[44] of the time the ratio would be within this range of the ratio
Confidence interval	The upper bound is defined by the ratio plus the absolute precision. the lower bound is defined by the ratio minus the absolute precision.
Relative Precision	The relative precision is calculated as the absolute precision divided by the ratio itself. By convention, relative precisions are the statistic that are targeted in sampling (ie. 90/10 is a relative precision metric)
Finite population correction (FPC)	FPC is a factor that reduces the measured error of samples drawn from small populations (less than 300). FPC applies when the ratio is applied to the same population from which the sample was drawn.

Figure 37 shows an example:

- the adjustment factor (ratio) as a blue point
- the 90 percent confidence interval *with finite population correction* (blue)
- the 90 percent confidence interval *without finite population correction* (green)

Figure 37: Ratio Diagram Example



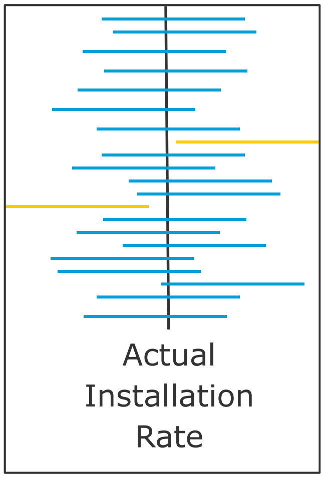
The plus/minus (±) error (%) indicated at the 90 percent confidence interval is the absolute difference between the estimated percentage and the upper or lower confidence bound. For example, in Figure 37, the ratio is 94 percent and the non-FPC 90 percent confidence interval is ± 5 percentage points (i.e., 94 percent ± 5 percent).[45] Another way of saying this is that there is a 90 percent probability that the actual ratio for

[44] 90% is the confidence limit that we are using.

[45] The critical value for calculating the confidence interval ± for each adjustment factor is determined using Student's t-distribution and n-1 for the degrees of freedom, where n is the sample size. The critical value for the gross savings adjustment factor is determined using the degrees of freedom based on the minimum sample size for the components of the adjustment factor. The gross savings adjustment factor is a product of

the next year's program lies between 89 and 99 percent. Figure 38 demonstrates this concept by showing twenty hypothetical confidence intervals calculated from twenty different samples of the same population. Eighteen out of twenty (90 percent) include the true population ratio

Figure 38. Ninety Percent Confidence Interval



Note: Each horizontal line represents a confidence interval. Yellow confidence intervals do not include the actual ratio.

The relative precision of the ratio is calculated as 5%/94% =5.3%.

For low ratios, relative precisions may be quite high, even when the confidence interval around the ratio is quite narrow. Consider a ratio of 40% with the same 5% absolute precision as in the above example. While the absolute precisions are the same, the latter ratio (40%) has a relative precision of 5%/40% =12.5%.

Because relative precisions can over-represent error for low ratios (and under-represent errors for ratios above 100%), we prefer to set thresholds for reporting and application based on the absolute precision rather than the relative precision.

For determining which ratios to report and apply we will use the following rules:

- The minimum sample size for a reporting or application domain will be five.
- The absolute precision threshold for reporting ratio for a domain will be +/- 20% at 90% confidence with FPC-on.
- The absolute precision threshold for applying ratio for a domain will be +/- 15% at 90% confidence with FPC-on for retrospective application.
- The absolute precision threshold for applying ratio for a domain will be +/- 20% at 90% confidence with FPC-off for prospective application.

the installation rate and the engineering verification factor. For 2-tailed estimates (ratios that could be above or below 100%) the appropriate t-stat used to calculate precision from the standard error is close to 1.645.

Reporting domains will be defined as combinations of the following categorizations where sample sizes and precisions allow:

- Stratification segments
- NTG Category (for FR and SO)
- CPSV Category (for Gross results)
- Measure types (shown in Figure 4)

Table 59 and Table 61 present the maximum number of reporting domains for the NTG results and Table 62 and Table 63 present the maximum number of reporting domains for the CPSV results.

There will be cases where some of the groups defined by a categorization have sufficient precision, while others do not. In these cases, we will combine the groups that do not meet reporting thresholds into an "other" group. For example, we may have sufficient precision to report separate ratios for Enbridge Commercial Controls, Heat Recovery and HVAC, but not enough to report the ratios for the other six measure types. In this case, we will report the three groups that we have sufficient precision for and group the rest into a "Balance of commercial/Other" group. Table 60 provides an example of how the Enbridge NTG domains presented in Table 59 could potentially be collapsed during ratio estimation.

No results will be reported that blend Union and Enbridge samples. Large Volume and RunitRight will also not be combined with other programs segments due to their different designs.

For application of CPSV results our initial list of application domains will be within stratification segment with separate domains for each CPSV category and measure type (as shown in the tables below). Those domains that meet the pre-defined precision and sample size criteria, described above, will have results applied at this level. For the rest of the list we will combine domains in the most logical manner appropriate to the ratio in order to achieve combinations that meet criteria and where possible are a meaningful grouping of measures. For example, we will combine CPSV categories within measure types and combine measure types within CPSV categories as is most reasonable given the estimation approaches used (ie if there is little difference in simple vs complex measures in the calculation method for building shell measures we would combine the simple and complex building shell first rather than simple building shell into a "simple-other" domain).

For application of NTG results the same process will be used as for CPSV, but with the NTG category substituting for the CPSV category.

Table 59. Enbridge NTG Domains

Utility	Program	NTG Category	Measure Type
Enbridge	Commercial	Action	Operational Improvements
Enbridge	Commercial	Equipment	Building Shell
Enbridge	Commercial	Equipment	Controls
Enbridge	Commercial	Equipment	HVAC
Enbridge	Commercial	Equipment	Heat Recovery
Enbridge	Commercial	Equipment	Steam and Hot Water
Enbridge	Industrial	Action	Operational Improvements
Enbridge	Industrial	Equipment	Building Shell
Enbridge	Industrial	Equipment	Controls
Enbridge	Industrial	Equipment	Greenhouse
Enbridge	Industrial	Equipment	HVAC
Enbridge	Industrial	Equipment	Heat Recovery
Enbridge	Industrial	Equipment	Other Equipment
Enbridge	Industrial	Equipment	Process Heat
Enbridge	Industrial	Equipment	Steam and Hot Water
Enbridge	Multi-Residential	All	Controls
Enbridge	Multi-Residential	All	HVAC
Enbridge	Multi-Residential	All	Heat Recovery
Enbridge	Multi-Residential	All	Operational Improvements
Enbridge	Multi-Residential	All	Steam and Hot Water
Enbridge	RunitRight	Action	RunitRight

Table 60. Example of Potential Enbridge NTG Domain Collapsing

Utility	Program	NTG Category	Measure Type
Enbridge	Commercial & Multi-Residential	Equipment	Controls
Enbridge	Commercial & Multi-Residential	Equipment	HVAC
Enbridge	Commercial & Multi-Residential	Equipment	Steam and Hot Water
Enbridge	Commercial	Equipment	Other Commercial Equipment
Enbridge	Industrial	Action	Operational Improvements
Enbridge	Industrial	Equipment	Controls
Enbridge	Industrial	Equipment	Heat Recovery
Enbridge	Industrial	Equipment	Other Industrial Equipment
Enbridge	Multi-Residential	All	Multi-Residential Other
Enbridge	RunitRight	Action	RunitRight

Table 61. Union NTG Domains

Utility	Program	NTG Category	Measure Type
Union	Commercial	Action	Controls
Union	Commercial	Action	Maintenance
Union	Commercial	Action	Optimization
Union	Commercial	Action	Steam and Hot Water
Union	Commercial	Equipment	Building Shell
Union	Commercial	Equipment	Controls
Union	Commercial	Equipment	HVAC
Union	Commercial	Equipment	Heat Recovery
Union	Commercial	Equipment	New Construction
Union	Commercial	Equipment	Other Equipment
Union	Commercial	Equipment	Steam and Hot Water
Union	Industrial	Action	Controls
Union	Industrial	Action	HVAC
Union	Industrial	Action	Maintenance
Union	Industrial	Action	Optimization
Union	Industrial	Action	Steam and Hot Water
Union	Industrial	Equipment	Ag and Greenhouse
Union	Industrial	Equipment	Building Shell
Union	Industrial	Equipment	Controls
Union	Industrial	Equipment	HVAC
Union	Industrial	Equipment	Heat Recovery
Union	Industrial	Equipment	Other Equipment
Union	Industrial	Equipment	Process Heat
Union	Industrial	Equipment	Steam and Hot Water
Union	Large Volume	Action	HVAC
Union	Large Volume	Action	Heat Recovery
Union	Large Volume	Action	Maintenance
Union	Large Volume	Action	Optimization
Union	Large Volume	Action	Other Equipment
Union	Large Volume	Equipment	Ag and Greenhouse
Union	Large Volume	Equipment	Building Shell
Union	Large Volume	Equipment	Controls
Union	Large Volume	Equipment	HVAC
Union	Large Volume	Equipment	Heat Recovery
Union	Large Volume	Equipment	New Construction
Union	Large Volume	Equipment	Other Equipment
Union	Large Volume	Equipment	Steam and Hot Water
Union	Multi-Family	All	Controls
Union	Multi-Family	All	New Construction
Union	Multi-Family	All	Steam and Hot Water

Table 62. Enbridge CPSV Domains

Utility	Program	CPSV Category	Measure Type
Enbridge	Commercial	Complex	Building Shell
Enbridge	Commercial	Complex	Controls
Enbridge	Commercial	Complex	HVAC
Enbridge	Commercial	Complex	Heat Recovery
Enbridge	Commercial	Complex	Operational Improvements
Enbridge	Commercial	Complex	Steam and Hot Water
Enbridge	Commercial	Simple	Building Shell
Enbridge	Commercial	Simple	Controls
Enbridge	Commercial	Simple	HVAC
Enbridge	Commercial	Simple	Heat Recovery
Enbridge	Commercial	Simple	Operational Improvements
Enbridge	Commercial	Simple	Steam and Hot Water
Enbridge	Industrial	Complex	Building Shell
Enbridge	Industrial	Complex	Controls
Enbridge	Industrial	Complex	Greenhouse
Enbridge	Industrial	Complex	HVAC
Enbridge	Industrial	Complex	Heat Recovery
Enbridge	Industrial	Complex	Operational Improvements
Enbridge	Industrial	Complex	Other Equipment
Enbridge	Industrial	Complex	Steam and Hot Water
Enbridge	Industrial	Simple	Building Shell
Enbridge	Industrial	Simple	Greenhouse
Enbridge	Industrial	Simple	HVAC
Enbridge	Industrial	Simple	Heat Recovery
Enbridge	Industrial	Simple	Operational Improvements
Enbridge	Industrial	Simple	Other Equipment
Enbridge	Industrial	Simple	Process Heat
Enbridge	Industrial	Simple	Steam and Hot Water
Enbridge	Multi-Residential	Complex	Controls
Enbridge	Multi-Residential	Complex	HVAC
Enbridge	Multi-Residential	Complex	Heat Recovery
Enbridge	Multi-Residential	Complex	Steam and Hot Water
Enbridge	Multi-Residential	Simple	Controls
Enbridge	Multi-Residential	Simple	HVAC
Enbridge	Multi-Residential	Simple	Heat Recovery
Enbridge	Multi-Residential	Simple	Operational Improvements
Enbridge	Multi-Residential	Simple	Steam and Hot Water

Table 63. Union CPSV Domains

Utility	Program	CPSV Category	Measure Type
Union	Commercial	Complex	Building Shell
Union	Commercial	Complex	Controls
Union	Commercial	Complex	HVAC
Union	Commercial	Complex	Heat Recovery
Union	Commercial	Complex	Maintenance
Union	Commercial	Complex	New Construction
Union	Commercial	Complex	Optimization
Union	Commercial	Complex	Other Equipment
Union	Commercial	Complex	Steam and Hot Water
Union	Commercial	Simple	Building Shell
Union	Commercial	Simple	Controls
Union	Commercial	Simple	HVAC
Union	Commercial	Simple	Heat Recovery
Union	Commercial	Simple	Maintenance
Union	Commercial	Simple	Optimization
Union	Commercial	Simple	Other Equipment
Union	Commercial	Simple	Steam and Hot Water
Union	Industrial	Complex	Ag and Greenhouse
Union	Industrial	Complex	Building Shell
Union	Industrial	Complex	Controls
Union	Industrial	Complex	HVAC
Union	Industrial	Complex	Heat Recovery
Union	Industrial	Complex	Maintenance
Union	Industrial	Complex	Optimization
Union	Industrial	Complex	Other Equipment
Union	Industrial	Complex	Process Heat
Union	Industrial	Complex	Steam and Hot Water
Union	Industrial	Simple	Ag and Greenhouse
Union	Industrial	Simple	Building Shell
Union	Industrial	Simple	Controls
Union	Industrial	Simple	HVAC
Union	Industrial	Simple	Heat Recovery
Union	Industrial	Simple	Maintenance
Union	Industrial	Simple	Optimization
Union	Industrial	Simple	Process Heat
Union	Industrial	Simple	Steam and Hot Water
Union	Large Volume	Complex	Ag and Greenhouse
Union	Large Volume	Complex	Building Shell
Union	Large Volume	Complex	Controls
Union	Large Volume	Complex	HVAC
Union	Large Volume	Complex	Heat Recovery
Union	Large Volume	Complex	Maintenance
Union	Large Volume	Complex	New Construction
Union	Large Volume	Complex	Optimization
Union	Large Volume	Complex	Other Equipment
Union	Large Volume	Complex	Steam and Hot Water
Union	Multi-family	Complex	Controls
Union	Multi-family	Complex	Heat Recovery
Union	Multi-family	Complex	New Construction
Union	Multi-family	Complex	Other Equipment
Union	Multi-family	Simple	Building Shell
Union	Multi-family	Simple	Controls
Union	Multi-family	Simple	HVAC
Union	Multi-family	Simple	Steam and Hot Water

APPENDIX F DATA COLLECTION INSTRUMENT OUTLINES

This appendix provides outlines of the topics to be included in each of the data collection instruments.

Program Energy Advisors

The outline for the initial Program Energy Advisor interview is presented below:

- **Introduction**
- **General Interactions**
  - Their typical responsibilities
  - The nature of their routine communications and interactions with Custom C&I customers and how this might vary with the size of the customer or the customer type (e.g. chain stores)
- **DSM Program Promotion**
  - How they target program recruitment at Custom C&I customers of certain types or in certain areas
  - Nature of program recruitment; communication type by customer size and rate class
  - How they become aware of potential energy efficiency projects
  - How they promote energy efficiency
  - How they identify which customer representatives are the key project decision makers
  - Which customer representatives are the key project decision makers and how this might vary depending on company/organization size or type
  - At what stage in project development they typically get involved with a project
  - How many projects are typically rejected
  - What are the barriers to program participation and how they try to mitigate them
  - What information, financial incentives or technical assistance they offer to Custom C&I customers for energy efficiency projects
  - What they perceive to be their most valuable contributions to the development of energy efficiency projects
  - How frequently they rely on program technical support staff for project support
  - How closely they monitor the progress of active projects
    - If there is any evidence of project cancellations due to free ridership
  - Whether they have received any training or guidance on how to minimize free ridership
  - Whether there are any warning signs that a project might be a free rider
  - What roles vendors play in project identification
    - How Energy Advisors interact with vendors
    - How vendors work to mitigate free ridership
- **Closing**

Participating Customers

The outline for our Participant IDI is presented below, with details to be provided in the survey instruments and methods memos.

OUTLINE:

- **Introduction**
- **Informed Respondent**
  - Cite specific project, determine involvement

- Program awareness
- Equipment choice
- Role
- Responsibilities
- Ask about how long at company (since before the project date?)
- Identify names of other primary project contacts, for potential follow up conversation with DNV GL engineer

- **Organization Policies and Purchase Procedures**
- **General Program Awareness and Interactions**
- **Custom Program Savings Verification**
  - Specific questions determined based on engineer review of project documentation
- **Specific project verification (Framing)**
  - When first considered?
  - Reasons for project?
  - Major sources of info?
  - The general decision-making concerning energy related purchases and practices
  - Who in their company or organization makes decisions about equipment replacement and retrofit projects and how this might vary with the size or cost of the project
  - What information sources are used in making these decisions
  - Whether the company/organization has any formal requirements or informal guidelines about the purchasing of energy using equipment and, if so, what are these requirements/guidelines
  - Whether their company has a corporate "green " mandate
  - The development of the specific program-incentivized project
  - Where the idea for the project originated and who were the key persons involved in the project conception -- whether within the participant's company/organization or without (e.g., vendors, Custom C&I program Energy Solutions Consultants)
  - Who was involved in the planning and development of the project details
  - Who was involved in the decision to go ahead with the project
  - At what stage in this project conception, planning and development process did the Custom C&I program get involved
  - Whether the program provided any services to the respondent's company/organization beyond the financial incentives (e.g., training, audits, technical assistance, helping find a vendor, selling the project to upper management, etc.). To inform the free ridership questions, the interviewers will have information on all program activities reported by the tracking databases, but this query is designed to collect information on program activities that may be unreported and also to find out which program activities were top-of-mind for the respondent.
  - Whether the project changed from its original conception and what these changes were and why they were made

- **Direct attribution battery**
  - Determining the overall influence of the program, along with program effects on
    - Timing

        - Efficiency
        - Sizing or Quantity
    - Long term program effect (secondary attribution)
- **Spillover battery (for customers in both FR and Spillover samples)**
    - Inquire about additional projects *after* other projects[46]
        - First check to ensure not incentivized
        - Project type
        - Project data
        - Project contact
        - Project location
        - Project dates

- **Firmographics**
    - Business type and
    - Business size (ft2 and # of employees)
    - whether they lease or own their facilities

- **Closing**

Participating Vendors

IDIs with up to 80 of these vendors will follow the following outline:

- **Introduction**
- **Informed Respondent**
- **Company background**
    - Which products or services they sell
    - Which types of C&I customers they typically do business with
    - What the size of their company is

- **Sales and marketing**
    - How they promote energy efficiency
    - How they identify which customer representatives are the key project decision makers
    - Which customer representatives are the key project decision makers and how this might vary depending on company/organization size or type
    - What role the Custom C&I program incentives play in their sales pitches

- **General program involvement and influence (General Framing)**
    - How they became involved with the Custom C&I program

[46] Information collected regarding additional projects will be used not only to calculate spillover, but to check against program records and ensure that the project was not a tracked project with direct attribution.

- Why they became involved with the program
- How frequently they offer program incentives
- How frequently they interact with program staff
- How they keep track of Custom C&I program incentives and requirements
- Whether the Custom C&I programs have provided them with any sales leads
- Whether they have received any training from the program
- Whether there are other services that the program provide them
- To what degree the Custom C&I program incentives and other services influence the implementation of energy efficiency projects in the C&I sector
- What types of C&I customers are more likely to be influenced by program incentives and which types are less likely to be influenced
- Whether they are offering energy efficient products or services through the program that they did not offer before becoming involved with the program
- Whether they are recommending energy efficient products or services more frequently now than they did before becoming involved with the program
- Whether they have suggestions as to what kind of interventions would increase the program's influence in the project

- **Project Specific Framing**
  - Whether they were involved in originating the project idea and, if so, what was their role (informed respondent)
  - Whether they were involved in planning and the development of the project details, and if so, what was their role
  - Whether they were involved in the decision to go ahead with the project, and if so, what was their role
  - At what stage in this project conception, planning and development process they got involved
- **Project Specific Attribution**
  - Whether the availability of the Custom C&I program financial incentives or other Custom C&I program services (e.g., training, audits, technical assistance, helping find a vendor, selling the project to upper management, etc.) that the participant received had any influence on
    - timing or
    - efficiency
    - quantity/size of the project

    and if so, what was the nature of this influence.
- **Closing**

APPENDIX G CPSV SITE REPORT TEMPLATES

The embedded documents below are the draft templates for CPSV that will be used for the TSER and Onsites respectively.

CPSV Onsite Site Report Template - OE

CPSV TSER Site Report Template - OE

APPENDIX H CPSV RIGOUR LEVELS

The CPSV plan calls for two types of data collection: telephone-supported engineering review (TSER) and onsite. There are adjustments that might entail more or less work at each site. Table H details likely engineering effort levels for the standard, increased, and decreased levels. The levels of effort are averages. Some sites may require substantially more effort, while some sites may entail less effort.

Based on the tracking data we have identified the simplest projects as a level of stratification and will used TSER interviews to verify the projects at these sites. The more complex onsite sample will also have varying degrees of effort requirements in order to allow more effort at more complex sites.

Table H: M&V Description for Proposed Engineering Effort Levels

Effort Level	Description
Telephone-supported engineering review (TSER)	Lower rigour projects. Application desk review, telephone interviews, possible revised engineering calculations; primarily for qualitative assessment.
Standard Onsite	Simpler projects. Detailed application review, on-site verification, collection of data on key parameters, revised engineering calculations, billing data analysis, and possible spot measurements.
Higher Rigour Onsite	Small, medium and large scale projects that may or may not require monitoring or metering. Detailed application review, on-site verification, collection of data on key parameters, revised engineering calculations, billing data analysis, and possible spot measurements / short term post monitoring.
Very High Rigour Onsite	Largest and most complex projects. Detailed application review, on-site verification, collection of data on key parameters, billing/interval data analysis, calibrated simulation models, spot measurements, long-term post monitoring, pre-verification and short-term measurement. May require larger teams, including senior staff and multiple site visits.

Most site-specific impact evaluation efforts for Standard Onsite points will fall into the category of lower rigor level of effort. However, there are exceptions and adjustments that might entail more or less work at each site. During the file review adjustments of this sort should be noted and the sites will be reviewed by the engineering team lead (Phani Pagadala) to determine which level of rigour is required. Up to 20 sites (primarily Large Volume) will receive higher rigour onsites and up to two sites will receive very high rigour onsites to establish the relative value of increased rigour levels in future evaluation.

Each site will be assigned a single point of contact (POC) for the purposes of communications with the customer, the utility and within CPSV itself. The POC will be a more senior engineering team member who is experienced in the energy efficiency field (preferably a registered professional engineer) and will be responsible for co-ordinating the work of their team, tracking progress on each project review, becoming intimately familiar with the documentation and technical requirements of the work to be performed, ensuring that quality control procedures are implemented, and reporting on project review progress and any issues to the engineering team lead (Phani Pagadala).

Higher rigour sites could involve the addition of elements such as:

- A fully specified regression analysis of consumption information from utility bills with inclusion/adjustment for changes and background variables over the time period of the analysis that could potentially be correlated with the gross energy savings being measured.
- Twelve (12) months post-retrofit consumption data are required.
- Twelve (12) months pre-retrofit consumption data are required, unless program design does not allow pre-retrofit billing data, such as in new construction. In these cases, well-matched control groups and post-retrofit consumption analysis is allowable.
- Sampling must be adequate (in general, a minimum of six data points will be required) for a valid regression-based estimate.
- Building energy simulation models that are calibrated as described in IPMVP Option D requirements. If appropriate, evaluators may alternatively use an engineering model with calibration.
- Retrofit isolation engineering models as described in IPMVP Option B requirements.

APPENDIX I TEC METHODOLOGY DECISIONS

This appendix contains the discussion history of methodological decisions that were left unresolved following the initial project kickoff meeting in 2014.

Date: June 9, 2015

Memo to:
Bob Wirtshafter, Independent Member
Ted Kesik, Independent Member
Chris Neme, Green Energy Coalition
Jay Shepherd, School Energy Coalition
Julie Girvan, Consumers Council of Canada
Ravi Sigurdson, Enbridge Gas
Marc Hull-Jacquin, Enbridge Gas
Tina Nicholson, Union Gas
Meredith Lamb, Union Gas

Copy:
Mimi Goldberg, DNV GL
Tammy Kuiken, DNV GL

Prep. by: Ben Jones, DNV GL

Ontario Gas NTG Evaluation Kickoff Meeting Items

This memo memorializes the discussions of unresolved parking lot items from the 2014 Ontario Gas Net-to-Gross Evaluation kickoff meeting. It is intended to identify which of the items were resolved, assigned (action items), or discussed, but ultimately re-tabled at the meeting (parking lot items). The initial Parking Lot items, DNV GL and TEC takes are retained for context (in grey).

Parking Lot Items Discussed

Several Items at the kickoff meeting were discussed but ultimately tabled without a resolution. The "DNV GL Take" below has the evaluation team's initial thoughts about how each issue should be addressed, while the TEC Take provides the TEC's consensus prior to the follow up meeting.

1. *How much contact should the evaluation have with program staff regarding specific projects?*
    - The utilities would like the evaluation to meet with program staff to discuss the specifics of all projects, not just the specific large or complicated ones or the ones we deem need additional information.
    - Other TEC members worry that too much contact with the utility reps will lead to a biased evaluation.
    - *DNV GL Take* – For complex projects, understanding the timing and specifics of the program's interactions with the customer provides the evaluation with the ability to tailor questions prior to the core attribution sequence to the specific customer experience. These custom questions will be phrased to remind the customer about the interactions, while being careful not to bias the customer's responses to the core attribution questions.
        - The TEC is not in a position to provide endorsement on this point at this time. Discussion with DNV is required.
    - TEC Take:
        - DNV should determine the extent of contact it requires with utility program staff, in order to be fully informed on the customer's relationship with each utility prior to

conducting the Net to Gross survey, given the complexity of the project and the contents of the project files. DNV will follow up as required with the utilities.
- o Discussion with DNV is required on the highlighted issue above regarding tailoring questions to remind customers about their interactions with the utility.

- June 11 Follow up discussion results (not discussed on July 16):
  - o **TEC Action Item:** TEC to discuss guidelines for framing[47] questions and usage of information from program in probes. Decision required prior to survey instrument development.
  - o Open questions on usage of
    - framing questions to remind customer of decision making process
    - program-supplied information in framing question-related probes
  - o Rationale for questions and scoring to be provided with survey instruments once drafted.
  - o Notes for consideration:
    - Specific questions and probe instructions will be reviewed by TEC prior to fielding interviews. Initial decision for TEC is whether or not the general approach is acceptable.
    - Important to remember that this section of the interview is not part of the scoring algorithm. It is intended to help respondents recall a project and process that may have occurred a few years ago. It is not intended to push the participant into giving more credit to the program than they would if we asked the NTG questions when the decision was fresh in mind. Aiding participant recall through framing questions attempts to remove an aspect of self-report surveys that can potentially bias results against giving programs credit for the decision to install EE equipment.

2. *Can the evaluation determine which portions of the attribution were due to financial incentives, which were other services, etc?*
   - *DNV GL Take* – The proposed attribution approach and the current scope of the evaluation does not allow for proportionally assigning attribution credit to different program influences. Attribution is also not a zero sum game: both technical and financial assistance may be necessary for a project to proceed; the absence of either one could be enough to prevent a customer from going forward. The surveys and interviews will gather qualitative information about the influence of different program activities on projects. The evaluation will report these (anonymized) responses relative to the final attribution scores in order to provide the TEC and programs some feedback in this area.
   - TEC Take:
     - o The TEC would like DNV GL to gather and report on qualitative information about the influence of different program activities on projects to the extent that can be done within the defined project scope and budget.
     - o The related item of the construct of the raw data and whether or not it will be shared requires discussion with DNV.
   - June 11 Follow up discussion results (not discussed on July 16):

[47] Framing questions are those that remind the customer of the decision-making process and are not used in the attribution scoring.

  - TEC Take #1 resolved
  - TEC Take #2 tabled
  - Notes on TEC Take #1 decision:
    - DNV GL to include qualitative discussion in text of participant-reported reasons for results describing NTG and spillover analysis results. Qualitative information will be provided with context such as number of respondents who provided a given reason.
    - Some open-ended responses will be scrubbed and provided in report to add context and support to the results.
- Potential TEC or utility interest in later additional analysis using the data collected
  - Notes on TEC Take #2 discussion:
    - Data must be anonymized before delivery to TEC
    - Decision to be based on usefulness and cost

3. *Do we want to make a concerted effort to talk to self-direct customers who only spent a portion of their incentive money? As opposed to customers who used it all because they lose it otherwise.*
   - *DNV GL Take* – Assuming that data on this topic is available to the evaluation and categorizing customers by proportion of incentive money spent is straightforward, the evaluation could potentially stratify based on this metric, or not stratify based on it but still attempt to report results for each group separately. Stratification by a categorization allows the evaluation to ensure that one group is not over-represented in the final weighted results, given the potential that there are meaningful NTG differences based on this categorization it likely will make sense to stratify by it if possible.
   - TEC Take:
     - The TEC agrees that the sample for Union's self-direct customers should be representative of the entire self-direct program, including both self-direct customers who spent all their allocated funds and those who spent only a portion of them. The TEC will defer to DNV's expert judgment regarding whether stratification based on this variable is appropriate to maximize the accuracy of a NTG for the entire program.
     - DNV should also note that a portion of Union's self-direct funds were not used by customers to which they were initially allocated. Those unused funds were then dispersed via an aggregated pool approach where projects were supported based on their lifetime natural gas savings and cost effectiveness. Again, the TEC will defer to DNV's expertise regarding how to best incorporate NTG impacts from the aggregate pool approach into an NTG for the entire program.
   - June 11 Follow up discussion results: Resolved
     - DNV GL to use expert judgment in making decision
     - Final stratification to be representative
     - The aggregated pool approach may change participant behavior in terms of what measures they do when

4. *The utilities report lifetime savings; should the evaluation use a dual baseline net-to-gross calculation? If so, how will the evaluation determine existing efficiency baseline savings without doing the full verified gross savings calculation process?*
   - *DNV GL Take* – If the program tracks dual baseline savings, the evaluation could use the information in our net-to-gross calculations. Otherwise, we might be able to use another

approach, such as assuming a ratio of the difference in savings from the dual baselines based on another study.

- TEC Take:
    1. The 2008 Summit Blue Free Ridership Study accounted for advancement through the concept of partial free ridership. Thus, the utilities do adjust savings for advancement but do not take a dual baseline approach. The TEC would like to discuss with DNV the alternative approaches.
    2. This item requires discussion with DNV to determine the implications of this for the NTG study. Note that the utilities are about to face a new DSM Framework in 2015. We do not yet know how goals will be set in that framework. It is possible that they will be set differently than the current lifetime savings (CCM) approach. Thus, we would like to know if it would be possible to adjust an NTG result computed for a CCM metric to a TRC metric if such a change was necessitated by a change in the DSM framework? Is DNV able to do a lifetime and annual calculation?
- June 11 Follow up discussion results: Not Resolved
    - **DNV GL Action Item:** DNV GL to provide simplified explanation of the two approaches and the pros and cons of each.
    - **TEC Action Item:** TEC to decide whether to pursue both methods, or select one. Resolution needed prior to starting analysis.
    - Providing both LCNS and Y1NS results is relatively straight forward, however using LCNS for these programs would require a general rather than specific estimation approach for dual baselines, making it less accurate than its original intended design
- July 16 Follow up discussion results: Resolved
    - Study will use Y1NS method with lifetime savings

5. *There is dissention about when influence occurred and what it means for NTG, largely around projects that receive incentives and are free riders in the current program year but were not free riders when they participated the first time in a past program year. How many historical program years should be taken into account by the study in determining NTG?*
    - *DNV GL Take* – This is a crucial question for the evaluation. What type of NTG are we measuring? If the study is intended to capture current program effects then a short time horizon should be used in framing questions for customers and vendors. If the study is intended to show the cumulative effect of the programs over time, then a longer time horizon should be used and past program participation and the effect of that participation on recent within-program projects should be taken into account. The surveys can be designed to capture either type of NTG, but we do not recommend attempting to capture both the current program and cumulative program versions of attribution and spillover at once: this would result in longer, more confusing surveys for customers. This is a critical item to resolve prior to developing survey instruments and interview guides. The decision as to which NTG type to pursue is ultimately a policy decision that may come down to the intent of the Ontario Board of Energy's definition of Net-to-Gross.
    - TEC Take: The TEC is not in agreement on what type of NTG the study is measuring (cumulative program effects vs. current program effects). In the absence of both TEC consensus and direction from the Ontario Energy Board, would it be possible in the current

budget and scope to calculate the NTG both ways capturing both current and cumulative effects? During discussions, the TEC considered the issues of:

- Long life cycle projects versus projects of a repetitive nature;
- The continuous improvement focus of the custom program design;
- Asymmetrical treatment of accounting for utility influence and savings using a short term approach; and
- Projects in which the lifetime claim accounts for all behaviours and years versus those projects that do not.

- June 11 follow up discussion results: Not Resolved
  - **TEC Action Item:** Decide which approach is preferred or whether surveys and interviews should attempt to capture both types of program effects. Decision required prior to survey instrument development.
  - Specific program activities that influenced the project we're looking at in this program year are taken into account no matter when they had influence. This applies primarily to the long life cycle projects.
  - Both types of program effects are important. Capturing both is interesting and also allows flexibility if OEB later decides in favor of one approach over the other.
  - Potentially could capture both types for specific projects or project types where the difference is likely to be greatest (recurring O&M for instance)
  - Deciding on one or the other prior to reporting is important to avoid higher stakes debates once results are known
- July 17 Follow up discussion results: Partially Resolved
  - TEC approves capturing long sales cycle program effects in estimation of free ridership
  - **TEC Action Item:** Continue discussion of how to capture "in program" spillover: projects incentivized in current year that were free riders based on current year program effects, but attributable to prior program participation. Consensus appeared to be that the study should capture these effects as an incremental portion of net savings so that it can be removed if need be. How to label these savings is also unresolved.
- June 9 2015 Subcommittee meeting results: Resolved (pending broader TEC approval)
  - Subcommittee recommends that the primary objective of the free ridership estimation will be to capture the effect of the program(s) on the current project. The effect on the current project of prior and indirect program experience will be captured in a secondary, less rigorous question sequence. The work plan will propose specifics for operizationalizing this approach.

6. *Should the evaluation do spillover analysis with the large industrial customers in Union Gas' new self-direct program, even though there hasn't been much time for them to complete projects? It would give the TEC something to use going forward, even if it's understated.*
   - *DNV GL Take* – Most of the data collection with this group of customers is likely to be via in depth interviews (rather than CATI surveys), which offers flexibility to inquire qualitatively about spillover potential for the program going forward as well as whether any spillover has already occurred as a result of the 2013 program. Another possible option is to ask these customers about spillover from previous program experiences in 2011 and 2012, and then

ask how the current program design would change the likelihood for future spillover. We recommend leaving this as an open question until the evaluation team learns more about the program and the overlap in customers in the 2011/2012 programs and the 2013 program.

- TEC Take: The TEC agrees to leave this as an open item until DNV has had a chance to learn more about Union's self-direct program. After DNV's review of the program, the TEC will expect a recommendation from DNV on how to perform the spillover analysis on Union's self-direct program.
- June 11 follow up discussion results (not discussed on July 16): Tabled.
  - **DNV GL Action Item**: DNV GL will recommend to the TEC a course of action for estimating spillover for the Union self-direct program once more information has been reviewed.

Net-to-Gross Policies:
Cross-Cutting Jurisdictional Review

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December 14, 2017

TABLE OF CONTENTS

1. INTRODUCTION

This report reviews energy efficiency (EE) policies across different jurisdictions related to the estimation of net-to-gross (NTG) values and their application within an integrated policy framework. The objective is to better understand the NTG landscape and provide information that might inform Ontario policy decision-making related to NTG in evaluation, program planning, use in measuring progress toward savings targets, and in determining shareholder incentives.

Navigant, Inc. and Apex Analytics (Navigant Team) performed two analyses:

1. Case study analyses for three states: Massachusetts, California, and Illinois. These states were selected because, like Ontario, they have a long history of large-scale utility efficiency programs and have addressed many of the same issues regarding NTG policy that Ontario is facing today. In addition, each state has revised its policies in the past few years, resulting in recent experience in assessing NTG issues and their relationship to EE targets and incentives. The team interviewed experts in each state, including evaluators, utilities, and regulators, all experienced professionals directly involved in developing and applying NTG results or developing NTG policy in their respective states.
2. To place these case studies in a larger context, the team conducted an update to a 2015 review of NTG policies across the US.[1] This update uses state energy policy documents and websites, evaluation reports, and prior studies that sought to summarize NTG policies across states in the US.

This report is organized in the following sections:

- Section 2 presents the results from the in-depth analysis of the case study states of Massachusetts, California, and Illinois.
- Section 3 presents the findings from a comprehensive jurisdictional scan of NTG policies and the relationship of those policies to other demand-side management (DSM) requirements.
- Appendix A contains additional detail on the high level, state-by-state review.

[1] This research represents an update to a 2015 Navigant study -- Navigant. *Iowa Energy-Efficiency Net-to-Gross Report*. Prepared for the State of Iowa Department of Commerce Utilities Board. 2015. Link: https://efs.iowa.gov/cs/groups/external/documents/docket/mdax/mjax/~edisp/1201494.pdf

2. CASE STUDIES: MASSACHUSETTS, CALIFORNIA, AND ILLINOIS

This section describes the framework, history, and expert opinions regarding NTG policies, including shareholder incentives, timing of evaluation results, decision-making, NTG methods, and market effects from a closer examination of NTG policies in Massachusetts, California, and Illinois.

2.1 Approach

Massachusetts, California, and Illinois were selected as each has sizeable investments in EE programs, has implemented programs over a long period of time, and has a long history of program evaluation. In addition, each state has recently used stakeholder processes to revise the methods used to estimate NTG and how NTG is applied for incentive calculations and program planning. As a result, each has recently contemplated the pros and cons of different NTG uses and approaches while revising their policies and approaches.

The Navigant team examined state energy policy documents and websites, evaluation reports, and prior studies that sought to summarize the NTG policies in these three states. In addition, experts from each case study state were interviewed to expand the depth of the information and develop a better understanding of how policies were implemented in practice. Respondents included evaluators, utility experts, and regulators, all experienced professionals directly involved in developing and applying NTG results, or developing NTG policy in their respective states. Interviews were conducted in November 2017.

2.2 Summary of Findings

This case study review produced four overarching themes and four cross-cutting findings related to the application of NTG estimation methods. The four overarching themes are presented below:

Theme 1. **Applying NTG estimates for incentive and target calculation.** All three states have shareholder incentives, with California revising existing incentives programs in the past 2 years and Illinois designing an incentives program scheduled to start in 2018. Net savings and NTG are one of the factors used in determining incentives and judging progress toward targets in each state; however, each state has developed structures that reduce the influence of after-the-fact (i.e., retrospective) application of NTG estimates. Massachusetts and Illinois do not apply retrospective NTG estimates for determining shareholder incentives, and California's new incentive structure reduces the effect of retrospective application of NTG estimates by making it only one of four factors that are used to determine incentives and by using retrospective NTG only for select programs.

Theme 2. **Aligning savings estimates with ratepayer value.** Experts interviewed indicated that the policy purpose in using net savings (either prospectively or retroactively) is to align utilities' goals with ratepayer value. In this context, NTG estimates provide information used to inform EE investment decisions and program plans. However, the experts also reported that using net savings puts pressure on the accuracy of NTG evaluation results, specifically when the results are applied retrospectively to assess achievement of savings targets and calculation of utility incentives. Applying NTG estimates prospectively reduces uncertainty for utilities by eliminating the risk of a retroactive application of a different NTG ratio than that assumed in program planning and avoids the controversy and arguments over attribution issues that have occurred in other jurisdictions.

Theme 3. **Finalizing NTG estimates.** The process used to finalize NTG estimates to be used in shareholder calculations, program re-design, and EE targets involved more than taking the result of a study. In all three states, stakeholders had the opportunity to question, challenge, and suggest modifications to the initial estimates produced by an evaluation, management, and verification (EM&V) study. For example, in Massachusetts there is a debate and discussion or results with the goal of gaining a consensus value. If there is no agreement on the value, the regulator's evaluation consultant makes a determination considering issues raised by stakeholders. In addition, there are avenues to appeal this determination in Massachusetts if the decision is viewed as unreasonable by involved parties.

Each of the three states examined has a process by which agreement is sought among stakeholders as part of the process to finalize the NTG estimates. The experts interviewed indicated that these processes were driven by the view that NTG estimation methods all face challenges in application. This was particularly true for the self-report survey method, which is most often used for C&I customer programs, and where judgment is required to develop question batteries and survey protocols and translate survey responses into NTG values.

Theme 4. **Collaborative Overall stakeholder process**. In addition to transparency and review of final NTG estimates, the stakeholder processes in each state were predicated on defined, open stakeholder processes that build confidence in the NTG estimation process. All three case study states have adopted processes that develop agreed-upon approaches for estimating NTG as well as processes for finalizing NTG estimates. Pre-defined methods include agreeing on self-report questions and NTG assignment algorithms, incorporating multiple influence factors (e.g., program, trade ally, and market based), and scoring algorithms tested through sensitivity analyses. These common algorithms allow NTG results to be compared across programs and over time. Stakeholder processes in the case study states were predicated on transparency and discussion to build confidence in the NTG estimation process and final NTG values. Experts in each state report that the prospective application of results, combined with the consistency of the pre-defined methods and transparent stakeholder processes throughout all stages of evaluation, has created more certainty and confidence for stakeholders in terms of the actions needed meet EE targets. Additional benefits of the re-designed processes in these three states includes a more collaborative stakeholder effort and a focus on continuous improvement of programs compared to the processes that states had in prior years.

Four cross-cutting NTG methods findings are shown below:

1. ***Selected NTG methods.*** Each case study state uses methods other than self-report surveys, such as randomized control trials (RCTs) and comparison states, but these are typically used for residential or mass-market commercial products. All experts noted concerns with self-report methods but said that the primary method for custom project NTG is self-report survey methods due to the unique nature of commercial and industrial (C&I) custom projects.
2. ***Mitigating issues with self-report methods.*** Given concerns with self-report methods, experts noted the following approaches are used to improve the accuracy of self-report studies:
    - **Fast feedback:** Fast feedback refers to survey methods where the respondents are asked about factors influencing their participation in a program at a time near to when they participated—e.g., within 3 months of completing participation. Experts noted the value in using fast feedback to gain the most accurate responses for free ridership, but it is not required in any state. A number of Illinois utilities use a parallel path evaluation approach for selected custom projects that allows for real-time NTG. In California, pre-screening of custom projects with respect to an initial NTG value to reduce risks of surprise NTG values when the full impact evaluation is performed. This two-step

approach helps produce a “no surprise” approach that builds confidence in the NTG estimates.

- **Sensitivity analysis:** Sensitivity analysis (with full transparency regarding the scoring) has been used in all three case study states, primarily when the pre-defined batteries are first developed and tested, but the algorithms are also periodically revisited. This can be important as different but reasonable assumptions used in translating question responses into NTG values can result in different NTG values.
- **Triangulation:** The perspective of vendors is collected in all states for custom projects on a project-by-project basis (e.g., if the customer states the trade ally recommendation was important) and can increase the NTG result. Triangulation with vendors/trade ally surveys is also used to address the influence of factors that program participants may not be well positioned to address—e.g., the relative influence of multiple program influences on program impacts. As noted below, multiple experts noted the difficulty of participants understanding attribution of any individual influence on their decision-making, as there are many potential influences in the EE marketplace.
- **Other best practices*:*** Other best practices mentioned by experts include the following: including multiple factors in the NTG scoring (program influence and other non-program influences), ensuring the questions and weighting are fully vetted, consistency checking, and gaining insight into the project story by spending additional time with the participant to understand the project and possibly meeting with implementation staff knowledgeable about the project.

3. ***Previous program influence and other program influence.*** In Massachusetts, the pre-defined algorithm provides for some credit to be given to previous program influence (i.e., credit for influence that builds over time when a program covers multiple years), while the Illinois and California common batteries do not include this as an improvement to NTG. Experts in those states indicate their general agreement with this policy of assuming that previous program influence results in some current year free ridership. Yet, they mentioned that for this to be fair, spillover studies should fully account for this impact. In terms of other fuel programs (i.e., the influence of gas and electric programs), Massachusetts counts this as a program influence factor, and evaluators in California and Illinois may add other programs as a program influence factor. Experts indicated that it is difficult for a program participant to disentangle the influence of multiple programs (e.g., when more than one entity is providing incentives or information to encourage program participation) and recommended best practices to view simultaneous programs as a single offering for free ridership purposes.[2]
4. ***Market effects and spillover.*** In all three states, experts indicated that there is room for improvement in estimating spillover and market effects. Multiple experts noted that, although assessing free ridership is best done soon after the project, the best time for spillover is at a later point in time. Because of this, there are examples of spillover studies being conducted separately from free ridership studies.

2.3 Massachusetts Case Study

In Massachusetts, the program administrators (PAs) oversee EE programs and the evaluations of those programs. The Massachusetts Energy Efficiency Advisory Council (EEAC) was created by the Green

[2] The trade allies in the industry may have a better perspective on how overall program impacts may be influenced by multiple programmatic efforts in a jurisdiction.

Communities Act of 2008 to guide the development of energy efficiency plans by developing, implementing, evaluating, and monitoring the implementation of these plans.[3] The Massachusetts Department of Energy Resources (DOER) is ultimately responsible for EM&V and provides oversight with support from a team of EEAC evaluation consultants that manage stakeholder processes and the overall EM&V effort. The PAs implement programs consistent with 3-year plans, which are established in collaboration with the EEAC and approved by the Massachusetts Department of Public Utilities (DPU).[4]

Massachusetts has shareholder incentives based on net savings and includes free ridership and participant and nonparticipant spillover in its definition of net savings. The EEAC facilitates a collaborative stakeholder process to define NTG factors on a prospective basis, which are agreed upon for each 3-year program cycle; yet, gross evaluation results based on realization rates are applied on a retrospective basis. Massachusetts uses an agreed-upon, pre-defined algorithm for C&I NTG surveys[5] and uses methods such as sensitivity analysis, triangulation, and a bonus for prior program participation. Table 1 displays basic information about Massachusetts NTG policies.

Table 1. Massachusetts NTG Policies

Structural Components	Massachusetts
Shareholder incentives	Savings and net benefits
Definition of net savings	Includes free ridership, participant spillover, nonparticipant spillover
Application of NTG results	Prospective, including savings claims and target setting
Application of gross evaluation results	Retrospective based on realization rates
Final NTG values	Evaluation studies with review and approval by EEAC with defined appeals process
Frequency of NTG updates	At least every 3 years
Approach to market effects	Allowed to include
NTG bonus for previous program participation?	Yes
NTG uses fast feedback methods	Not required
Sensitivity analysis	Not required for defined algorithms
Triangulation	Included in the standard C&I algorithm
Agreed upon algorithm	Yes[6]

Source: Navigant team research

[3] For additional information on the EEAC purpose, governance, and composition, see the Massachusetts Advisory Council website at http://ma-eeac.org/about/.

[4] For additional information on the EE plans, including the state's EM&V plans, see the Massachusetts Advisory Council website at http://ma-eeac.org/plans-updates/

[5] For the commonly used algorithm and questions, see the Tetra Tech, 2014–*2015 Commercial and Industrial Natural Gas Programs Free-ridership and Spillover Study* at http://ma-eeac.org/wordpress/wp-content/uploads/CI-Natural-Gas-Programs-Free-ridership-and-Spillover-Study.pdf

[6] Tetra Tech, *2014–2015 Commercial and Industrial Natural Gas Programs Free-ridership and Spillover Study*, 2015.

In addition to the document review, the Navigant team interviewed four experts in Massachusetts, including two utility staff, one regulatory staff, and one consultant.

2.3.1 Shareholder Incentives

Massachusetts' shareholder incentives are based on a savings mechanism and a value mechanism, with performance assessed at the portfolio level using cumulative 3-year results.[7] The savings component is allocated to programs on the basis of program dollar of benefits and the value component amount is allocated to programs on the basis of program dollar of net benefits.[8] For 2016-2018, the design-level incentive is set at $100 million for electric efforts and $18 million for gas efforts. Net savings include free ridership and both participant and nonparticipant spillover.[9]

All four experts interviewed reported that shareholder incentives are based on net benefits as a way to align policy goals with PA interests. For example, one expert said, "It makes sense to base incentives on net savings in order to align PA interest with society interest." One expert noted that if the policy goal is to provide value to ratepayers, then net benefits encourage PAs to "perform optimally and minimize cost." Another stated that this incentive mechanism focuses the use of "ratepayer dollars to achieve measurable, attributable savings."

Yet, experts also noted the drawbacks of the shareholder incentive mechanism. First, the use of net benefits was reported by two experts to cause some confusion, as savings achieved by programs must be converted to benefits to find out if the shareholder incentives were earned. Additionally, all experts stated that the use of net benefits puts pressure on evaluation methods to estimate attribution accurately, but there are issues with all NTG estimation methods. One expert noted that, "we are exploring limits of social science to answer questions regarding attribution." This expert continued, saying that there are other fields with social program evaluation where they are concerned with attribution, but "few other fields that have to come up with regularly repeated, highly granular, supposedly precise methods, which is a demanding mission" (see Section 2.3.4).

Several experts noted that if the policy goals were different than maximizing ratepayer value, then using gross savings as a shareholder incentive metric might be appropriate. Three experts mentioned that if the policy goals were total savings (impact on the grid, environmental goals, and carbon or GHGs) then using gross savings as a metric might be more appropriate. Finally, one expert noted that for the purposes of shareholder incentives, using a deemed or negotiated NTG result may be appropriate; however, there still would be a need to conduct research into attribution to inform program design and investment decisions.

2.3.2 Application of NTG Results

Prior to the 2013-2015 program cycle, Massachusetts applied both gross evaluation results (e.g., realization rates) and NTG ratios on a retrospective basis to calculate savings achievements and shareholder incentives. Yet, this caused tension in the system, with significant disagreements over the NTG estimates. It was described by one expert as "really, really bad in the past;" another expert described NTG results as "extremely negative as retrospective tool." A third expert noted, with respect to incentives, that when PAs are "losing money based on subjective studies, it gets ugly." Therefore, in the

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[7] *2016-2018 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan*, p 237. http://ma-eeac.org/wordpress/wp-content/uploads/Exhibit-1-Gas-and-Electric-PAs-Plan-2016-2018-with-App-except-App-U.pdf

[8] See gas and electric incentive models at http://ma-eeac.org/wordpress/wp-content/uploads/Appendix-R-Electric-PI-Model.xlsx and http://ma-eeac.org/wordpress/wp-content/uploads/Appendix-R-Gas-PI-Model.xlsx

[9] *2016-2018 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan*, p 258.

most current cycle, Massachusetts adjusted its policies to apply NTG factors on a prospective basis for each 3-year plan period. The perspective of the MA DPU[10] was summarized in a recent study,[11] stating:

> *The DPU accepted the argument that retrospective application of a NTG ratio creates uncertainty and puts program administrators at risk insofar as they invest in a program with an assumed NTG level that can later be revised downward. The DPU reasoned that this would encourage conservative program planning and implementation that would be unlikely to meet to the aggressive savings goals associated with the Green Communities Act.*

All experts described their views of the tradeoffs related to the prospective versus retrospective use of NTG estimates. Two experts noted that retrospective application of NTG results may be more accurate for estimating actual net savings achievements. Yet, the drawbacks listed by the experts outweighed this positive element. All stated the prospective application of NTG results leads to more effective program planning and more certainty for PAs in terms of the actions needed to achieve program targets and incentives. In addition, all experts reported inherent value in studying net savings and using the results as a planning tool to guide effective spending of ratepayer funds. This information is used to inform program planning and, as stated by one expert, “make rational decisions at the time of investment.” A positive feature noted by experts is that focusing on future planning creates a more collaborative, positive, future-focused environment for stakeholders. They said that it allows the regulators to understand and agree to a prudent use of funds moving forward, and it allows the PAs to use best-available information to develop and implement programs. One expert noted that, “prospective application allowed partnership of EEAC to get best results” (this process is described in Section 2.3.3). Additionally, two experts indicated difficulty with having a framework where gross savings factors are applied retrospectively and NTG is applied prospectively, and expressed interest in a system where all evaluation results are applied prospectively.

Currently, the NTG results[12] are updated prior to each 3-year plan and applied through the duration of the period. Several experts noted this “remove[s] some of the volatility” of NTG results, thereby providing stability and certainty for PAs.

In practice, this means that NTG studies are completed approximately 6 months prior to the start of the plan period and, therefore, must be planned and studied 1-2 years prior to the plan period. For example, for the 2019-2121 plan, NTG studies must be completed by mid-2018 and are being planned and implemented in 2017 and early 2018.[13]

Several experts noted concerns with accepting NTG values for 3-year periods, as it can lead to long lags between study implementation and application of results, especially for the end of the 3-year implementation cycle. One expert stated, “the 3-year lock has been considered great for risk mitigation but not great for perceived accuracy.” Another expert stated that this can lead to risks in fast-moving markets, such as lighting. This expert also noted that, “If [the NTG] estimate is too high, ratepayers take a bath. If it’s too low, the PA stops the program and misses opportunities.” Two experts stated that the 3-

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[10] Massachusetts Department of Public Utilities, DPU 11-120-A, “Order on Program Net Savings and Environmental Compliance Costs,” August 10, 2012.

[11] Northeast Energy Efficiency Partnerships. Regional Net Savings Research, Phase 2: Definitions and Treatment of Net and Gross Savings in Energy and Environmental Policy. NMR, 2012.

[12] For the detailed list by sector, measure, FR, SOP SONP, and NTG factors are listed, see p. 390 *2016-2018 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan*. “Appendix B: Net to Gross Impact Factors.”

[13] In this example, the program participants are likely from the 2015-2016 program years.

year lock was more important in the past when the programs were less mature and the NTG results were changing; since then, the results have been more stable.

2.3.3 Process for Finalizing NTG Results

As noted above, in Massachusetts, the DOER is ultimately responsible for EM&V and conducts oversight through a team of EEAC evaluation consultants that manages stakeholder processes and oversight for EM&V. In terms of NTG policies, evaluators recommend NTG results to the EEAC consultants. The EEAC then discusses and debates these results with the goal of gaining consensus on the value, which may be different than the initially recommended result. If there is no consensus, the EEAC consultant makes the final decision, which can be appealed through multiple layers, including the DPU and courts. However, since this system was put in place 8 years ago, there has not yet been a dispute or appeal.

Multiple experts noted the collaborative, transparent process facilitated by the EEAC for finalizing NTG results. Although one expert reported that there are often “multiple meetings and calls to debate results,” the process was described by several experts as collaborative and transparent. One expert noted that because NTG “answers are not easy,” there needs to be a process with “enough room for reasonable people to disagree,” which they felt was provided by the EEAC process.

Several experts noted the value of the transparency and ongoing communication embedded in this process. They referenced the ongoing interaction between EEAC consultants, PAs, and evaluation vendors, which “avoids miscommunication.” This expert stated that, “When utilities have to stay hands-off until the final decision, it leads to issues of misunderstanding the programs and not understanding data appropriately.” Finally, one expert noted that the process was easier than in the past due to the “standardized battery of C&I” NTG questions, which allowed PAs and vendors to “know the rules of the game” and minimize “some of the biggest disputes over results.”

Experts noted that the EEAC often uses evaluation results to determine negotiated values. For example, because the NTG results will be used prospectively, the results may be adjusted to better align with future programs—account changes in future participants, likely changes in the market, or remove outliers from past participants. Experts also agreed that it is important to conduct primary research on NTG, with one stating, “you can’t improve something you don’t understand, so I don’t think you should stop doing the studies. It’s an absolute necessity, at least at a qualitative level, to understand what is changing the world and what is not.”

In terms of access by utilities or PAs to survey data at the individual respondent level, one expert noted that this was not required in Massachusetts and was based on the policies of individual EM&V contractors. In their experience, “contractors will not release information if used to identify specific customers.” However, according to one expert, the evaluation contractors can provide useful information by providing cross-tabulations or frequencies that can be used to understand how responses to certain questions drive the NTG values and conduct sensitivity analyses (e.g., looking at impacts of specific questions on the scoring algorithm). This approach protects confidentiality while providing information necessary to understand what questions and responses affect the final NTG estimates. This has reduced the need to share the detailed data.

2.3.4 NTG Methods

Massachusetts uses multiple methods to estimate net savings, including self-report surveys, market effects studies, econometric (top-down) modeling, quasi-experimental models, and RCTs. When the team asked experts which of these methods are used for custom projects, all answered that only self-report methods are being used. One expert called custom projects the “single best poster child for self-report methods," noting that the custom nature of each project and the markets they work within "rules out other methods," as it cannot easily be randomized or understood econometrically. Therefore, for custom projects, the primary method used in Massachusetts is self-report surveys, and studies use a common but not required battery of C&I questions and NTG algorithm.[14]

Every expert noted the problems with self-report methods for NTG, with one expert calling them "flawed" and another "fallible." One expert referenced Churchill's famous[15] quote "Democracy is the worst form of government, except for all the others" by saying, "Self-report is the worst form of NTG methods, except for all of the others." This same expert noted that self-report methods have drawn a lot of criticism because they are "widely used and affects stakeholders." Yet, they stated that other methods would likely draw "just as many complaints because every NTG method has serious threats to validity." They continued saying that it is "not because of bad choices, but because we are operating at limits of what we can know." Similarly, another expert mentioned that the underlying information—understanding attribution in a counterfactual scenario—is a hard question to answer. Another expert stated that the "only method that is reasonably free from threats to validity is RCT," but also said that it was difficult or impossible to implement for custom programs. It should be noted that the problem of attribution is not unique to EE program evaluation—it is equally challenging for assessing investments and policies across all fields.[16]

2.3.5 Mitigating Issues with Self-Report Methods

The comments of the experts above regarding concerns with self-report surveys make it important to apply methods that can help mitigate the well-documented issues. All respondents mentioned the value of the pre-defined C&I NTG algorithm, which was noted as a "common method but not strictly required or followed," although most studies follow the standard method. Two experts indicated having a common algorithm allows NTG results to be compared over programs and time. Two experts also noted that using a common method allows for the algorithm to be updated, tweaked, and improved over time, leading to a more sophisticated approach that "people are comfortable with because it's been incrementally changed over time."

In terms of specific approaches to mitigating problems with self-report methods, experts had the following insight:

- **Fast feedback:** All respondents noted that minimizing time between when the project is completed and when the NTG survey occurs is important. One stated that staffing can change over time and another "would expect that recall to fade on the issue of freeriding." Yet, one expert reported that minimizing the "lag between intervention and self-report hasn't been a strength" in Massachusetts, and another noted "we would like to have fast feedback, but the MA framework is not fast." Additionally, one expert stated that although fast feedback is best for free ridership, the opposite is true for spillover. Specifically, they said, if surveys "show up too soon, you might not capture all the spillover." See Section 2.4.7 for more on spillover studies.
- **Sensitivity analysis:** Sensitivity analysis was not reported by experts as required or used in Massachusetts; however, it was conducted when the methods were originally developed and is currently being conducted as part of the NTG update process for the next 3-year cycle.

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[14] Tetra Tech, *2014–2015 Commercial and Industrial Natural Gas Programs Free-ridership and Spillover Study,* 2015.

[15] https://www.winstonchurchill.org/resources/quotes/the-worst-form-of-government/

[16] See Section 2.4 of *Chapter 17: Estimating Net Savings: Common Practices* of *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures.* US Department of Energy, 2014.

- **Triangulation:** At a project level, the algorithm includes vendor perspectives when the respondent reports that the vendor recommendation was an important factor in their decision.[17] This project-specific approach for incorporating trade ally influence works for custom programs due to the size and scope of the projects (i.e., trade allies can recall and comment on specific projects).
- **Other best practices:** Experts also noted other best practices in self-report methods, including time-series check-ins of the NTG within the 3-year plan period to give insight to the implementer of their NTG status and time to make program adjustments in an attempt to improve the NTG. Another noted that the "way questions are stylized is incredibly important."

2.3.6 Previous Program Influence and Other Programs Influence

In Massachusetts, the C&I algorithm has an adjustment[18] for previous program influence, which increases NTG ratios (decreases free ridership). One expert noted the benefit of including this factor as a way to ensure programs gain credit for their long-term efforts with C&I customers.

In terms of multiple programs working concurrently, Massachusetts conducts combined evaluations for its statewide programs and its algorithm specifically accounts for projects that have both gas and electric measures in a comprehensive offering. The algorithm[19] includes questions about the influence of a secondary fuel program; based on this result, it may increase the NTG (decrease free ridership). Several experts noted agreement with this approach, saying that it is not best practice to try to allocate attribution across different program sponsors. Specifically, one expert noting it is "nearly impossible to break out" attribution in a single project and that policies should encourage PAs to work together and provide more comprehensive offerings. Another expert said, there are "so many drivers and influences – utilities, state policies, advertising, stocking behavior, trade allies – so many things going on. We're missing a lot."

2.3.7 Market Effects and Spillover

Although Massachusetts policies allow spillover to be included in the NTG results, several experts stated they think that comprehensive market effects and spillover that are not being captured by the current approaches. Experts reported that there is value in delaying research on spillover to make sure that the influence of the program has had time to impact participant decisions. Another expert noted that they feel that Massachusetts is not fully capturing market effects and they would like to see more efforts in this area.

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[17] In Massachusetts, the C&I algorithm includes contacting vendors or design professionals identified by program participants as being most influential in their decision to install the electric saving measures through the program and their response can only increase NTG.

[18] Impact of previous participation is calculated through a series of four questions. Participants are asked to state whether they agree or disagree with four statements about the effect past participation has had on their decision-making. Based on the number of statements with which they agree, their free ridership is reduced by 75%, 37.5%, or not reduced at all. Source: *2014–2015 Commercial and Industrial Natural Gas Programs Free-ridership and Spillover Study*.

[19] If a participant rates the influence of the gas project as high (7 or greater on a scale of 0 to 10), the free ridership score remains the same. If the participant rated the influence of the gas project a 6 or less, the free ridership score is reduced by half. According to the Massachusetts free ridership study, this reduction is necessary because the previous factors focus on the specific effect of the program incentive and the overall effect of the program. Without this adjustment, the influence of providing a comprehensive project (one that includes both gas and electric) is understated. Source: *2014–2015 Commercial and Industrial Natural Gas Programs Free-ridership and Spillover Study.*

In terms of market effects, the 2016-2018 plan[20] states that, "to quantify program impacts that have translated to market effects, first a baseline must be established, and then changes from the assumed baseline can be determined to be program induced." Only then can the market effects be counted in net savings.

2.3.8 Other Policies

Massachusetts has an EE resource standard, gas and electric decoupling, and no lost revenue recovery mechanism. Massachusetts has a carbon policy and gross savings were used to set compliance goals with Massachusetts Global Warming Solutions Act (GWSA), as described in the 2016-2018 statewide plan:

> *While [attribution] factors are appropriate for use with the GCA,[21] which seeks to determine which savings resulted from PA program efforts (net savings), the GWSA seeks to quantify all energy efficiency GHG reductions without regard to PA program attribution. Consequently, calculating GHG reductions based upon net savings would undervalue the contribution of energy efficiency to GHG emission reductions.*[22]

2.4 California Case Study

In California, the California Public Utilities Commission[23] (CPUC) is responsible for conducting impact evaluation research on behalf of the utilities, including research into NTG values. The utilities conduct process and market studies in coordination with CPUC staff. The CPUC uses an ex ante review process[24] to review and approve deemed savings estimates and stores measure information, including NTG values, in the Database for Energy Efficient Resources (DEER) and in non-DEER work paper archives.[25]

The CPUC has been responsible for NTG research since 2006, and policies have evolved over that time. For the 2006-2008 period, the financial mechanisms included both shareholder incentives and penalties and were based only on the outcomes of evaluated net savings. During that period, the CPUC conducted the evaluations without input from the utilities but under contract with evaluation consultants that had supported the utilities in the past. In 2009, as shareholder incentives and penalties were being calculated, stakeholders voiced serious concerns about the validity of NTG results and what came to be called the "changing of the goal posts." To improve the transparency and collaboration of the system, the CPUC adopted several changes to the shareholder incentive mechanism and the expectations around cooperation between the utilities and the Commission staff on evaluation activities.[26]

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[20] *2016-2018 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan*, p. 254.

[21] Green Communities Act

[22] 2016-2018 Massachusetts Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan P 258.

[23] For additional information on the CPUC's role in evaluation, see the CPUC Energy Efficiency Evaluation Measurement and Verification website: http://cpuc.ca.gov/General.aspx?id=5399

[24] For additional information on the ex-ante process, see the CPUC Ex Ante Review website: www.cpuc.ca.gov/General.aspx?id=4132

[25] Additional information can be found at DEER (Database for Energy Efficiency Resources) http://www.deeresources.com; and Non-DEER work paper web page: http://www.deeresources.com/index.php/non-deer-workpapers

[26] Sangeetha Chandrashekeran; Julia Zuckerman, and Jeff Deason, January 2014, *Raising the Stakes for Energy Efficiency California's Risk Reward Incentive Mechanism*, https://climatepolicyinitiative.org/wp-content/uploads/2014/01/Raising-the-Stakes-for-Energy-Efficiency-Californias-Risk-Reward-Incentive-Mechanism.pdf

Currently, California bases its shareholder incentives[27] on a combination of net savings and three other (non-savings) factors, including custom project review performance, non-resource programs, and codes/standards. The state now applies NTG on a prospective basis for most of the portfolio; however, for inputs and measures that are determined to be "uncertain," such as custom project NTG, the evaluated NTG results are applied retrospectively.[28] The CPUC conducts primary research on NTG values and then uses a regulatory stakeholder input process to update prospective DEER values for NTG. California uses a pre-defined survey for most NTG analysis, including a unique algorithm for residential and C&I that is disclosed in the evaluation planning process.[29] Table 2 displays basic information about California NTG policies.

Table 2. Basic California NTG Policies

Structural Components	California
Shareholder incentives	Net savings (lifecycle) plus three non-savings factors[30]
Definition of net savings	Includes free ridership, participant spillover, nonparticipant spillover
Application of NTG results	Prospective for most of the portfolio for goal setting and claiming savings; retrospective for custom project NTG and other uncertain factors.
Application of gross evaluation results	Same as NTG results process
Final NTG values	Evaluation studies, work paper proposals from utilities, and DEER values
Frequency of NTG updates	Annually, where required by process
Approach to market effects	Separate spillover research
NTG bonus for previous program participation?	No
NTG uses fast feedback	Not required, but pre-screening occurs for custom programs
Sensitivity analysis	Yes
Triangulation	Yes, where possible
Agreed upon algorithm	Yes

Source: Navigant team research

In addition to the thorough document review, the Navigant team interviewed three experts in California, including one utility staff, one former regulatory staff member, and one consultant.

[27] CPUC Energy Savings Performance Incentive (ESPI) http://www.cpuc.ca.gov/General.aspx?id=4137

[28] CPUC Decision 13-09-023 September 5, 2013 *DECISION ADOPTING EFFICIENCY SAVINGS AND PERFORMANCE INCENTIVE MECHANISM* p. 50; http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M076/K775/76775903.PDF

[29] Example of NTG survey instrument available for public review: 2013-14 NTG Standard Very Large Interview Guide https://pda.energydataweb.com/api/view/1199/IALC_Customer_NTG%20survey_Final_11-07-14.pdf

[30] Custom project review performance, non-resource programs, and codes/standards.

2.4.1 Shareholder Incentives

For the 2006-2008 period, California had a shareholder incentive mechanism that was based on net savings and contained both incentives and penalties. Specifically,[31] if utilities met 80% of their net savings goal, they would receive an incentive; if they met less than 65% of their goal, they would receive a penalty. This mechanism was reported by experts to result in disagreements among stakeholders and in large risks in terms of lost incentives based on an uncertain NTG estimate applied retrospectively. One expert said, "When incentives are tied exclusively to net savings, it puts a lot of pressure on evaluation to estimate net savings with a high degree of accuracy, which the science cannot provide."

When the evaluations for the 2006-2008 period were completed, they revealed that the goals were not achieved. One expert said that, "the entire process was brought into the political realm and policymakers were, among other things, frustrated that the utilities and the CPUC staff and consultants were not able to resolve their own disputes through collaborative engagement." In a 2010 decision, the Commission made several modifications to the original rules for the incentive mechanism and awarded the utilities financial incentives based on the changes.[32] The Office of Ratepayer Advocates filed a petition in 2014 (note this was 6 years after the end of the program cycle being evaluated) requesting the CPUC rescind the payments based upon improper communications between a utility and a Commissioner in violation of state law and CPUC rules. In 2015, the CPUC issued a decision re-opening the case, which was ultimately resolved via settlement approved by the Commission in October 2016.[33]

Beginning in 2013, after thorough reconsideration of a revised incentive mechanism, the CPUC adopted the Energy Savings Performance Incentive (ESPI) mechanism, which provided roughly $25 million in ex ante and ex post incentives in 2015 for net savings accomplishments. The incentive payments are based on achievements against four separate factors:

1. Net savings, which is calculated separately for certain and uncertain measures (see Section 2.4.2 for more detail). Net savings includes free ridership and participant and nonparticipant spillover, although California uses an estimated 5% adder[34] for spillover to portfolio savings.[35]
2. Ex ante review performance, which represents effectiveness of utilities in implementing the pre-review of custom projects, such as being timely and having proper documentation.
3. Codes and standards, based on utility expenditures for codes and standards advocacy, compliance, and other program activity.
4. Non-resource programs, based on utility expenditures for programs that do not achieve direct energy savings.

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[31] Described in detail in Sangeetha Chandrashekeran; Julia Zuckerman, and Jeff Deason, *Raising the Stakes for Energy Efficiency California's Risk Reward Incentive Mechanism*, January 2014, https://climatepolicyinitiative.org/wp-content/uploads/2014/01/Raising-the-Stakes-for-Energy-Efficiency-Californias-Risk-Reward-Incentive-Mechanism.pdf

[32] Decision 10-12-049; DECISION REGARDING THE RISK/REWARD INCENTIVE MECHANISM EARNINGS TRUE-UP FOR 2006-2008; December 16, 2010. See ordering paragraphs. http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/128879.pdf

[33] Office of Ratepayer Advocates Review of 2006 - 2008Risk / Reward Mechanism http://ora.cpuc.ca.gov/general.aspx?id=3626

[34] CPUC Decision 13-09-023 September 5, 2013; *DECISION ADOPTING EFFICIENCY SAVINGS AND PERFORMANCE INCENTIVE MECHANISM,* p. 27.

http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M076/K775/76775903.PDF

[35] CPUC Decision 13-09-023 September 5, 2013; *DECISION ADOPTING EFFICIENCY SAVINGS AND PERFORMANCE INCENTIVE MECHANISM* Ordering Paragraph 3, p. 94.

http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M076/K775/76775903.PD

Experts generally reported that the current mechanism has been less controversial than the previous mechanism, with one saying, “it is better now because the risk of NTG results have been mitigated [with the use of multiple factors in the incentives calculation] and the process is more transparent.” The utilities are also more consistently using the NTG ratios the Commission recommends in their program planning and implementation; therefore, less divergence is occurring in savings claims and evaluated results on NTG. In terms of multiple factors, one expert noted that the new incentive mechanism “recognizes that the portfolio is diverse and recognizes that the Commission is asking utilities to do more than just acquire savings.” The current incentive mechanism was described by an expert as a “reasonable compromise”—the mechanism is clear about which and how much of the incentive payments are at risk based on measure or program performance (see Section 2.4.3). One expert said that, “Shareholder incentive is nice – but people aren’t thinking about it much anymore,” which they attributed to the relatively small size of the incentive payment compared to the previous mechanism.

The incentive mechanism in California is tied to the lifecycle net savings, given that goals are currently net savings and the incentive structure is intended to encourage long-term investments in EE. Although goals were gross savings during the 2009-2012 period,[36] net goals have more recently prevailed as better aligned with how EE is included in the state’s load forecasting.[37] Additionally, a recent potential study estimated net potential above naturally occurring adoption (free ridership).[38]

2.4.2 Application of NTG Evaluation Results

During the 2006-2008 period, California applied all NTG and other evaluation results on a retrospective basis for the incentive payments. As noted above, this created a system that caused friction among stakeholders because of the perception of uncertainty and the implications of the results. In particular, stakeholders voiced concerns about “moving the goal posts,” meaning that the expectations around judging performance appeared to change (related to retroactive application). One expert said, “retroactive application of results were very problematic, especially when a decision is made after programs have been designed and implemented, it messes with the business planning structure.”

Therefore, in addition to adjusting the stakeholder incentive as described above, California also adjusted its framework to move NTG and other evaluation results to a prospective basis. The current California model has an annual process to update as many deemed savings parameters as possible with new information coming from recent evaluations studies and other factors like code updates or major market trends. On this schedule, the majority of the portfolio inputs (such as savings and NTG values) are updated on a prospective annual basis and used for program planning and goal setting.[39] Each year’s measures and parameters in the portfolio for the upcoming year are reviewed for their contributions to “uncertainty.” If they are selected, then payment for energy achieved for those measures will be delayed (or applied retrospectively) for the purposes of the incentive payment. This structure, according to one

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[36] For more information, see CPUC, “History of California Public Utility Commission Goals for Energy Efficiency,” 2010. www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=4069

[37] California Energy Commission, *ESTIMATES OF ADDITIONAL ACHIEVABLE ENERGY SAVINGS: Supplement to California Energy Demand 2014□2024 Revised Forecast,* SEPTEMBER 2013 CEC□200□2013□005□SD; p. 9. http://www.energy.ca.gov/2013publications/CEC-200-2013-005/CEC-200-2013-005-SD.pdf

[38] Navigant Consulting, Inc. *Energy Efficiency Potential and Goals Study for 2018 and Beyond, Final Public Report,* Prepared for: California Public Utilities Commission, September 25, 2017. (http://www.cpuc.ca.gov/General.aspx?id=6442452619)

[39] CPUC D.15-10-028 October 22, 2015, *DECISION RE ENERGY EFFICIENCY GOALS FOR 2016 AND BEYOND AND ENERGY EFFICIENCY ROLLING PORTFOLIO MECHANICS*; Section 3.2.4. Rolling Portfolio Cycle Schedule http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M155/K511/155511942.pdf

expert, is designed to hold out some portion of incentive payments until the uncertainties are resolved through ex post evaluation. The list of uncertain measures is developed each year and reviewed by stakeholders (see Section 2.4.3). C&I custom programs are always included in this list based on the Commission rules due to their variability based on the custom nature of participation.

Experts noted that, although a portion of the portfolio remains retrospectively applied, the system now works much better because these items are “called out in advance and utilities have a chance to weigh in” at the time of that decision and provide feedback. Additionally, one expert stated that NTG results have “changed little from year to year for the custom programs, so all parties and stakeholders understand how they will be evaluated, and can manage for successful outcomes in their evaluations.”

For custom projects, the retrospective application of results has led to some utilities employing pre-review and screening of individual projects to assess NTG and baselines prior to project approval. This helps the utilities decide if they want to invest in large individual projects, with prior knowledge of the likely result of the NTG study. One expert indicated this has led to changes in program design (e.g., eligibility requirements) to try to minimize free ridership.

2.4.3 Process for Finalizing NTG Results

For the 2006-2008 program cycle, CPUC staff conducted evaluations without utility involvement (except to provide datasets) because of the strict legal construct for the shareholder incentive payments in place at the time, according to one expert. Results were presented as final for the purposes of determining the eligible incentive amounts. Given the conflict that resulted, the Commission required adoption of a more cooperative structure for evaluation processes in the next program cycle (2010-2012).

In addition to submitting a joint master evaluation plan,[40] the primary change in the processes was that all evaluations would be conducted with key points for public engagement. Commission staff developed a process that reflected this requirement in three basic steps, which is still currently used (see Table 3):

[40] *2013-2016 Energy Division & Program Administrator Energy Efficiency Evaluation, Measurement and Verification Plan Version 7*, available at: https://pda.energydataweb.com/api/view/1688/EM&V%20Evaluation%20Plan%202013-2016%20Plan%20V.7%20December%202016-lastround-12-5-2016.pdf.

Table 3. California Evaluation Review Process

General Expectation	Process to Meet Expectation
Specify what will be evaluated (for purposes of the incentive payment and generally)	• Publish an annual master evaluation plan (CPUC and investor-owned utility [IOU] staff) • Identify evaluation priorities for specific sectors and estimated budgets • Solicit public input on high level priorities
Publicly vet evaluation plans	• Evaluation plans for CPUC and IOUs posted for public comment • Most study plans also have a webinar to discuss evaluation priorities and methods
Publicly vet results for comment prior to finalization	• Studies are shared in draft form for public comment • Deviations from the methods in the evaluation plan are highlighted • Implications of results (for incentive payment) or for DEER updates are highlighted
(extra step) Response to recommendations	• Program implementers are required to respond in writing as to what actions they will take on the recommendations in the report

Source: Section 5.4 Energy Division IOU Collaboration in the Master Evaluation Plan

All experts stated this level of transparency was an improvement and has led to substantial reduction in conflict over evaluation results.

Prospective savings estimates and other parameters are developed in the DEER process.[41] Annually, certain measures or baseline assumptions in the DEER database are updated using new evaluation information or other market information (like new codes and standards). Based on this information, the DEER team recommends savings and NTG results to be used in the upcoming program years. These values may differ from the evaluation results because of the need to forecast, but the differences from evaluation results are explained and justified by the DEER team. The proposed updates are shared for public review and stakeholders provide input, which may drive further changes. The Commissioners approve the values either in a ruling or a decision, but largely CPUC staff, consultant, and stakeholders attempt to resolve disputes in advance.

The uncertain measures process (for retrospective applications) is conducted annually. In the fall of each year, the CPUC hosts public meetings for any stakeholder to weigh in on the evaluation priorities for the year in the master evaluation plan. In addition, an uncertain measure list is published each year identifying the technologies and parameters that must be evaluated for stakeholder incentives to be made on the savings claims.[42] As specific evaluations are planned, the evaluation plan is posted on the CPUC's public comment platform and a webinar is typically held to solicit feedback on the scope of the evaluation and even specifics of the methods. This includes how NTG will be determined and sharing survey instruments and algorithms that will be used to assess free ridership or spillover. At the end of the evaluation, the draft results are shared publicly. This allows all stakeholders to weigh in on the results and confirm that the agreed-upon methods were followed.

[41] CPUC Ex Ante Review website: www.cpuc.ca.gov/General.aspx?id=4132

[42] 2018 Final Uncertain Measure List; http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455469 or http://www.cpuc.ca.gov/General.aspx?id=4137

One expert noted that if utility representatives want to see individual results for large custom projects, then CPUC staff and consultants will hold a meeting with utility representatives because these may contain confidential participant information. After comments are processed, the evaluation consultants finalize the report and post it publicly.[43] The utilities are required to respond to the recommendations in the report within 60 days and the results are used to inform their incentive payment claims. If they make an incentive claim that is counter to the evaluation findings, they have the burden of proof to demonstrate those results are wrong; however, that has not happened yet. The Commission makes the final determination on the incentive payment by the end of each year.

2.4.4 NTG Methods

In California, multiple methods are used to estimate net savings, such as self-report, econometric choice models, and market surveys. One expert noted that "market approaches" to understand NTG are better than self-reports, but there are challenges to this because there must be both treated and untreated markets and the result is a combination of free ridership and spillover together. Another expert stated that there are only a "limited pool of NTG tools that can be deployed after the program has happened" and that "better tools require more integration with program design and can be more expensive." Two experts discussed the potential opportunity to use industry standard practice baselines as a potential alternative to NTG, but also noted the difficulties with this method, such as understanding industry practices for custom projects.

Therefore, the experts reported that self-report surveys using pre-defined questions and algorithms are used as the primary method for estimating free ridership. One expert stated that "methods must be sensitive to how the program is deployed" and, therefore, self-report surveys make sense for custom projects. This is because "deep conversation with [a] customer seems reasonable," but that it needs to be backed up with documentation of how the utility or program implementer intervened in the decision-making process to lead to the more efficient outcome.

For C&I, a consistent set of questions is used for determining NTG.[44] It was developed to improve consistency and transparency by using a consistent survey instrument. One expert mentioned the value in having an approach that is "reliable year to year," thereby providing stability in approaches. This has led to lower variance in results and more stability in NTG values. However, this expert also noted, "consistent NTG values doesn't mean it's accurate." This same expert stated they have "zero faith in any self-report method," as it is asking participants counterfactual questions that they "probably don't know the answer to but they will give an answer anyway."

2.4.5 Mitigating Issues with Self-Report Methods

Having conducted evaluations for years that leverage self-report methods, California has developed and implemented multiple approaches to mitigate issues with these methods, including:

- **Fast feedback:** California does not have specific policies on the timing of NTG surveys. As noted above, because of the retrospective application of results for shareholder incentives, some utilities (and the Commission) are using pre-screening on NTG prior to project approval.

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[43] Example of Final Impact Evaluation Report for Commercial Industrial and Ag: https://pda.energydataweb.com/api/view/1845/IALC%202015%20Custom%20Report%20Final.pdf

[44] The Nonresidential Net-To-Gross Ratio Working Group, *Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers*, Prepared for the Energy Division, California Public Utilities Commission, October 16, 2012.

- **Sensitivity analysis:** Sensitivity analysis is required in the California algorithm.[45] One expert stated that although they conduct "sensitivity analysis and scenarios for every evaluation, it makes little difference" because the algorithm has been tested and refined over time.
- **Triangulation:** Experts mentioned that program-level triangulation is occurring for residential programs, especially for upstream programs where there are multiple streams of information. For custom projects, California uses vendor surveys to assess program influences on their customer recommendations. However, this score is only used if the participant rated the vendor score as the highest influence and the vendor indicated the program was highly influential. In these cases, the vendor score increases the NTG; in no instance would it decrease the result.
- **Multiple scores:** In California, the NTG questions and algorithm includes both program and non-program (e.g., corporate policy) influence scores to account for different ways of measuring program influence.
- **Other best practices:** One expert had multiple suggestions for mitigating issues with self-report surveys, including using warm-up questions to improve the discussion, understanding the project story, delaying the counterfactual questions until later in the discussion, and ensuring that consistency checks happen before an interviewer gets off the phone. The same expert indicated that they do not think that short surveys of NTG are accurate for custom projects, as they do not fully account for the unique nature of these projects.

2.4.6 Previous Program Influence and Other Program Influence

The California NTG framework does not give additional NTG credit for previous program influence. One expert stated that the algorithm is focused on measuring influence within the period and it does not "look backward." Although this expert described it as "possibly a little harsh," they also said that there would have to be a limit on counting previous program influence, saying, "How do you decide how far you go back on program influence?" On the other hand, one expert noted that California does account for cases in which a technical assessment or audit was done a few years ago, which is considered as current program influence.

In California, joint program participation could be accounted for in the program components score. The question lists a variety of possible program and non-program influences and asks the participant to rate the influence of that aspect on their decision. In a program where the joint fuel nature was important, the evaluator can add this to the list of possible program influence.

2.4.7 Market Effects and Spillover

Experts noted the importance of capturing spillover to understand program influence, but also noted the difficulty in estimating spillover. California has a unique approach to NTG in that it includes free ridership on a project or program basis but includes spillover using a portfolio-level adjustment. This adjustment is meant to account for both participant and nonparticipant spillover, and was set at 5%, based on the fact that there was no credible estimate for the actual amount of spillover and applying a percent adjustment to the whole portfolio was easier than estimating per measure.[46] The CPUC stated,[47] "We find it more

[45] *Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers,* October 2012.

[46] Decision 12-11-015; November 8, 2012 *DECISION APPROVING 2013-2014 ENERGY EFFICIENCY PROGRAMS AND BUDGETS*, pg. 55 http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M034/K299/34299795.PDF

[47] *DECISION APPROVING 2013-2014 ENERGY EFFICIENCY PROGRAMS AND BUDGETS*, p. 55.

appropriate to apply a portfolio-level 'market effects adjustment' of 5% across the board to the entire 2013-2014 portfolio cost-effectiveness calculation in recognition that California's long history of commitment to energy efficiency resources has resulted in measure adoption outside of program channels."

Recently, the CPUC completed a spillover study that found some differences among sectors (residential was higher than C&I) and by fuel type.[48] One expert indicated that their perspective on this study was that "spillover is even harder to quantify and estimate" than free ridership. Another expert noted that a "separate spillover interview is probably best practice" and that delaying the interview will "get the best spillover insight."

2.4.8 Other Policies

California has specific climate change and carbon reduction policies: AB 32 (California Global Warming Solutions Act of 2006[49]) and more recently, SB350 (Clean Energy & Pollution Reduction Act of 2015[50]). Both raise expectations for meeting and increasing EE goals. When asked about the relationship between carbon policies and net savings, one expert said the discussion is similar to the gross versus net conversation. On the one hand, overall carbon reduction (and consumption reductions) is the focus of carbon policies. Yet, the additional effect over what is already happening in the market (i.e., net savings) is also important to understand the incremental impact of activities. The same expert opined that EE has never been fully reconciled with carbon goals. Assumptions for deemed savings measures are not tightly aligned with realistic avoided emissions. With a greener grid in California, the value of being leaner through efficiency will be more dependent on time and location than it has in the past.

2.5 Illinois

In Illinois, PAs[51] are typically gas and electric utilities, and they are responsible for managing evaluations[52] with oversight from the Illinois EE Stakeholder Advisory Group (SAG). SAG[53] reviews EE plans including portfolio and program designs, draft EM&V workplans, and the Illinois Technical Resource Manual (TRM).[54]

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[48] Opinion Dynamics, *PY2013-2014 CALIFORNIA STATEWIDE RESIDENTIAL AND NONRESIDENTIAL SPILLOVER STUDY*, 2017. https://pda.energydataweb.com/api/view/1936/CA%20Statewide%202013-14%20Res%20Nonres%20Spillover%20Report%20DRAFT%202017-08-18%20(2).pdf

[49] See 2006 Assembly Bill No. 32, Chapter 488 at: http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf

[50] See 2015 Senate Bill No. 350, Chapter 547 at http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

[51] Typically, PAs are utilities: Ameren IL, ComEd, Nicor Gas, and Peoples Gas-North Shore Gas.

[52] For more information on roles of various parties, please see: Illinois Energy Efficiency Policy Manual Version 1.1 - A Manual Guiding the Operation of Illinois Energy Efficiency Programs. See: http://ilsagfiles.org/SAG_files/Subcommittees/IL_EE_Policy_Manual_Subcommittee/2017_Revision/IL_EE_Policy_Manual_Version_1.1_5-5-17_FINAL.pdf.

[53] For more information on the SAG, see IL SAG website: www.ilsag.info/net-to-gross-framework.html and Illinois Energy Efficiency Policy Manual Version 1.1 - A Manual Guiding the Operation of Illinois Energy Efficiency Programs. http://ilsagfiles.org/SAG_files/Subcommittees/IL_EE_Policy_Manual_Subcommittee/2017_Revision/IL_EE_Policy_Manual_Version_1.1_5-5-17_FINAL.pdf. Note the NTG framework has been superseded by the NTG policy in the Policy Manual.

[54] See current and historic IL TRMs: http://www.ilsag.info/technical-reference-manual.html

Illinois does not currently have shareholder incentives or penalties, although the electric utilities will have shareholder incentives beginning in 2018 and gas utility annual energy savings goals are adjusted to align with changes to Illinois TRM values.[55] Illinois began using a prospective approach to NTG factors in 2013, including all areas of the portfolio. SAG oversees the collaborative stakeholder process that defines the prospective NTG factors, which includes free ridership and participant and nonparticipant spillover. Illinois' pre-defined NTG questions and algorithms are included in the TRM, which includes unique variations for residential and C&I programs.[56] Table 4 displays basic information about Illinois NTG policies.

Table 4. Basic Illinois NTG Policies

Structural Components	Illinois
Shareholder incentives	None until 2018
Definition of net savings	Includes free ridership, participant spillover, nonparticipant spillover
Application of NTG results	Prospective, including savings claims and targets
Application of gross evaluation results	Custom is retrospective using realization rates; TRM-based measures are prospective
Finial NTG values	Evaluation studies, SAG process
Frequency of NTG updates	Annually
NTG bonus for previous program participation?	No
NTG uses fast feedback	Not required, increasingly used for selected programs
Sensitivity analysis	Yes, required by TRM
Triangulation	Yes
Agreed upon algorithm	Yes, in TRM

Source: Navigant team research

In addition to a thorough document review, the Navigant team interviewed three experts in Illinois, including two evaluators and one regulatory staff.[57]

2.5.1 Shareholder Incentives

As noted above, Illinois does not currently have shareholder incentives; however, in 2018, the electric utilities will have shareholder incentives based on net savings. One expert reported that "in an ideal world" the shareholder incentives would be based on multiple factors with "the bulk of money on benefits and some amount of money on the other policy objectives you care about" such as comprehensiveness and geographic equity. Gas utilities have historically had penalties (and no shareholder incentives); while

[55] Illinois EE Policy Manual Version 1.1. Section 6.2, Adjustable Savings Goals

[56] The most recent version of the NTG questions and algorithms can be found in Volume 4 of the IL TRM v6.0 (http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_4_X-Cutting_Measures_and_Attach_020817_Final.pdf)

[57] An interview with a utility representative was scheduled, but interviewee was unable to attend due to personal circumstances.

this remains the same, beginning in 2018, their annual energy savings goals will be adjusted to align with changes to Illinois TRM values.[58]

Although Illinois has historically not had shareholder incentives, the use of net savings has been influential in the state. It is used to calculate savings achievements, which could have resulted in penalties for savings shortfalls. Experts noted that using net savings is valuable to ensuring that the impact of utility programs are monitored because, as one expert noted, “utilities have a decent amount of influence in terms of how they influence programs to push higher NTG or lower.” Another expert stated that they “think it’s a good idea to get utilities invested in doing a good job and helps to build support senior executives.” A third expert mentioned that assessing net savings is particularly important for custom programs because it is common to pay for projects that would have happened otherwise. The best programs influence the market by “marketing, technical assistance and identify opportunities and convince customers to do it.”

The Illinois TRM is consistent with the experts the team interviewed in terms of the importance of attribution, while also expressing caution with the ability to know the counterfactual, stating:[59]

> *Attribution provides credible evidence that there is a causal link between the program activities and the outcomes achieved by the program. Attribution research estimates the difference between the outcomes and those that would have occurred absent the program (i.e., the counterfactual). As such, it is important to realize that the concept of the counterfactual cannot be proven with certainty. This statement is not about poor methods, but about the counterfactual itself. Because programs work with people and are usually not a laboratory experiment that can be replicated over and over to find out what actions people would have taken absent an intervention, one would need a time machine to take people back in time and not provide the program. Since time machines do not exist, evaluators have developed methods that approximate the counterfactual to the best of their ability.*

2.5.2 Timing of Evaluation Results

Historically, Illinois had a system with retrospective application of gross and net savings factors. Experts generally agreed that the uncertainty this caused utilities was not productive. One expert noted that the value of retrospective NTG was that it measured “actual performance,” but they said structure caused utilities to “worry about it and become risk averse,” which could lead to them doing a sub-optimal job in delivering programs. One expert said that utilities wanted to be able to track whether they were meeting their goals, but they could not manage the risk “if they were unsure what the NTG value would be.” In fact, another expert noted that this system had “risk to the utility with no means for them to react to the uncertainty.” They continued, saying the policy, “didn’t align incentives with producing better savings or better programs” and discouraged innovation, as utilities were trying to minimize NTG risk.

In 2013, Illinois moved to a prospective approach to its NTG results and since 2016, NTG algorithms have been included in the TRM. The prospective NTG values are produced annually by independent evaluators, reviewed by stakeholders, and finalized by October 1 of each year. These new NTG values are prospectively effective 3 months later to begin the calendar year.[60]

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[58] Illinois EE Policy Manual Version 1.1. Section 6.2, Adjustable Savings Goals

[59] IL TRM v.60, Volume 4, p 22 (http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_4_X-Cutting_Measures_and_Attach_020817_Final.pdf).

[60] Illinois Energy Efficiency Policy Manual Version 1.1

Experts noted that early in the process to move to prospective values, there was concern that utilities would have less incentive to monitor NTG and improve their programs; however, because the results are reviewed annually, they are seeing that programs have an incentive to minimize NTG. Three experts stated it is important in a prospective framework to update NTG results regularly. One expert also mentioned that evaluations conducted annually on each program may expend too many resources, so finding a balance of keeping NTG up-to-date but reducing costs is important.

The experts' views on the value of the prospective approach were consistent with documentation in the Illinois NTG framework.[61] It discusses several benefits of the prospective framework for NTG:

- Higher certainty of claims for PAs in terms of meeting targets and achieving incentives—reduces short term performance risk.
- Provides a strong, albeit diminished, incentive for PAs to work to maximize NTG ratios and net savings by continually doing the necessary research to understand markets and make program changes as appropriate in a timely fashion.
- Ensures that decisions about new initiatives or significant program changes are made, recognizing and balancing performance risk as part of the overall portfolio. This provides PAs with an incentive to design and deliver these programs to minimize free riders initially. Thus, PAs can experiment with innovative strategies.

2.5.3 Process for Finalizing on NTG Results

In Illinois, SAG conducts an annual process to update the prospective NTG values and then updates them in the TRM. Annually, evaluators recommend prospective NTG values based on evaluation results and include the reasoning for their recommendation. This is presented to the SAG, where members have the opportunity to "question, challenge and suggest modifications to the evaluators' initial recommended deemed NTG Ratios for the upcoming program year."[62] The goal of the meeting is to reach consensus on the values. If consensus is not reached, then the SAG facilitator develops a document that identifies the issue, different opinions, and the basis for those opinions and then shares with SAG participants an opportunity to review and comment. If consensus still cannot be reached, the evaluators' final recommended NTG values are used. These values may be different from the evaluators' initial recommendation because they consider all comments and discussions from the SAG process.

Experts reported that the current process is smooth and collaborative. One expert said that early in the process there were "intense weeks and months" of debating and negotiating on NTG. Another expert said, "there was a fair amount of SAG values that were not evaluation recommendations," as varying results (e.g., gas and electric) led to negotiated results. However, over time, the process has become faster and evaluation results are being used more often. One expert said the "process is down to a few meetings to determine future NTG."

In Illinois, they also have a process for a mid-year determination of NTG values for new programs that come up during the year. The process is the same: evaluators recommend a NTG result, but instead of actual results, this "may be based on secondary research, when that research produces relevant results,

[61] Optimal Energy, *Proposed Framework for Counting Net Savings in Illinois*. 2010. Available at: http://ilsagfiles.org/SAG_files/NTG/NTG%20Framework.pdf.

[62] Illinois Energy Efficiency Policy Manual Version 1.1.

…otherwise a NTG Ratio of 0.80 will be used."[63] One expert described this as "helpful and has provided flexibility for mid-year program components that come up."

In terms of data access to individual results, evaluators manage the confidentiality of the data. Though, one expert stated that it is possible that evaluators would provide the Illinois Commerce Commission with individual results if requested, and NTG data has been shared with the utilities to conduct their own sensitivity analysis.

2.5.4 NTG Methods

The Illinois TRM lists several methods for NTG estimation,[64] including self-report, econometric/revealed preference approach, RCTs and quasi-experimental designs, deemed or stipulated NTG ratios, market analyses, structured expert judgment approaches, program theory-driven approach, and case studies design. The TRM notes that several of these are not used in Illinois, including common practice baseline approaches and market analyses.

As discussed in Section 2.3.1, the TRM notes concerns with self-report methods of the counterfactual. One expert states that they think self-reporting is a "terrible method but better than all the rest" and that they "would love the ability to do more RCTs" to estimate net savings. This expert noted skepticism of Delphi approaches and common practice baselines, which they see as not appropriate to measure program influence.

Although the TRM lists many options, Illinois evaluations primarily uses self-report methods for NTG estimation. For custom projects, experts did not report any other approaches than self-report to estimate net savings for custom projects. One expert said, "by definition, custom is different kinds of products, so you really have to talk to customer."

Prior to 2015, there were multiple variations of self-report surveys and algorithms being used in the state, which were noted in 2014 to be causing uncertainty as, "different evaluation methodologies, contractors, and simple random statistical variation can influence the measurement of NTG, resulting in a higher than desired level of uncertainty for PAs if used solely on a retroactive basis."[65] This document recommended that:

> *Wherever possible, joint and consistent statewide evaluations be performed. This will eliminate these uncertainties, allow for more direct comparison between PA's performance, as well as provide economies of scale and greater consistency and certainty to PAs about likely future evaluation results. We propose that standardized approaches to measuring free ridership and spillover be adopted in Illinois that ensure consistent measurement both across territories and over time.*

This led to Illinois Commerce Commission orders[66] for each utility that required the developing and adopting consistent statewide NTG methodologies (IL-NTG Methods). For example, the Nicor docket noted it would "help ensure the independence of the evaluators, to improve efficiency in the evaluation

[63] IL TRM v.6, Volume 4

[64] IL TRM v.6, Volume 4, p. 91-95.

[65] Optimal Energy, *Proposed Framework for Counting Net Savings in Illinois.* 2010.

[66] For example, see Nicor Gas Order (Docket No. 13-0549) – p 41/42.

process, and to ensure programs across the state as delivered by the various Program Administrators can be meaningfully and consistently evaluated." It also noted that the "adoption of IL-NTG Methods would save on ... limited evaluation resources by having a common reference document for the evaluators to use in estimating net savings for Illinois."

Based on these orders, SAG undertook a process to develop NTG methods for inclusion in the statewide TRM. These were first included in Illinois TRM v5.0 and contain differences for sectors and programs.[67]

All experts noted the benefit of the common methods, with one saying, "contentiousness was reduced because differences in methodologies were mitigated." Another said it "mitigates debate about which method is used and there's a designated time for that debate to occur" among stakeholders. This expert continued, saying that the common method "mitigates uncertainty and mitigates potential for gaming." Another expert said that the process of determining prospective NTG values is much easier with "everyone using the same approach, because there is less room for differences in approaches," and arguing is reduced because "if numbers are different it's hard to argue due to methodology."

The TRM is updated annually,[68] and SAG reviews any changes to it. The TRM describes the NTG methods as "partially binding," but it allows evaluators to deviate from the methods if it submits a proposal to SAG and gains their approval.[69]

2.5.5 Mitigating Issues with Self-Report Methods

Illinois mitigates issues with self-report methods through multiple approaches:

- **Fast feedback:** Illinois does not have specific policies on the timing of NTG surveys. Several experts noted that fast feedback is better for free ridership accuracy, with one indicating that programs should "measure free ridership as soon as possible after the decision." Another expert said fast feedback is "best practice – if a lot of time has passed, the customer will internalize the decision, or they forget." Due to the annual updates of NTG values in Illinois, several experts mentioned that increasingly NTG research is being conducted in waves throughout the year, on a rolling basis soon after projects are completed.
- **Sensitivity analysis:** Sensitivity analysis is required in the Illinois algorithm for C&I measures. This was particularly important as the algorithms were first being developed, and it was difficult to reach consensus on the scoring approach; thus, the TRM actually required multiple methods for scoring to be presented as part of the prospective approval process. After initial analysis, however, sensitivity analysis has become less important. One expert called it a "good idea" but said "no one pays attention to it," as the results and algorithm have been tested over several years and have stabilized.
- **Triangulation:** Experts reported that program-level triangulation is used for some programs, particularly for residential. The Illinois TRM does also propose using a weighted scoring method to integrate results from various perspectives based on perceived accuracy, data reliability, and statistical confidence/precision. The weight for each method is the average score for that method

[67] Various NTG for: core non-residential (free ridership and spillover) protocols, free ridership only for: small business, C&I new construction, study-based and technical assistance. For residential, there are cross-cutting approaches and program-specific ones such as upstream lighting, prescriptive rebates, new construction, multifamily, and home energy audits. Across sectors includes behavioral protocols (including RCTs and non-randomized designs). See IL TRV v5.0, Volume 4.0.

[68] IL TRM v.6, Volume 4, Updating the IL-NTG Methods

[69] IL TRM v.6, Volume 4, Procedure for Non-Consensus Items

divided by the sum of the average scores for all methods. For custom projects, however, the Illinois TRM vendor influence is accounted for in the program components score—although it could be considered either a program or non-program influence. If a vendor is considered a program influence, a high rating from the participant would trigger a vendor interview and program influence on the vendor would be assessed through a separate survey, which could increase the NTG result.[70]

- **Multiple scores:** In Illinois, the NTG questions and algorithm includes multiple factors to account for different ways of measuring program influence. For C&I programs, the Illinois algorithm averages the program factor, program influence, and no-program scores,[71] while for residential, only the program influence and no-program scores are used.
- **Other best practices:** Experts also discussed other best practices to mitigate issues with self-report surveys, including: "not relying on a single response," probes for contradictions, and "indirect questions that give a sense of whether customers would have done this or not." Another expert stated that it is important for custom projects to use professional interviewers in order to understand the project story, "follow-ups to avoid non-response bias," and making sure "question wording is good."

2.5.6 Previous Program Influence and Other Programs' Influence

In the Illinois TRM, previous program participation is not directly accounted for and does not give a bonus to NTG. Joint program participation in Illinois may be accounted for in the program components score, as the question lists a variety of possible program and non-program influences and asks the participant to rate the influence of that aspect on their decision. In a program where another joint fuel program was important, the evaluator can add this to the list of possible program influences. One expert noted that asking customers to understand unique influences of various programs is difficult, saying, "equipment is a single decision, not multiple decisions…To ask customers to tease influence is not realistic." Another noted that the best practice in joint programs is to conduct a "single evaluation and single NTG value."

2.5.7 Market Effects and Spillover

The Illinois Policy Manual is clear that free ridership should be included in all NTG ratios, but it is somewhat vague on spillover, saying:

> *Spillover shall be included whenever possible and feasible in each NTG calculation. Whenever a NTG value is calculated for components of a Program, it will still include Free Ridership, and if feasible, Spillover. … Evaluators are not required to always include Spillover in NTG calculations due to the costs of Spillover research, but excluding Spillover might unfairly reduce Program calculated savings. Evaluators should consider Spillover, including logical reliance on deemed values and secondary research developed from evaluations of other Illinois Programs and other jurisdictions, to estimate Spillover in relation to the predicted impacts of such Measurements. Also, a sector or Portfolio-level Spillover analysis should be considered by each utility at least*

[70] IL TRM v.6, Volume 4, p. 28-33.

[71] The program factor is the maximum importance of the incentive, program marketing, or other program factor; program influence score is based on an allocation of 100 points between program and non-program influences; the no-program score is the likelihood the customer would have installed the same exact equipment in absence of the program.

> *once every Plan period when it is feasible and considered viable by evaluation. All such Spillover research should be conducted while being mindful of costs and other evaluation needs.*[72]

Although the policy manual includes spillover and the TRM includes prescriptive methods for estimating participant and nonparticipant spillover, experts stated that there are areas of opportunity for improving the estimates of market effects and spillover. One expert noted it is “hard to measure nonparticipant spillover” and that Illinois is “consistently under-estimating non-part spillover,” which they described as “huge and growing and having influence that isn’t able to capture.” Another expert said that there is a reasonable amount of long-term market transformation, customer awareness, and natural adoption of EE due to programs, and utilities “should get credit for it.” One utility has started to split spillover into separate studies,[73] conducting an overarching sector-wide spillover survey.

[72] IL Policy Manual, Section 7.3 Free Ridership and Spillover.

[73] For more information on the evaluation plan, see http://ilsagfiles.org/SAG_files/Meeting_Materials/2014/June_10_2014_TAC_Teleconference/IL_Spillover_Research_FINAL_2014-06-06.pdf

3. JURISDICTIONAL SCAN

This section provides a high-level review of NTG policies across North America, including the use of gross versus net values, components of NTG values, and the use of prospective versus retrospective values. In addition, the Navigant team examined how overall EE policies and regulatory considerations are related to the choice of NTG policies and approaches, as well as how they may link to other policy mechanisms such as lost revenue recovery, risk-reward mechanisms, and integrated resource planning.

This effort leverages prior work conducted for an EE stakeholder group that included utilities and regulators in Iowa in 2015.[74] To update and refresh the 2015 data, the Navigant team contacted industry experts that conduct NTG work across all US states (reaching out to over 30 experts) to confirm the status of NTG policies in each state and indicate any changes that have taken place since 2015. This outreach was particularly helpful in providing insight and understanding into many of the NTG nuances and complexities that often are not fully provided in public documents. For example, the terminology and definitions specific to a given jurisdiction can result in policies that appear similar across jurisdictions but, in practice, can be quite different.

3.1 Descriptions of High-Level NTG Policies

This section describes the framework of the high-level review. The findings are organized into five general policy categories to provide a basis for comparisons across jurisdictions. The five policy categories used in this analysis are:

1. ***Overall NTG policy.*** This shows whether or not PAs must report savings and assessment against goals (including risk-reward mechanisms) at the gross or net level. Note that states that use a NTG of 1.0 are assumed to effectively be gross states because there are no upward or downward adjustments due to program attribution. Additionally, states that use common practice baselines are assumed to be gross savings states.
2. ***Definition of net savings (allowance for spillover).*** Within jurisdictions that use net savings for reporting, there is a wide variation of which aspects of NTG are allowed in terms of savings claims. Some states consider net savings to be net of free ridership but not to include any aspects of spillover. Other states allow different aspects of spillover (i.e., participant and nonparticipant) to be counted as achieved net savings.
3. ***NTG methods.*** Certain states (including the case study states above) have developed specific NTG methods for use in their states. This can include specifics regarding the calculations (e.g., survey batteries and analysis algorithms for self-report approaches). These methods (or protocols) may be recommended (allowing for certain adjustments each year), but certain states may adopt a more rigid approach (e.g., Pennsylvania) where the developed protocols are required to be used more consistently over time for similar programs.
4. ***Fixed or researched net savings.*** A number of net savings states lock in a fixed NTG value that applies to all, or at least most, programs. Note that while this has a prospective aspect to it (in that NTG is fixed prior to the program year), this is considered different than the team's definition

[74] See: Navigant (2015). *Iowa Energy-Efficiency Net-to-Gross Report.* Prepared for the State of Iowa Department of Commerce Utilities Board. Link: https://efs.iowa.gov/cs/groups/external/documents/docket/mdax/mjax/~edisp/1201494.pdf

of prospective NTG (below), which is typically based on researched values that can vary by program and measure.

5. ***Prospective versus retrospective application of net savings values.*** Another practice is the prospective use of NTG values, whereby NTG values researched in a current program year are applied prospectively to future year(s) rather than retrospectively to the current or past program year(s). Once NTG values are established, they are essentially locked until an updated value is derived and applied prospectively for going-forward program design, setting targets, and incentives.

3.2 Jurisdiction Scan – Discussion

This section presents the results of the high-level review of NTG policies, with the discussion grouped into the policy categories set out above. Some overview findings include:

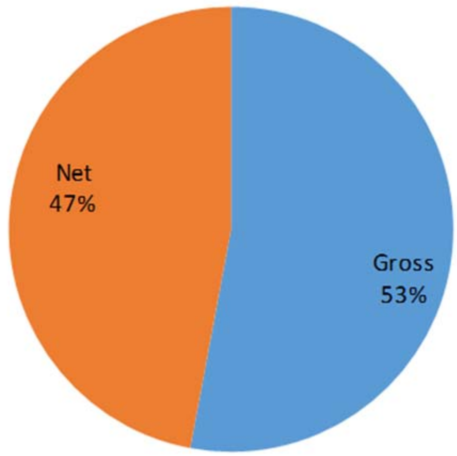
- Slightly over half of the jurisdictions (53%) use gross savings to assess whether energy savings goals and targets have been met. In some cases, gross savings are adjusted by in-field realization rate studies, and it is this adjusted gross value that is used to assess progress to goals and targets.
- Of those states that use net savings as the primary metric, nearly all of them (88%) include participant spillover and 67% include non-participant spillover.
- Most states that use net savings use either fixed NTG values or apply NTG on a prospective basis to facilitate program planning, progress to goals and targets, and use in determining shareholder incentives.
- There is a trend toward using a stakeholder process to develop agreed-upon methods for use in estimating NTG.
- States with financial incentives or other risk-reward policies are more likely to use net savings when assessing goals and incentives.

The balance of this section discusses the results of the jurisdictional scan for the five policy categories set out above.

3.2.1 Overall NTG Policy: Gross vs. Net

This policy category considers the role of gross and net savings in the reporting of energy savings and assessment against overall savings goals and targets. The research showed that slightly over half of the jurisdictions (53%) use gross savings in assessing achievement against savings goals. Note that gross states include states with limited (and in some cases minimal) utility efficiency programs. In addition, a number of states appear as gross savings states (e.g., Pennsylvania) but encourage and sometimes require NTG estimates and research to help improve program design. In fact, there is no state that the team is aware of that would prohibit NTG research for this purpose. This jurisdictional distribution of net versus gross is essentially the same as was found in the 2015 review of NTG policies.

Figure 1. Percentage of Jurisdiction Adoption of Net vs. Gross Policy

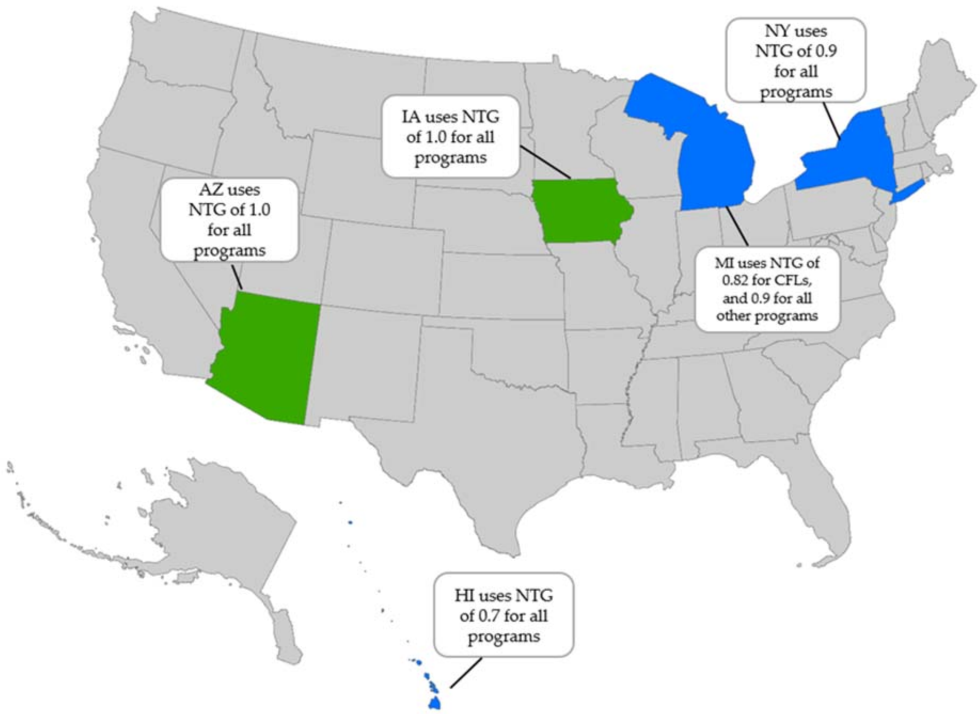


Source: Navigant team research

While some states adopt an overall net policy and others adopt a gross policy, a number of net states deem all program NTG values at 1.0 or a different value.[75] As shown in Figure 2, there are several states that currently adopt a NTG of 1.0 for all programs, while three states—Hawaii, Michigan, and New York—rely on fixed NTG values that differ from 1.0 for all programs within their EE portfolios. The ratios range from 0.7 to 0.9, and Michigan lowered the NTG for CFLs based on research showing a lower NTG than the other measures in the portfolio. Arkansas uses a similar approach during the first year of program implementation by having all programs use a stipulated NTG of 0.8. CFLs were the exception and were required to use an NTG of 0.62. After the first year, the programs were required to rely on researched values.

[75] Note this is considered different than prospectively deeming NTG ratios by program/measure based on researched values. These are global, portfolio-wide deemed values that are not regularly updated based on ongoing research. In addition, as noted above, states that deem NTG as 1.0 are counted as gross states for purposes of determining gross versus net policy.

Figure 2. States with Deemed NTG Values



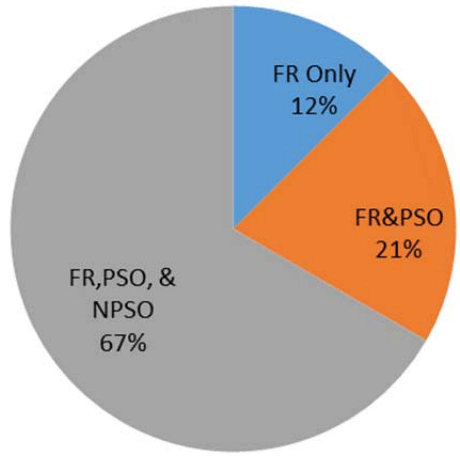
Source: Navigant team research

3.2.2 Definition of Net Savings (Allowance for Spillover)

As shown in Figure 3, over two-thirds (67%) of those jurisdictions that use net savings allow for free ridership, participant spillover, and nonparticipant spillover, while 21% allow for free ridership and participant spillover but do not allow for nonparticipant spillover.[76] Only 12% of the jurisdictions with net savings (a total of three states) limit net savings to net of free ridership (i.e., do not allow for contributions from spillover to count toward the net savings estimates).

[76] Note that the team is including market effects as a subset of non-participant spillover rather than breaking it out separately. This is because the team is not considering it in the context of market transformation studies, but rather as a subcategory of non-participant spillover. Precedent for this distinction is set by the US Environmental Protection Agency (EPA) in the *Model Energy Efficiency Program Impact Evaluation Guide: A resource of the National Action Plan for Energy Efficiency* (NAPEE), available at: http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf

Figure 3. Inclusion of Free Ridership (FR), Participant Spillover (PSO), and Non-Participant Spillover (NPSO) in NTG Ratios (n=24)



Source: Navigant team research

3.2.3 NTG Methods Protocols

Several states reviewed as part of the jurisdictional scan have used open stakeholder processes to develop common methods for estimating NTG in their state. This can span the use of regression/statistical methods, but there often is a specific focus on developing agreed-upon methods for estimating NTG using self-report survey methods. States that have developed agreed-upon frameworks for survey methods include California, Massachusetts, Illinois, and Pennsylvania.

The primary reason for developing common approaches to NTG estimation is to help ensure that differences over time or between PA service territories are due to actual differences in program attribution as opposed to differences in research methodologies. In addition, bringing together PAs and their evaluators to develop these common methods is perceived as an opportunity to refine and improve existing methods, ensure transparency, and provide all stakeholders with greater confidence in the results of these studies. In addition, discussion and debate on the specifics of an applied method helps provide an appropriate policy and planning context around the resulting NTG estimates, which can be used to support good planning and policy decisions.

The primary drawback of common approaches, however, is that they can be perceived as inflexible and thus, inappropriate for programs that do not fit a typical model. They can also be seen as stifling innovation for new and potentially superior approaches. In response to these concerns, some of the more recent protocols have tried to retain some flexibility (e.g., giving example questions that can be adapted to specific program designs and features); plus, in some cases, they also allow evaluators to propose alternative methods that can attempted with regulatory approval.

The NTG methods guidance documents in both California and Massachusetts focus on the selection of methods (i.e., which methods are most appropriate for specific program types) as well details regarding the application of estimation methods for select programs. In general, more specific guidance has been developed for applying self-report methods, as these are often viewed as requiring greater judgment in their application. For example, these guidance documents can go as far as listing example questions and scoring algorithms used to determine NTG estimates. More recently, both Illinois[77] and Pennsylvania have followed the lead of California and Massachusetts by instituting common NTG approaches.[78]

Most portfolios offer such a diversity of programs and the guidance often focuses on the recommended NTG methods—i.e., the best methods for certain program types (e.g., downstream rebates). More detailed guidance on the application of NTG estimation methods is often developed for those programs that are viewed as more challenging in terms of producing NTG estimates or are viewed as more important to the overall portfolio's total savings. Recently, there has been an effort to expand the number of programs for which guidance in the application of methods are developed. For example, Pennsylvania and Illinois both include guidance for appliance recycling programs, and Illinois includes guidance for a common approach to estimate NTG for upstream lighting.

3.2.4 Prospective vs. Retrospective Applications

NTG ratios can be sensitive to the methods used, and any variation in NTG estimates directly results in a proportional change in the estimated net savings (i.e., a 1% drop in NTG results directly in a 1% drop in attributable savings). As a result, PAs (often gas or electric utilities) perceive significant risk and uncertainty with retrospective NTG application in terms of the actions needed to meet targets and calculate incentives. Thus, the majority of net states use NTG results prospectively rather than retrospectively. Prospective NTG application means that any updates to NTG values are applied in future program years, not in the year in which they are developed or to prior program years. As shown in Figure 4, over half of the jurisdictions with net savings (62%) use either a prospective/fixed NTG or a combination of prospective and retrospective.[79]

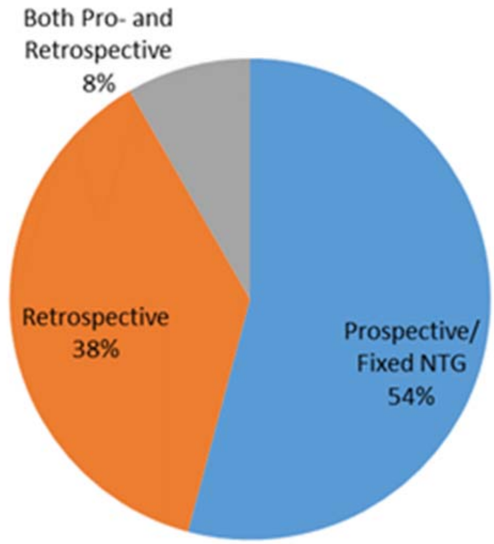
The prospective approach reduces risks for PAs; however, to be effectively implemented, it requires careful planning in terms of the timing and nature of the NTG research so that the results are still considered timely and applicable going forward. NTG research needs to be updated as markets and incentive structures change and as secondary research from other similar programs indicates increased variability in NTG values across programs.

[77] IL TRM v6.0, Volume 4: http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_4_X-Cutting_Measures_and_Attach_020817_Final.pdf

[78] Jane Peters and Ryan Bliss, *Common Approach for Measuring Free-riders for Downstream Programs*, Prepared by Research Into Action as part of the Statewide Evaluation for the Pennsylvania Electric Distribution Companies and the Pennsylvania Technical Utility Staff, December 23, 2014.

[79] California, as part of the ESPI, allows prospective NTG for some measures but retrospective NTG for measures that are determined to be less stable in terms of program attribution.

Figure 4. Use of Prospective vs. Retrospective NTG (n=24)



Source: Navigant team research

3.2.5 Relationship between NTG Policy and Other DSM Policy Objectives

While a review and summary of NTG approaches, trends, and policies is helpful for supporting decision-making, it is also important to understand NTG policy in the context of other DSM policies. Certain jurisdictions may have DSM policies—particularly financial policies—where the importance of more precise, fully attributable savings estimations can be perceived as being more important. In addition, other DSM policies may be related to the treatment of NTG. The Navigant team examined a number of DSM policies and their relationships to NTG policy:

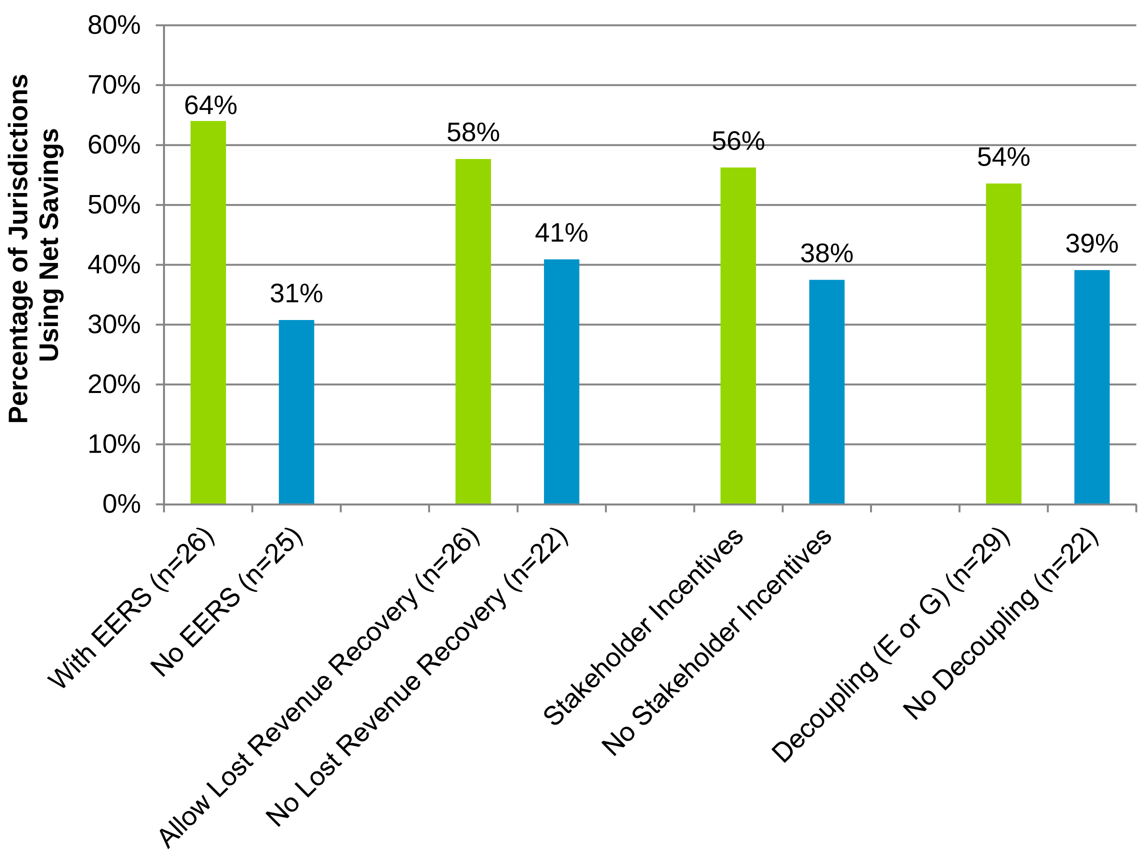
- **Energy efficiency resource standards (EERS):** State-level policy that sets long-term mandatory energy savings targets for utilities and EE PAs.
- **Decoupling:** A regulatory tool that serves as a means of helping utilities overcome the throughput incentive—i.e., the contribution to gross income that occurs with every energy unit sold because the unit (variable) price recovers some of a utility's fixed costs. A decoupling mechanism separates a utility's revenue from its unit sales volume without affecting the design of customer rates.
- **Lost revenue recovery:** Allows a utility to recover the lost revenue attributable to DSM programs by increasing revenue by that same amount. It can be based on decoupling (see above) or by adjustments (rate adjustment).
- **Risk-reward mechanisms:** Allows utilities to earn incentives for meeting or exceeding goals, or imposes financial penalties for savings shortfalls.

Figure 5 displays trends and correlations between the NTG policies and the broader DSM policy objectives. Note the sample sizes are small and each subset of analysis (e.g., examining only states that have net savings policies) leads to even smaller sample sizes. The results, therefore, need to be used with caution; they may not imply causation, but strong correlations do suggest that certain policies may be related.

The analysis focused on two of the most important NTG policies: the overarching policy of requiring savings goals and targets to be expressed as gross versus net savings, and for those jurisdictions that use net savings, whether or not the NTG is applied prospectively or retrospectively. These NTG policies are then compared against the different DSM policies outlined above.

As shown in Figure 5, jurisdictions that have an EERS allow lost revenue recovery and have bonuses or penalties that tend to also require net rather than gross savings. These differences are substantial; for example, 56% of the jurisdictions that have stakeholder incentives/penalties also require net savings, as compared to only 38% of those that do not have stakeholder incentives/penalties requiring net savings. Similarly, 58% of the jurisdictions that allow for lost revenue recovery require net savings, compared to only 41% of the jurisdictions that do not allow for lost revenue recovery. Each of these DSM policies with greater correlation with net savings also tend to be associated with increased stakes—particularly financial—in terms of the outcome. In other words, states where there are potentially millions of dollars on the line on the outcome of the savings assessment also tend to use net rather than gross savings.

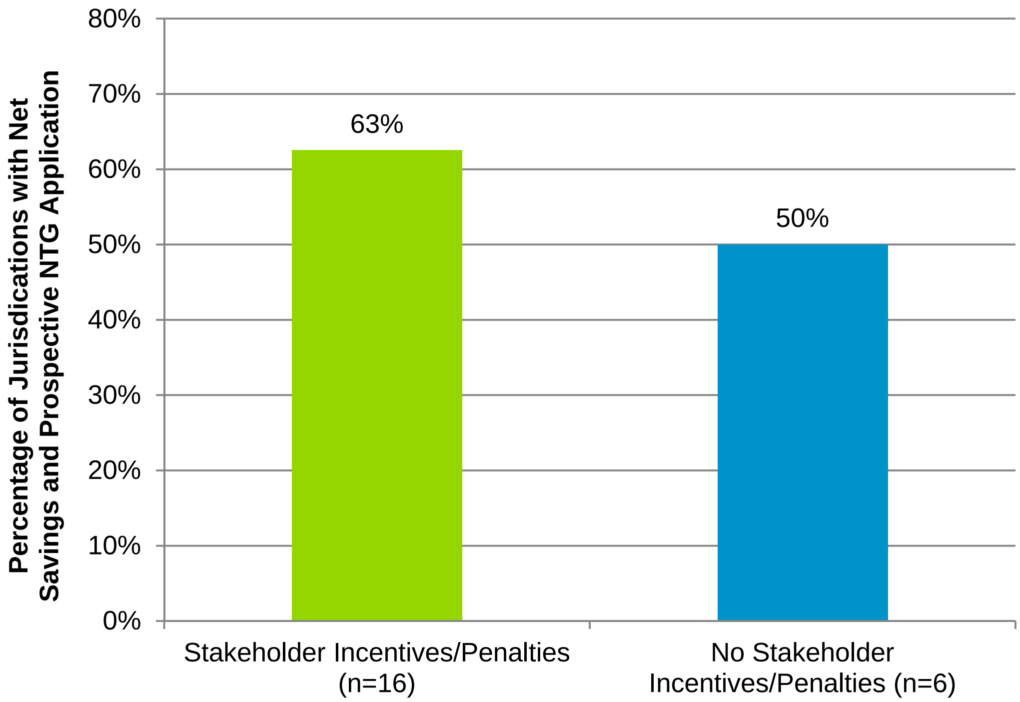
Figure 5. Percentage of Jurisdictions with Net Savings and a DSM Policy



Note, for example, the first green bar indicates that 64% of the states that have an EERS require net savings and the second green bar says that 58% of the states that allow for lost revenue recovery also require net savings, and the blue bar indicates the percentage of jurisdictions that do not have those policies that also require net savings.
Source: Navigant team research.

The Navigant team also examined the relationship of prospective versus retrospective NTG application and other DSM policy objectives. Due to the small sample size, the analysis was limited to only stakeholder incentives/penalties. As shown in Figure 6, jurisdictions with incentives are more likely (63%) to have prospective application of NTG findings versus areas without incentives (50%). Note that only six states with net savings did not have a bonus or penalty, so the sample size is quite small.

Figure 6. Percentage of Jurisdictions with Prospective NTG Application by Other DSM Policy (States with Net Savings Only) [80]



Source: Navigant team research

[80] Note that because California and Colorado have both prospective and retrospective NTG they are not included in this chart.

APPENDIX A. JURISDICTION NTG POLICY SUMMARY

	Use of Gross or Net Savings			Components of NTG				DSM/Cost Recovery Policies				
State	(A) Gross (savings assume NTG of 1.0) or Net?	(B) NTG Fixed at single value other than 1.0 for all measures?	(C) If (b)=Y then ask: What is the alternative value?	Participant SO	Non-Participant SO	Free Ridership	Goal Assessment: Gross, Fixed Net, or Adjusted (retro) Net?	Energy Efficiency Resource Standard	IRP Process	Decoupling	Lost Revenue Recovery	Risk / Reward
Alabama	Gross	No	N/A	N	N	N	Gross	No	No	No	Yes	Bonus
Alaska	Gross	No	N/A	N	N	N	Gross	No	No	No	No	No
Arizona	Gross assuming NTG of 1.0	No	N/A	N	N	N	Gross	Yes	Yes	E&G	Yes	Bonus
Arkansas	Net	No	N/A	Y	Y	Y	Retrospective	Yes	Yes	E&G	Yes	Bonus
California	Net	No	N/A	Y	N	Y	Fixed and Retrospective	Yes	Filing rqmt long-term plans	E&G	No	Both
Colorado	Net	No	N/A	Y	Y	Y	Fixed and Retrospective	Yes	Yes	No	Yes	Bonus
Connecticut	Net	No	N/A	Y	Y	Y	Fixed	Yes	Filing rqmt long-term plans	E, Pending G	Yes	Bonus
Delaware	Gross	No	N/A	N	N	N	Gross	No	Yes	Pending G	Pending	No
District of Columbia	Gross	No	N/A	N	N	N	Gross	No	No	E	No	Bonus
Florida	Net	No	N/A	Y	Y	Y	Retrospective	No	Filing rqmt long-term plans	No	Yes	Bonus
Georgia	Net	No	N/A	Y	Y	Y	Fixed	No	Yes	G	No	Bonus
Hawaii	Net	Yes	0.7	N	N	Y	Fixed	Yes	Yes	No	No	Bonus
Idaho	Gross	No	N/A	N	N	N	Gross	No	Yes	E	No	No
Illinois	Net	No	N/A	Y	Y	Y	Fixed	Yes	Filing rqmt long-term plans	G	No	Bonus
Indiana	Gross	No	N/A	Y	Y	Y	Gross	Yes	Developin g IRP	G	Yes	Bonus
Iowa	Gross assuming NTG of	No	N/A	Y	Y	Y	Gross	Yes	No	No	No	No

	Use of Gross or Net Savings			Components of NTG				DSM/Cost Recovery Policies				
State	(A) Gross (savings assume NTG of 1.0) or Net?	(B) NTG Fixed at single value other than 1.0 for all measures?	(C) If (b)=Y then ask: What is the alternative value?	Participant SO	Non-Participant SO	Free Ridership	Goal Assessment: Gross, Fixed Net, or Adjusted (retro) Net?	Energy Efficiency Resource Standard	IRP Process	Decoupling	Lost Revenue Recovery	Risk / Reward
	1.0											
Kansas	Net	No	N/A	N	N	Y	Retrospective	No	No	No	Yes	Bonus
Kentucky	Gross	No	N/A	N	N	N	Gross	No	Yes	No	Yes	Bonus
Louisiana	Gross	No	N/A	N	N	N	Gross	No	Yes	No	Yes	Bonus
Maine	Net	No	N/A	Y	N	Y	Fixed	Yes	No	No	No	No
Maryland	Gross	No	N/A	N	N	N	Gross	Yes	No	E&G	Yes	No
Massachusetts	Net	No	N/A	Y	Y	Y	Fixed	Yes	Filing rqmt long-term plans	E&G	Yes	Bonus
Michigan	Net	Yes	0.9 for all measures except CFLs/LEDs, which are 0.82	Y	Y	Y	Fixed	Yes	Filing rqmt long-term plans	E&G	Yes	Bonus
Minnesota	Gross	No	N/A	N	N	N	Gross	Yes	Yes	G, Pending E	No	Bonus
Mississippi	Gross	No	N/A	N	N	N	Gross	No	No	No	Pending	Pending
Missouri	Net	No	N/A	Y	Y	Y	Fixed	No	Yes	No	Yes	Bonus
Montana	Gross	No	N/A	N	N	N	Gross	No	Yes	No	Yes	Pending
Nebraska	Gross	No	N/A	N	N	N	Gross	No	Yes	Pending G	No	No
Nevada	Net	No	Varies	Y	Y	Y	Fixed	No	Yes	G	No	No
New Hampshire	Gross	No	N/A	N	N	N	Gross	No	Yes	No	Yes	Bonus
New Jersey	Gross	No	N/A	N	N	N	Gross	No	No	G	No	No
New Mexico	Net	No	N/A	N	N	Y	Retrospective	Yes	Yes	No	Yes	Bonus
New York	Net	Yes	0.9	Y	Y	Y	Fixed	Yes	No	E&G	No	Bonus
North Carolina	Net	No	N/A	Y	Y	Y	Retrospective	Yes	Yes	G	Yes	Bonus
North Dakota	Gross	No	N/A	N	N	N	Gross	No	Yes	No	No	No
Ohio	Gross	No	N/A	N	N	N	Gross	Yes	Filing rqmt long-term plans	E	Yes	Bonus
Oklahoma	Gross	No	N/A	N	N	N	Gross	No	Yes	No	Yes	Bonus
Oregon	Net	No	N/A	Y	Y	Y	Fixed	Yes	Yes	E&G	Yes	No
Pennsylvania	Gross	No	N/A	Y	Y	Y	Gross	Yes	No	No	No	Penalty
Rhode Island	Net	No	N/A	Y	Y	Y	Fixed	Yes	Yes	E&G	Yes	Bonus
South Carolina	Gross	No	N/A	N	N	N	Gross	No	Yes	No	Yes	Bonus
South Dakota	Net	No	N/A	Y	N	Y	Retrospective	No	Yes	No	Yes	Bonus

	Use of Gross or Net Savings			Components of NTG				DSM/Cost Recovery Policies				
State	(A) Gross (savings assume NTG of 1.0) or Net?	(B) NTG Fixed at single value other than 1.0 for all measures?	(C) If (b)=Y then ask: What is the alternative value?	Participant SO	Non-Participant SO	Free Ridership	Goal Assessment: Gross, Fixed Net, or Adjusted (retro) Net?	Energy Efficiency Resource Standard	IRP Process	Decoupling	Lost Revenue Recovery	Risk / Reward
Tennessee	Gross	No	N/A	N	N	N	Gross	No	No	G	No	No
Texas	Gross	No	N/A	N	N	N	Gross	Yes	Filing rqmt long-term plans	No	No	Bonus
Utah	Net	No	N/A	Y	Y	Y	Retrospective	No	Yes	G	Yes	No
Vermont	Net	No	Varies	Y	Y	Y	Fixed	Yes	Yes	E	No	Bonus
Virginia	Gross	No	N/A	N	N	N	Gross	No	Yes	G	Pending	No
Washington	Gross	No	N/A	Y	Y	N	Gross	Yes	Yes	Yes	No	Incentive
West Virginia	Gross	No	N/A	N	N	N	Gross	No	No	No	No	Pending
Wisconsin	Net	No	N/A	Y	N	Y	Retrospective	Yes	No	No	No	No
Wyoming	Net	No	N/A	Y	N	Y	Retrospective	No	Yes	G	Yes	No

2015 DSM DEFERRAL AND VARIANCE ACCOUNT DISPOSITION

2015 DSM DEFERRAL AND VARIANCE ACCOUNT BALANCES

The purpose of this evidence is to describe the three DSM deferral accounts and their respective 2015 balances. As explained in Exhibit A, Tab 1 and Exhibit A, Tab 2, Union is proposing to dispose of audit adjusted balances (reflecting the removal of NTG Study results from 2015 DSM results). Union's proposed audit adjusted schedules are provided at Exhibit A, Tab 3, Appendix A, Schedules 1 to 4. For comparative purposes, and in accordance with Section 11.0 of the Guidelines Union has also provided the audited balances and supporting schedules at Exhibit A, Tab 3, Appendix B, Schedules 1 to 4.[1] As 2015 is a transition year, Union has given consideration to compliance with budget rules in effect during the previous 2012-2014 DSM Framework.

This evidence is organized as follows:

1. Account No. 179-75 Lost Revenue Adjustment Mechanism
2. Account No. 179-111 Demand Side Management Variance Account
    2.1. DSMVA 15% Overspend
    2.2. Budget Transfers Between Programs
    2.3. Evaluation Budget

[1] Section 11.0, p.37 of the Guidelines states *the natural gas utilities should apply annually for the disposition of any balances in their LRAMVA and DSMVA and, if applicable, apply for a shareholder incentive amount associated with the previous DSM program year and disposition of any resulting DSMIDA balance. This application should include the final results as outlined in the Final Evaluation and Audit Reports, and information setting out the allocation across rate classes of the balances in the LRAMVA, DSMVA and DSMIDA.*

1. ACCOUNT NO.179-75 LOST REVENUE ADJUSTMENT MECHANISM ("LRAM")

The LRAM deferral account is used to track, at the rate class level, the variance between the actual impact of DSM activities undertaken by the natural gas utility and the forecasted impact included in distribution rates.[2] There is a time lag from when Union receives audited volume savings to the time those volume savings are reflected in distribution rates. LRAM amounts are only recorded in the deferral account until such time as the OEB sets distribution rates for the utility based on a new load forecast including the LRAM impacts at December 31, 2015 (i.e. annual rates filings).

The LRAM deferral account has a debit balance of $0.617 million. This balance includes volume savings for contract rate classes related to 2014 audited full year DSM activities ("2014 Annual

[2] EB-2014-0134 Filing Guidelines to the Demand Side Management Framework for Natural Gas Distributors (2015-2020), p. 39.

Volumes") at 2015 OEB-approved distribution rates ("2015 Rates") and the audit adjusted monthly volumes related to the new 2015 DSM measure installations ("New 2015 Monthly Volumes"), per the Guidelines, at 2015 Rates.[3]

Exhibit A, Tab 3, Appendix A, Schedule 2, p. 1 provides detail of the LRAM deferral account balance by rate class. Exhibit A, Tab 3, Appendix A, Schedule 2, pp. 2 and 3 provides the 2014 and 2015 contract rate class LRAM volumes and the corresponding revenue impact for 2015. The 2014 and 2015 contract rate class LRAM volumes were not reflected in Union's 2015 Rates. The deferral balance of $0.617 million includes $0.448 million related to 2014 LRAM volumes (see Exhibit A, Tab 3, Appendix A, Schedule 2, p. 2, line 10, column (e)). The $0.448 million is comprised of lost revenues from audited 2014 annual contract rate class volume savings of 104,756 10^3 m^3 at 2015 Rates. The remaining balance of $0.170 million relates to 2015 LRAM volumes (see Exhibit A, Tab 3, Appendix A, Schedule 2, p. 3, line 10, column (e)). The $0.170 million is comprised of lost revenues from audit adjusted 2015 monthly contract rate class volume savings of 49,134 10^3 m^3 at 2015 Rates. The 2015 LRAM balance represents the volumetric reductions beginning the month volume savings were realized from new DSM measures implemented in 2015 and for the remaining months of the 2015 year.

The LRAM deferral account does not include volume variances for general service rate classes as these were captured in the Normalized Average Consumption ("NAC") deferral account. The

[3] EB-2014-0134 Filing Guidelines to the DSM Framework for Natural Gas Distributors (2015-2020), p.39.

NAC deferral account was disposed of in Union's 2015 Disposition of Deferral Account Balances (EB-2016-0118) proceeding.[4]

The 2014 audited LRAM volume savings were reflected in contract delivery rates beginning January 1, 2016. As such, Union has not recorded any further lost revenues related to 2014 LRAM volume savings in the LRAM deferral account subsequent to 2015. As the 2015 DSM audit process was not complete when Union filed its 2017 Rates application (EB-2016-0245), Union adjusted 2017 volumes by 2015 pre-audit results. The 2015 pre-audit LRAM volume savings were reflected in contract delivery rates beginning January 1, 2017. As per Union's 2017 Rates evidence, the variance related to the difference between the 2015 pre-audit and audited (or in this case audit adjusted) results will be captured in the LRAM deferral account.[5] Union expects to reflect the final 2015 DSM program audit adjusted results in its 2019 Rates application subject to the OEB Decision on this application. Union will record the full year impact of the lost revenues related to 2015 volume savings at 2016 OEB-approved distribution rates and will bring this balance forward in Union's 2016 Disposition of DSM Deferral and Variance Account Balances proceeding. Similarly, Union will record the variance between the 2015 pre-audit amount included in 2017 and 2018 Rates and the 2015 audit adjusted results at 2017 and 2018 OEB-approved distribution rates and will bring this balance forward in Union's 2017 and 2018 Disposition of DSM Deferral and Variance Account Balances proceedings.

[4] This treatment is consistent with the Settlement Agreement approved by the OEB in Union's 2014-2018 Incentive Regulation Mechanism ("IRM") Agreement (EB-2013-0202).
[5] EB-2016-0245 Exhibit A, Tab 1, p. 6.

2. ACCOUNT NO.179-111 DEMAND SIDE MANAGEMENT VARIANCE ACCOUNT ("DSMVA")

The DSMVA records the difference between actual DSM spending by rate class and the DSM budget included in rates by rate class. The credit balance of $0.195 million (Exhibit A, Tab 3, Appendix A, Schedule 3, line 14, column (c)) represents the difference between actual 2015 DSM expenditures of $32.393 million and the $32.588 million budget included in 2015 rates.

In addition to the amount included in 2015 rates, in the 2015-2020 DSM Plan Decision the OEB approved Union to spend an incremental amount of $1.4 million on three items in 2015:[6]

1) $0.2 million on the Achievable Potential Study
2) $0.2 million on DSM and Infrastructure Planning Study
3) $1.0 million on DSM Tracking and Reporting System Requirements

During 2015, no costs were incurred related to either the Achievable Potential Study or the DSM and Infrastructure Planning Study (also known as the Integrated Resource Planning ("IRP") Study). Union began incurring costs in 2016 and spending continues in 2017. As such, recovery will be sought through the DSMVA as part of DSM deferral proceedings for 2016 and 2017 respectively.

As part of Union's 2015-2020 DSM Plan, Union requested a total of $6.0 million ($1.0 million in 2015 and $5.0 million in 2016) for the DSM Tracking and Reporting System upgrades. In the

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[6] EB-2015-0029 Exhibit A, Tab 2, p. 6.

2015-2020 DSM Plan Decision, the OEB approved $6.0 million for the System upgrades.[7] Due to the timing of the OEB's Decision, the $1.0 million approved spend in 2015 for the DSM Tracking and Reporting System upgrades were not reflected in Union's 2015 Rates. The $5.0 million approved spend in 2016 is reflected in Union's 2016 Rates.[8]

Costs of $0.214 million were incurred in 2015 related to initial work undertaken to develop a new DSM Tracking and Reporting System. Recovery of these costs is being sought through the DSMVA as part of this proceeding. These costs were incurred to develop a project roadmap, determine system requirements, and to complete the vendor selection process. Similarly, costs were incurred for the development of the new DSM Tracking and Reporting System in 2016 and spending continues in 2017 and beyond. The variance between the OEB-approved $6 million in costs and actual costs will be addressed as part of future DSM deferral proceedings.

Union followed the OEB-approved methodology to calculate the 2015 DSMVA balance.[9] Union used the DSMVA to track the variance between actual DSM spending by rate class, relative to the DSM budget included in rates by rate class. The customer incentive was allocated based on the amount spent within each rate class. All other program costs were allocated by customer class (e.g. Residential, Commercial/Industrial) and assigned by rate class based on the percentage allocation of the customer incentive costs. All portfolio-level costs that cannot be attributed to an individual program were allocated to a rate class based on the percentage

[7] EB-2015-0029 Decision and Order, January 20, 2016, Schedule A.
[8] EB-2015-0116 Rate Order, Working Papers, Schedule 11.
[9] EB-2015-0029 Exhibit A, Tab 2, pp. 22-23.

allocation of the program costs by rate class. The variance between the Low-Income DSM budget included in rates and the actual amount spent on Low-Income DSM programs is recovered in proportion to the OEB-approved 2015 distribution revenue by rate class. The overall 2015 Low-Income budget spend of $8.562 million, which includes the allocated portfolio costs, is allocated in proportion to the 2015 distribution revenue.[10]

Section 8.1 of the 2015-2020 DSM Plan Decision indicates 2015 is a transition year. Union therefore comments below on its compliance with budget rules in effect during the previous 2012-2014 DSM Framework.

2.1 DSMVA 15% OVERSPEND (DSM GUIDELINES FOR NATURAL GAS UTILITIES ISSUED JUNE 30, 2011, EB-2008-0346)

As per Section 13.2 of the OEB's DSM Guidelines, Union is eligible to recover up to an additional 15% overspend above its annual OEB-approved DSM budget through the DSMVA as long as its overall weighted scorecard target on a pre-audited basis for one or more of its scorecards has been achieved (provided the overspend was on program expenses). While Union underspent the 2015 DSM budget in rates by $0.195 million, it utilized the DSMVA mechanism to overspend on the Resource Acquisition and Low-Income scorecards. Both scorecards achieved pre-audit results above the weighted scorecard targets required for the 15% overspend to be accessed. The pre-audit scorecard results are summarized below, in Table 1.

[10] Per Union's 2015 Rates application (EB-2014-0271).

Table 1

2015 DSM Scorecard Results (Pre-Audit)

Scorecard	**Total Scorecard Target Achieved**
Resource Acquisition	136%
Low-Income	132%

As outlined in Table 11 of Union's 2015 Demand Side Management Draft Annual report dated April 22, 2016, the overspend on the Resource Acquisition and Low-Income scorecards was largely offset by an underspend on the Large Volume Program and on the Portfolio Research Budget.

2.2 Budget Transfers between Programs (DSM Guidelines for Natural Gas Utilities issued June 30, 2011, EB-2008-0346)

The OEB's DSM Guidelines for Natural Gas Utilities states that the utilities should inform the OEB and stakeholders in the event that cumulative fund transfers among OEB-approved DSM programs exceed 30% of the approved annual DSM budget for an individual natural gas DSM program. Union did not transfer more than 30% between programs.

2.3 Evaluation Budget (Settlement Agreement Section 2.5)

The Evaluation budget of $1.342 million (see 2015 DSM Final Annual Report at Exhibit B, Tab 1) was used solely for Evaluation expenditures.

2.4 RESOURCE ACQUISITION PROGRAM – INTEGRATED ENERGY MANAGEMENT SYSTEMS ("IEMS") (SETTLEMENT AGREEMENT SECTION 6.1)

The $0.650 million (see 2015 DSM Final Annual Report) budget associated with IEMS was allocated according to the provisions of the Settlement Agreement. There was no actual expense incurred in 2015 for IEMS activities. Union shifted $0.350 million of the IEMS budget to other programs and did not adjust the 2015 Resource Acquisition targets. The remaining balance of $0.300 million of the IEMS budget is credited to ratepayers in the DSMVA.

2.5 RESOURCE ACQUISITION PROGRAM – RESTRICTIONS ON RATE CLASS ALLOCATIONS (SETTLEMENT AGREEMENT SECTION 6.4)

In compliance with the terms of this Section, Union notified the OEB and Intervenors via a letter dated November 18, 2015 that it expected to exceed a shift in its Resource Acquisition budget of 100% for the Rate M7 class in 2015 due to customer switching across rate classes from Rate M4 and M5 to Rate M7. As noted in Exhibit A, Tab 3, Appendix A, Schedule 3, the actual shift to the Rate M7 class realized was 190%. The DSM costs in 2015 rates for Rate M7 were related to four customers. The actual 2015 DSM costs related to 28 customers (due to rate class migration beginning January 1, 2014).[11] For 2015, the variance is 190% and will be allocated to all Rate M7 customers based on actual volume. For 2016 and subsequent years, to address the discrepancy between the proportions of DSM costs in Rate M7 compared to Rates M4 and M5, Union pooled the costs for these three rate classes and reallocated them in proportion to the 2015

[11] EB-2016-0118 Exhibit A, Tab 2, Appendix A, Schedule 10.

approved billing units.[12] In accordance with the OEB's Decision on its 2015-2020 DSM Plan, Union will pool DSM costs recoverable from Rate M4, M5 and M7 customers in rates for 2016-2018.[13]

2.6 LARGE VOLUME RATE T1, RATE T2 AND RATE 100 PROGRAM (SETTLEMENT AGREEMENT SECTION 7)

Union adhered to the OEB-approved maximum program budget transfer rules between Rate T1, Rate T2 or Rate 100 to Rate T1, Rate T2 or Rate 100 respectively.[14] The overall under-spend of $1.779 million for the Large Volume Program is credited in the DSMVA. Union did not transfer budget dollars from any other part of the overall DSM budget into Rate T1, Rate T2 or Rate 100 rate classes.

3. ACCOUNT NO. 179-126 DEMAND SIDE MANAGEMENT INCENTIVE DEFERRAL ACCOUNT ("DSMIDA")

The purpose of the DSMIDA is to record the DSM incentive amount earned by Union as a result of its DSM program.[15] This account has a debit balance of $7.472 million to be recovered from ratepayers related to 2015 audit adjusted DSM activity. Exhibit A, Tab 3, Appendix A, Schedule 4 provides the breakdown of the DSMIDA by rate class. The 2015 DSM incentive Union achieved for each scorecard is presented in Table 2.

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[12] EB-2015-0029 Exhibit A, Tab 2, p.23.
[13] EB-2015-0029 Decision and Order, January 20, 2016, p.91.
[14] EB-2012-0337 2013-2014 DSM Plan Section 2, p. 14.
[15] EB-2014-0134 Filing Guidelines to the Demand Side Management Framework for Natural Gas Distributors (2015-2020), p. 39.

Table 2

Summary of 2015 Incentive Results by Scorecard

DSM Incentive			
Scorecard	Plan (100% Target)	Actual Audit Adjusted Results	Max Payout
Resource Acquisition	$2,304,733	$4,443,226	$5,761,833
Large Volume T2/T1/R100	$745,151	$0	$1,862,877
Low-Income	$1,124,051	$2,462,534	$2,810,129
Market Transformation	$226,689	$566,721	$566,721
Total	$ 4,400,624	$ 7,472,481	$ 11,001,560

3.1 RESOURCE ACQUISITION SCORECARD

Resource Acquisition programs seek to achieve direct, measurable savings via installation of energy efficient equipment. The Resource Acquisition scorecard included three performance metrics that support and incentivize technologies that drive deeper and longer savings for all customers. The overall 2015 Resource Acquisition program achieved 131% and Union is claiming a $4.443 million DSM incentive based on the 2015 scorecard targets and corresponding incentives. [16] The 2015 Resource Acquisition scorecard results are presented in Table 3.

[16] EB-2015-0029 Exhibit A, Tab 2, p.12.

Table 3

2015 Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Metric Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	612,421,363	816,561,818	1,020,702,272	90%	919,157,080	125%	*113%*
Deep Savings – Residential	934	1,254	1,556	5%	2,529	306%	*15%*
Deep Savings - C/I	7.88%	8.88%	9.88%	5%	8.08%	60%	3%
				Total Scorecard Target Achieved			***131%***
				Scorecard Incentive Achieved			***$ 4,443,226***
				% of Maximum Incentive Achieved			***77%***

3.2 LARGE VOLUME RATE T1, RATE T2 AND RATE 100 SCORECARD

The Large Volume scorecard measures the cumulative m^3 savings of participants within the Rate T1, Rate T2 and Rate 100 rate classes. The 2015 Large Volume program did not achieve a DSM incentive based on its performance compared to the targets approved by the OEB in EB-2015-0029.[17] The 2015 Large Volume scorecard results are provided in Table 4.

[17] EB-2015-0029 Exhibit A, Tab 2, p.17.

Table 4

2015 Large Volume Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Metric Achieved
	Lower Band	Target	Upper Band				
Rate T2/Rate 100 Cumulative Natural Gas Savings (m^3)	772,381,040	1,029,841,387	1,287,301,734	40%	658,010,847	28%	*11%*
Rate T1 Cumulative Natural Gas Savings (m^3)	154,692,013	206,256,017	257,820,021	60%	121,416,767	18%	*11%*
				Total Scorecard Target Achieved			***22%***
				Scorecard Incentive Achieved			***$ 0***
				% of Maximum Incentive Achieved			***0%***

3.3 LOW-INCOME SCORECARD

The Low-Income program seeks to achieve direct measurable savings by the installation of energy efficient equipment focusing on the needs of the Low-Income market segment. The overall 2015 Low-Income program achieved 140% and Union is claiming a $2.463 million DSM incentive based on the 2015 scorecard targets and corresponding incentives.[18] The overall 2015 Low-Income scorecard results are provided in Table 5.

[18] EB-2015-0029 Exhibit A, Tab 2, p.18.

Table 5

2015 Low-Income Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Metric Achieved
	Lower Band	**Target**	**Upper Band**				
Single Family Cumulative Natural Gas Savings (m^3)	19,500,000	26,000,000	32,500,000	60%	35,847,426	176%	*105%*
Multi Family Cumulative Natural Gas Savings (m^3)	13,200,000	17,600,000	22,000,000	40%	16,333,361	86%	*34%*
				Total Scorecard Target Achieved			***140%***
				Scorecard Incentive Achieved			***$2,462,534***
				% of Maximum Incentive Achieved			***88%***

3.4 Market Transformation Scorecard

In 2015, Union continued to focus its Market Transformation activity on the New Home Efficiency offering (Optimum Home). The overall 2015 Market Transformation scorecard achieved 150% and Union is claiming a $0.567 million DSM incentive based on the 2015 scorecard targets and corresponding incentives.[19] The 2015 Market Transformation scorecard results are provided below in Table 6.

[19] EB-2015-0029 Exhibit A, Tab 2, p.19

Table 6

2015 Market Transformation Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Metric Achieved
	Lower Band	Target	Upper Band				
Homes Built (>20% above OBC 2012) by Participating Builders	24.73%	29.73%	34.73%	100%	50%	306%	*306%*
				Total Scorecard Target Achieved			***150%***[20]
				Scorecard Incentive Achieved			***$566,721***
				% of Maximum Incentive Achieved			***100%***

The process to finalize DSMIDA related balances includes a third-party EM&V by an EC hired by the OEB. This process is discussed in further detail in Exhibit A, Tab 2.

[20] Scorecard capped at 150%. Actual scorecard achievement is 306%.

UNION GAS LIMITED
Audit Adjusted Deferral Account Balances (1)
Year Ending December 31, 2015

Line No.	Account Number	Account Name	Filed Balance ($000's)
	DSM Accounts (2)		
1	179-75	Lost Revenue Adjustment Mechanism	617
2	179-111	Demand Side Management Variance Account	(195)
3	179-126	Demand Side Management Incentive	7,472
4	Total DSM Accounts (Lines 1 through 3)		7,895
5	**Total Deferral Account Balances**		**7,895**

Notes:

(1) Audit adjusted balances reflect the final audited DSM amounts, adjusted to remove the NTG Study results from 2015 DSM results. The term audit adjusted refers to the fact that Union supports the application of the 2015 DSM EM&V results with the exception of the NTG Study results.

(2) There is no interest calculated on the above noted DSM deferral account balances as of December 31, 2015.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2015 LRAM Deferral Account Balance

Line No.	Particulars ($)	Amounts by DSM Plan Year 2014 [1]	2015 [2]	Total
		(a)	(b)	(c)
	South			
1	M4	103,545	77,633	181,179
2	M5	215,206	37,670	252,876
3	M7	27,232	33,060	60,292
4	T1	3,100	5,304	8,403
5	T2	3,237	1,488	4,726
6		352,320	155,155	507,475
	North			
7	Rate 20	38,092	7,195	45,286
8	Rate 100	57,188	7,527	64,716
9		95,280	14,722	110,002
10	Total	447,600	169,877	617,477

Notes:
[1] EB-2015-0276, Exhibit A, Tab 3, Schedule 2, page 2 of 3, column (e)
[2] EB-2015-0276, Exhibit A, Tab 3, Schedule 2, page 3 of 3, column (e)

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2014 - Audited

Line No.	Particulars ($)	2014 Audited Volumes [1] $10^3 m^3$	2014 LRAM Volumes in 2015 Rates $10^3 m^3$	2014 Net LRAM Volumes $10^3 m^3$	2015 Delivery Rates $\$/10^3 m^3$	Revenue Impact ($)
		(a)	(b)	(c) = (a) - (b)	(d)	(e) = (c) x (d)
	South					
1	M4	9,945	-	9,945	10.412	103,545
2	M5	9,141	-	9,141	23.543	215,206
3	M7	7,848	-	7,848	3.470	27,232
4	T1	4,195	-	4,195	0.739	3,100
5	T2	40,465	-	40,465	0.080	3,237
6		71,594	-	71,594		352,320
	North					
7	Rate 20	7,051	-	7,051	5.402	38,092
8	Rate 100	26,110	-	26,110	2.190	57,188
9		33,162	-	33,162		95,280
10	Total	104,756	-	104,756		447,600

Notes:
(1) EB-2015-0116, Rate Order, Working Papers, Schedule 17.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2015 - Audit Adjusted[(1)]

Line No.	Particulars	2015 Audited Volumes $10^3 m^3$	2015 LRAM Volumes in 2015 Rates $10^3 m^3$	2015 Net LRAM Volumes $10^3 m^3$	2015 Delivery Rates $\$/10^3 m^3$	Revenue Impact ($)
		(a)	(b)	(c) = (a) - (b)	(d)	(e) = (c) x (d)
	South					
1	M4	7,456	-	7,456	10.412	77,633
2	M5	1,600	-	1,600	23.543	37,670
3	M7	9,527	-	9,527	3.470	33,060
4	T1	7,177	-	7,177	0.739	5,304
5	T2	18,605	-	18,605	0.080	1,488
6		44,365	-	44,365		155,155
	North					
7	Rate 20	1,332	-	1,332	5.402	7,195
8	Rate 100	3,437	-	3,437	2.190	7,527
9		4,769	-	4,769		14,722
10	Total	49,134	-	49,134		169,877

Notes:

(1) Audit adjusted balances reflect the final audited DSM amounts, adjusted to remove the NTG Study results from 2015 DSM results. The term audit adjusted refers to the fact that Union supports the application of the 2015 DSM EM&V results with the exception of the NTG Study results.

UNION GAS LIMITED
Demand Side Management Variance Account
2015 - Audit Adjusted (1)

Line No.	Particulars ($000's)	2015 DSM Costs in 2015 Rates[(2)]	Actual DSM Costs [(3)]	Account Balance	Variance
		(a)	(b)	(c) = (b) - (a)	
	South				
1	M1	10,763,283	13,186,370	2,423,087	22.5%
2	M2	4,012,184	3,728,023	(284,161)	(7.1%)
3	M4	1,655,081	2,876,612	1,221,531	73.8%
4	M5	2,762,895	1,147,287	(1,615,608)	(58.5%)
5	M7	932,714	2,706,203	1,773,489	190.1%
6	T1	1,854,791	887,143	(967,648)	(52.2%)
7	T2	2,686,592	2,672,302	(14,290)	(0.5%)
		24,667,542	27,203,941	2,536,399	10.3%
	North				
9	Rate 01	3,843,188	2,779,747	(1,063,440)	(27.7%)
10	Rate 10	1,221,710	773,824	(447,885)	(36.7%)
11	Rate 20	1,003,649	838,501	(165,148)	(16.5%)
12	Rate 100	1,851,790	796,631	(1,055,159)	(57.0%)
13		7,920,337	5,188,704	(2,731,633)	(34.5%)
14	Total	32,587,879	32,392,645	(195,234)	-0.6%

Notes:

(1) Audit adjusted balances reflect the final audited DSM amounts, adjusted to remove the NTG Study results from 2015 DSM results. The term audit adjusted refers to the fact that Union supports the application of the 2015 DSM EM&V results with the exception of the NTG Study results.

(2) DSM Costs in 2015 rates as per EB-2014-0271, Working Papers, Schedule 11.

(3) Allocated as per the Settlement Agreement issued January 31, 2012 and the Decision and Order on the Settlement Agreement EB-2011-0327 issued on February 21, 2012.

UNION GAS LIMITED
DSM Incentive Deferral Account
2015 - Audit Adjusted (1)

Line No.	Particulars ($)	Amount (2)
		(a)
	South	
1	M1	3,565,990
2	M2	1,230,083
3	M4	694,078
4	M5	236,532
5	M7	631,583
6	T1	-
7	T2	-
		6,358,265
	North	
8	Rate 01	775,326
9	Rate 10	179,065
10	Rate 20	159,824
11	Rate 100	-
12		1,114,215
13	Total	7,472,481

Notes:

(1) Audit adjusted balances reflect the final audited DSM amounts, adjusted to remove the NTG Study results from 2015 DSM results. The term audit adjusted refers to the fact that Union supports the application of the 2015 DSM EM&V results with the exception of the NTG Study results.

(2) The DSM Incentive for 2015 is calculated and allocated to rate classes using the mechanism approved by the Board in EB-2011-0327.

UNION GAS LIMITED
Audited Deferral Account Balances
Year Ending December 31, 2015

Line No.	Account Number	Account Name	Filed Balance ($000's)
	DSM Accounts:		
1	179-75	Lost Revenue Adjustment Mechanism	602
2	179-111	Demand Side Management Variance Account	(195)
3	179-126	Demand Side Management Incentive	7,040
4	Total DSM Accounts (Lines 1 through 3)		7,447
5	**Total Deferral Account Balances**		**7,447**

Notes:
1 There is no interest calculated on the above noted DSM deferral account balances as of December 31, 2015.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2015 LRAM Deferral Account Balance

Line No.	Particulars ($)	Amounts by DSM Plan Year 2014 [1]	2015 [2]	Total
		(a)	(b)	(c)
	South			
1	M4	103,545	74,681	178,227
2	M5	215,206	36,890	252,096
3	M7	27,232	32,272	59,503
4	T1	3,100	1,462	4,562
5	T2	3,237	361	3,598
6		352,320	145,665	497,986
	North			
7	Rate 20	38,092	6,808	44,900
8	Rate 100	57,188	1,894	59,082
9		95,280	8,702	103,982
10	Total	447,600	154,368	601,968

Notes:
(1) EB-2015-0276, Exhibit A, Tab 3, Schedule 2, page 2 of 3, column (e)
(2) EB-2015-0276, Exhibit A, Tab 3, Schedule 2, page 3 of 3, column (e)

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2014 - Audited

Line No.	Particulars ($)	2014 Audited Volumes [1] 10^3 m^3	2014 LRAM Volumes in 2015 Rates 10^3 m^3	2014 Net LRAM Volumes 10^3 m^3	2015 Delivery Rates $\$/10^3$ m^3	Revenue Impact ($)
		(a)	(b)	(c) = (a) - (b)	(d)	(e) = (c) x (d)
	South					
1	M4	9,945	-	9,945	10.412	103,545
2	M5	9,141	-	9,141	23.543	215,206
3	M7	7,848	-	7,848	3.470	27,232
4	T1	4,195	-	4,195	0.739	3,100
5	T2	40,465	-	40,465	0.080	3,237
6		71,594	-	71,594		352,320
	North					
7	Rate 20	7,051	-	7,051	5.402	38,092
8	Rate 100	26,110	-	26,110	2.190	57,188
9		33,162	-	33,162		95,280
10	Total	104,756	-	104,756		447,600

Notes:
[1] EB-2015-0116, Rate Order, Working Papers, Schedule 17.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2015 - Audited

Line No.	Particulars	2015 Audited Volumes 10^3 m^3	2015 LRAM Volumes in 2015 Rates 10^3 m^3	2015 Net LRAM Volumes 10^3 m^3	2015 Delivery Rates $/$10^3$ m^3	Revenue Impact ($)
		(a)	(b)	(c) = (a) - (b)	(d)	(e) = (c) x (d)
	South					
1	M4	7,172	-	7,172	10.412	74,681
2	M5	1,567	-	1,567	23.543	36,890
3	M7	9,300	-	9,300	3.470	32,272
4	T1	1,978	-	1,978	0.739	1,462
5	T2	4,506	-	4,506	0.080	361
6		24,524	-	24,524		145,665
	North					
7	Rate 20	1,260	-	1,260	5.402	6,808
8	Rate 100	865	-	865	2.190	1,894
9		2,125	-	2,125		8,702
10	Total	26,649	-	26,649		154,368

UNION GAS LIMITED
Demand Side Management Variance Account
2015 - Audited

Line No.	Particulars ($000's)	2015 DSM Costs in 2015 Rates[1]	Actual DSM Costs [2]	Account Balance	Variance
		(a)	(b)	(c) = (b) - (a)	
	South				
1	M1	10,763,283	13,186,370	2,423,087	22.5%
2	M2	4,012,184	3,728,023	(284,161)	(7.1%)
3	M4	1,655,081	2,876,612	1,221,531	73.8%
4	M5	2,762,895	1,147,287	(1,615,608)	(58.5%)
5	M7	932,714	2,706,203	1,773,489	190.1%
6	T1	1,854,791	887,143	(967,648)	(52.2%)
7	T2	2,686,592	2,672,302	(14,290)	(0.5%)
		24,667,542	27,203,941	2,536,399	10.3%
	North				
9	Rate 01	3,843,188	2,779,747	(1,063,440)	(27.7%)
10	Rate 10	1,221,710	773,824	(447,885)	(36.7%)
11	Rate 20	1,003,649	838,501	(165,148)	(16.5%)
12	Rate 100	1,851,790	796,631	(1,055,159)	(57.0%)
13		7,920,337	5,188,704	(2,731,633)	(34.5%)
14	Total	32,587,879	32,392,645	(195,234)	-0.6%

Notes:

(1) DSM Costs in 2015 rates as per EB-2014-0271, Working Papers, Schedule 11.

(2) Allocated as per the Settlement Agreement issued January 31, 2012 and the Decision and Order on the Settlement Agreement EB-2011-0327 issued on February 21, 2012.

UNION GAS LIMITED
DSM Incentive Deferrral Account
2015 - Audited

Line No.	Particulars ($)	Amount [1]
		(a)
	South	
1	M1	3,391,844
2	M2	1,157,270
3	M4	630,835
4	M5	213,504
5	M7	570,092
6	T1	-
7	T2	-
		5,963,545
	North	
8	Rate 01	764,655
9	Rate 10	167,430
10	Rate 20	144,264
11	Rate 100	-
12		1,076,349
13	Total	7,039,894

Notes:
(1) The DSM Incentive for 2015 is calculated and allocated to rate classes using the mechanism approved by the Board in EB-2011-0327.

2015 DSM DEFERRAL AND VARIANCE ACCOUNT DISPOSITION

ALLOCATION AND DISPOSITION OF 2015 DSM BALANCES

The purpose of this evidence is to address the allocation and disposition of 2015 DSM-related deferral and variance account balances identified at Exhibit A, Tab 3, Appendix A, Schedule 1. As mentioned in Exhibit A Tabs 1 to 3, the balances Union is proposing to dispose of are audit adjusted balances, reflecting the removal of NTG Study results from 2015 DSM results. The allocation and disposition of the audit adjusted 2015 DSM balances is provided at Exhibit A, Tab 4, Appendix A. For comparative purposes, and in accordance with Section 11.0 of the Guidelines,[1] Union has also provided the allocation of audited DSM balances at Exhibit A, Tab 4, Appendix B.

This evidence is organized as follows:

1. DSM-Related Deferral Accounts
    1.1. Disposition of 2015 DSM-Related Deferral Account Balances
    1.2. General Service Bill Impacts

The allocation of 2015 audit adjusted DSM-related deferral and variance account balances to rate classes appears at Exhibit A, Tab 4, Appendix A, Schedule 1. Exhibit A, Tab 4, Appendix A,

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[1] Section 11.0, p. 37 of the Guidelines states *the natural gas utilities should apply annually for the disposition of any balances in their LRAMVA and DSMVA and, if applicable, apply for a shareholder incentive amount associated with the previous DSM program year and disposition of any resulting DSMIDA balance. This application should include the final results as outlined in the Final Evaluation and Audit Reports, and information setting out the allocation across rate classes of the balances in the LRAMVA, DSMVA and DSMIDA.*

Schedule 2 provides the unit rates for disposition to Union's in-franchise rate classes. Exhibit A, Tab 4, Appendix A, Schedule 3 provides the impact of the proposed disposition for general service customers in Union South and Union North.

Consistent with the treatment of 2015 as a transition year, Union has rolled-forward its 2014 DSM plan into 2015.[2] Accordingly, the allocation of 2015 DSM-related deferral and variance account balances to rate classes is consistent with the allocation methodologies approved by the OEB in Union's 2014 Disposition of DSM Deferral and Variance Account proceeding (EB-2015-0276).

1. DSM-Related Deferral Accounts

Union proposes to allocate the balance in the Lost Revenue Adjustment Mechanism ("LRAM") Deferral Account (No. 179-75) to contract rate classes in proportion to the margin reduction attributable to DSM activities appearing at Exhibit A, Tab 3, Appendix A, Schedule 2, p 1.

Union proposes to allocate the balance in the Demand Side Management Variance Account ("DSMVA") (No. 179-111) to rate classes in proportion to the variance between budgeted and actual DSM spending by rate class in 2015, with the exception of low-income spending which is allocated in proportion to the most recent OEB-approved distribution revenue by rate class.

Union proposes to allocate the balance in the Demand Side Management Incentive Deferral Account

[2] EB-2014-0134 Demand Side Management Framework for Natural Gas Distributors (2015-2020), p. 37.

("DSMIDA") (No. 179-126) to rate classes in proportion to the actual DSM spending by rate class in 2015 for scorecards where Union has achieved a DSM incentive.

1.1 DISPOSITION OF 2015 DSM-RELATED DEFERRAL ACCOUNT BALANCES

For general service Rate M1, Rate M2, Rate 01 and Rate 10 customers, Union proposes to dispose of the net 2015 DSM-related deferral and variance account balances prospectively over a six-month period beginning the first available QRAM after OEB approval. The prospective refund/recovery approach proposed for Rate M1, Rate M2, Rate 01 and Rate 10 customers is consistent with how Union disposed of 2014 deferral account balances in the 2014 Disposition of DSM Deferral and Variance Accounts (EB-2015-0276) proceeding. For purposes of calculating bill impacts, Union assumes implementation with the April 2018 QRAM.

For in-franchise contract rate classes, Union is proposing to dispose of the net 2015 DSM-related deferral and variance account balances as a one-time adjustment with the first available QRAM after OEB approval. This one-time adjustment approach is consistent with the methodology used for the disposition of 2014 deferral account and earnings sharing balances in 2014 Disposition of DSM Deferral and Variance Accounts (EB-2015-0276) proceeding.

1.2 GENERAL SERVICE BILL IMPACTS

General service customer impacts are presented at Exhibit A, Tab 4, Appendix A, Schedule 3. For a residential customer in Union South with annual consumption of 2,200 m^3, the charge for the period April 1, 2018 to September 30, 2018 is estimated to be \$4.80. For a residential customer in Union

North with annual consumption of 2,200 m^3, the charge for the period April 1, 2018 to September 30, 2018 is estimated to be a credit of $0.70.

UNION GAS LIMITED
Allocation of DSM Deferral Account Balances
2015 - Audit Adjusted

Line No.	Particulars ($000's)	Acct No.	Union North Rate 01	Union North Rate 10	Union North Rate 20	Union North Rate 100	Union North Rate 25	Union South M1	Union South M2	Union South M4	Union South M5A	Union South M7	Union South M9	Union South M10	Union South T1	Union South T2	Union South T3	Total (1)
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
	Delivery-Related Deferrals:																	
1	Lost Revenue Adjustment Mechanism	179-75	-	-	45	65	-	-	-	181	253	60	-	-	8	5	-	617
2	Demand Side Management Variance Account	179-111	(1,063)	(448)	(165)	(1,055)	-	2,423	(284)	1,222	(1,616)	1,773	-	-	(968)	(14)	-	(195)
3	Demand Side Management Incentive	179-126	775	179	160	-	-	3,566	1,230	694	237	632	-	-	-	-	-	7,472
4	Total Delivery-Related Deferrals		(288)	(269)	40	(990)	-	5,989	946	2,097	(1,126)	2,465	-	-	(959)	(10)	-	7,895

Notes:
(1) Exhibit A, Tab 3, Appendix A, Schedule 1.

UNION GAS LIMITED
General Service Unit Rates for Prospective Recovery/(Refund) - Delivery
DSM Deferral Account Disposition
2015 - Audit Adjusted

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	Forecast Volume (10^3m^3) (2)	Unit Rate for Prospective Recovery/(Refund) (cents/m^3)
			(a)	(b)	(c) = (a / b) * 100
	Union North				
1	Small Volume General Service	01	(288)	192,153	(0.1499)
2	Large Volume General Service	10	(269)	105,630	(0.2545)
	Union South				
3	Small Volume General Service	M1	5,989	650,698	0.9204
4	Large Volume General Service	M2	946	324,774	0.2913
5	Total General Service		6,378		

Notes:
(1) Exhibit A, Tab 4, Appendix A, Schedule 1.
(2) Forecast volume for the period April 1, 2018 to September 30, 2018.

UNION GAS LIMITED
Contract Unit Rates for One-Time Adjustment - Delivery
DSM Deferral Account Disposition
2015 - Audit Adjusted

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	2015 Actual Volume (10^3m^3)	Unit Rate (cents/m^3)
			(a)	(b)	(c) = (a / b) * 100
	Union North				
1	Medium Volume Firm Service	20	40	540,593	0.0074
2	Large Volume High Load Factor	100	(990)	1,398,188	(0.0708)
3	Large Volume Interruptible	25	-	147,757	-
	Union South				
4	Firm Com/Ind Contract	M4	2,097	457,207	0.4586
5	Interruptible Com/Ind Contract	M5A	(1,126)	209,157	(0.5384)
6	Special Large Volume Contract	M7	2,465	427,949	0.5761
7	Large Wholesale	M9	-	66,511	-
8	Small Wholesale	M10	-	301	-
9	Contract Carriage Service	T1	(959)	444,084	(0.2160)
10	Contract Carriage Service	T2	(10)	4,365,603	(0.0002)
11	Contract Carriage- Wholesale	T3	-	263,235	-
12	Total Contract Service		1,517		

Notes:
(1) Exhibit A, Tab 4, Appendix A, Schedule 1.

UNION GAS LIMITED
General Service Bill Impacts
2015 - Audit Adjusted

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m³) (1)	Volume (m³) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate 01	Delivery	(0.1499)	468	(0.70)
2		Commodity	-	468	-
3		Transportation	-	468	-
4			(0.1499)		(0.70)
5	Sales Service				(0.70)
6	Direct Purchase Bundled T				(0.70)
7	Rate 10	Delivery	(0.2545)	26,039	(66.27)
8		Commodity	-	26,039	-
9		Transportation	-	26,039	-
10			(0.2545)		(66.27)
11	Sales Service				(66.27)
12	Direct Purchase Bundled T				(66.27)
13	Rate M1	Delivery	0.9204	521	4.80
14		Commodity	-	521	-
15			0.9204		4.80
16	Sales Service				4.80
17	Direct Purchase				4.80
18	Rate M2	Delivery	0.2913	17,228	50.19
19		Commodity	-	17,228	-
20			0.2913		50.19
21	Sales Service				50.19
22	Direct Purchase				50.19

Notes:
(1) Exhibit A, Tab 4, Appendix A, Schedule 2, p. 1, column (c).
(2) Average consumption, per customer, for the period April 1, 2018 to September 30, 2018.

UNION GAS LIMITED
Allocation of DSM Deferral Account Balances
2015 - Audited

Line		Acct	Union North					Union South										
No.	Particulars ($000's)	No.	Rate 01	Rate 10	Rate 20	Rate 100	Rate 25	M1	M2	M4	M5A	M7	M9	M10	T1	T2	T3	Total (1)
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
	Delivery-Related Deferrals:																	
1	Lost Revenue Adjustment Mechanism	179-75	-	-	45	59	-	-	-	178	252	60	-	-	5	4	-	602
2	Demand Side Management Variance Account	179-111	(1,063)	(448)	(165)	(1,055)	-	2,423	(284)	1,222	(1,616)	1,773	-	-	(968)	(14)	-	(195)
3	Demand Side Management Incentive	179-126	765	167	144	-	-	3,392	1,157	631	214	570	-	-	-	-	-	7,040
4	Total Delivery-Related Deferrals		(299)	(280)	24	(996)	-	5,815	873	2,031	(1,150)	2,403	-	-	(963)	(11)	-	7,447

Notes:
(1) Exhibit A, Tab 3, Appendix B, Schedule 1.

UNION GAS LIMITED
General Service Unit Rates for Prospective Recovery/(Refund) - Delivery
DSM Deferral Account Disposition
2015 - Audited

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1) (a)	Forecast Volume (10^3m^3) (2) (b)	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (c) = (a / b) * 100
	Union North				
1	Small Volume General Service	01	(299)	192,153	(0.1555)
2	Large Volume General Service	10	(280)	105,630	(0.2655)
	Union South				
3	Small Volume General Service	M1	5,815	650,698	0.8936
4	Large Volume General Service	M2	873	324,774	0.2688
5	Total General Service		6,109		

Notes:
(1) Exhibit A, Tab 4, Appendix B, Schedule 1.
(2) Forecast volume for the period April 1, 2018 to September 30, 2018.

UNION GAS LIMITED
Contract Unit Rates for One-Time Adjustment - Delivery
DSM Deferral Account Disposition
2015 - Audited

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	2015 Actual Volume (10^3m^3)	Unit Rate (cents/m^3)
			(a)	(b)	(c) = (a / b) * 100
	Union North				
1	Medium Volume Firm Service	20	24	540,593	0.0044
2	Large Volume High Load Factor	100	(996)	1,398,188	(0.0712)
3	Large Volume Interruptible	25	-	147,757	-
	Union South				
4	Firm Com/Ind Contract	M4	2,031	457,207	0.4441
5	Interruptible Com/Ind Contract	M5A	(1,150)	209,157	(0.5498)
6	Special Large Volume Contract	M7	2,403	427,949	0.5615
7	Large Wholesale	M9	-	66,511	-
8	Small Wholesale	M10	-	301	-
9	Contract Carriage Service	T1	(963)	444,084	(0.2169)
10	Contract Carriage Service	T2	(11)	4,365,603	(0.0002)
11	Contract Carriage- Wholesale	T3	-	263,235	-
12	Total Contract Service		1,338		

Notes:
(1) Exhibit A, Tab 4, Appendix B, Schedule 1.

UNION GAS LIMITED
General Service Bill Impacts
2015 - Audited

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (1)	Volume (m^3) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate 01	Delivery	(0.1555)	468	(0.73)
2		Commodity	-	468	-
3		Transportation	-	468	-
4			(0.1555)		(0.73)
5	Sales Service				(0.73)
6	Direct Purchase Bundled T				(0.73)
7	Rate 10	Delivery	(0.2655)	26,039	(69.13)
8		Commodity	-	26,039	-
9		Transportation	-	26,039	-
10			(0.2655)		(69.13)
11	Sales Service				(69.13)
12	Direct Purchase Bundled T				(69.13)
13	Rate M1	Delivery	0.8936	521	4.66
14		Commodity	-	521	-
15			0.8936		4.66
16	Sales Service				4.66
17	Direct Purchase				4.66
18	Rate M2	Delivery	0.2688	17,228	46.31
19		Commodity	-	17,228	-
20			0.2688		46.31
21	Sales Service				46.31
22	Direct Purchase				46.31

Notes:
(1) Exhibit A, Tab 4, Appendix B, Schedule 2, p. 1, column (c).
(2) Average consumption, per customer, for the period April 1, 2018 to September 30, 2018.

2015
Demand Side Management
Final Annual Report

December 15, 2017

uniongas
An Enbridge Company

Table of Contents

Executive Summary

2015 is the nineteenth year that Union Gas Limited ("Union") has delivered natural gas savings to its customers through cost effective Demand Side Management ("DSM") programs. Union's DSM programs support residential, low-income, commercial and industrial customers to realize energy savings and environmental benefits by providing energy efficiency education, awareness and incentives. To date, Union's commitment to DSM initiatives has achieved more than $2.947 billion in net Total Resource Cost ("TRC") benefits.

2015 marked a transition between the final year of the Union's multi-year 2012-2014 DSM Plan (EB-2011-0327) and the first year of its 2015-2020 DSM Plan (EB-2015-0029). In the new 2015-2020 DSM Framework, the Ontario Energy Board outlined that "the gas utilities should roll-forward their 2014 DSM plans, including all programs and parameters (i.e., budgets, targets, incentive structure) into 2015. Under the new Framework, the Ontario Energy Board (OEB or the "Board") will lead the process of evaluating Union's DSM program results.

Success in 2015 includes strong program performance within the Resource Acquisition, Low-Income and Market Transformation scorecards. The company is pleased to report that the 2015 DSM portfolio generated 1.751 billion m^3 of cumulative natural gas savings with a program spend that was $32.393 million, or 5% under the 2015 DSM budget of $33.988 million. This achievement earned Union a DSM Utility Incentive of $7.472 million.

Union celebrates the success of its 2015 DSM programs and the associated significant energy reductions that ratepayers have realized.

1. Introduction

This DSM Annual Report presents a summary of Union's energy efficiency initiatives and results in terms of scorecards, budget spend, DSM Utility Incentive, and Lost Revenue Adjustment Mechanism Variance Account ("LRAMVA") for 2015. It also provides an avenue for Union to benchmark the results in this first year under the 2015-2020 DSM plan, highlight successes and lessons learned.

Union's 2015 DSM portfolio included programs directed towards Residential, Commercial/Industrial, Low-Income, Market Transformation and Large Volume customers as listed below:

Residential Program

- Energy Savings Kit Offering
- Home Reno Rebate Offering

Commercial/Industrial Program

- Prescriptive and Quasi-Prescriptive Offering
  - Water Heating Initiatives
    - Condensing Gas Water Heaters
    - Ozone Laundry Equipment
  - Space Heating Initiatives
    - Air Curtain Technology
    - Condensing Boilers
    - Condensing Make-up Air Units
    - Destratification Fans
    - Energy Recovery Ventilators and Heat Recovery Ventilators
    - Infrared Heaters
    - Demand Control Ventilation
  - Commercial Kitchen Initiatives
    - Energy Star Fryers
    - Demand Control Kitchen Ventilation
    - Energy Star Dishwashers
- Custom Offering
  - Customer Engagement – Communication and Education
  - Engineering Feasibility and Process Improvement Studies
  - Operation and Maintenance
  - New Equipment and Processes
  - Energy Management

Low-Income Program

- Home Weatherization Program Offering
- Affordable Housing Conservation Offering

Large Volume Program

- Customer Engagement – Communication and Education
- New Equipment and Processes
- Operations and Maintenance
- Process Improvement Studies
- Engineering Feasibility Studies
- Steam Trap Surveys
- Boiler Tune-ups

Market Transformation Program

- Optimum Home

2. Demand Side Management Framework

2.1 2015 DSM Plan

2015 marked a transition between the final year of the Union's EB-2011-0327 multi-year 2012-2014 DSM Plan[1] and the first year of Union's 2015-2020 DSM Plan EB-2015-0029 filed on April 1, 2015.[2]

Union's 2015-2020 DSM Plan was filed in accordance with the 2015-2020 Demand Side Management Framework for Natural Gas Distributors (EB-2014-0134, or "Framework"), the 2015-2020 Filing Guidelines to the Demand Side Management Framework for Natural Gas Distributions (EB-2014-0134, or the "Guidelines"). In Section 15.1 of the Framework, the Board outlined that "the gas utilities should roll-forward their 2014 DSM plans, including all programs and parameters (i.e., budget, targets, incentive structure) into 2015." Union followed the Board's direction and rolled over all elements of Union's 2014 DSM Plan into 2015.

On January 20, 2016, the Board released its Decision (EB-2015-0029, or "Decision") on Union's 2015-2020 DSM Plan. As part of its Decision, the Board approved Union's 2015 programs, scorecards, metrics, targets, incentives and budgets as filed.

Union's DSM activities are continuing to drive market change through focused efforts on delivering natural gas savings and related customer benefits. This annual report highlights Union's achievements in 2015.

2.2 Program and Portfolio Design

Union's 2015 DSM program activities fall within four program types:

- Resource Acquisition
- Large Volume
- Low-Income
- Market Transformation

The Resource Acquisition and Large Volume programs seek to achieve direct, measureable savings for an individual customer and involve the installation of energy efficient equipment.

Low-Income programs are similar in nature to Resource Acquisition programs, but are treated independently to recognize the unique needs of this customer base and that they may result in lower TRC net savings than non-low-income programs.

Market Transformation programs focus on facilitating fundamental changes that lead to greater market shares of energy efficient products and services. They influence consumer behaviour and attitudes in support of reducing natural gas consumption.

[1] Union's 2012-2014 DSM Plan was filed on September 23, 2011 in accordance with the Board's Demand Side Management Guidelines for Natural Gas Utilities EB-2008-0346.
[2] The plan was amended July 3, 2015 to capture minor corrections.

2.3 Cost Effectiveness Screening

The Board mandates cost effectiveness screening as the means for determining the economic value of a DSM program. The TRC test is used to screen for cost effectiveness at the program level. TRC benefits include the avoided costs associated with natural gas, electricity, and water savings over the life of the energy efficient equipment. TRC costs include the incremental equipment costs[3] associated with the energy efficient equipment in relation to its less-efficient equivalent, as well as any program, administrative, and evaluation costs attributed directly to the program.[4] Resource Acquisition programs are considered cost effective if the ratio of the *present value of the TRC benefits* to the *present value of the TRC costs* exceeds 1.0. To recognize that low-income programs result in significant benefits not captured by the TRC test, these programs are screened using a TRC threshold of 0.7. Market Transformation programs are assessed on their own merits based on the objectives of the program.

2.4 Program Evaluation

There are two broad categories of evaluations: impact evaluation and formative evaluation. Impact evaluations focus on participation and related savings resulting from DSM programs, while formative evaluations focus on the effectiveness of program design and delivery, and assess why program outcomes occur.

2015 marked a change in the process for conducting impact evaluations of Union's DSM programs. In a Board letter dated August 21, 2015 (EB-2015-0245), the Board noted that it will be taking a central role in the evaluation process of DSM program results. DSM programs will be evaluated on an annual basis, with results issued by the Board to be used by Union when it files applications for recovery of amounts related to DSM activities.

The Board's role includes the hiring of an independent third party auditor, or Evaluation Contractor ("EC"), to assess the results of the natural gas utilities' DSM programs. An Evaluation Advisory Committee ("EAC") will also be put in place to provide input to the EC and the Board on the evaluation and audit of DSM results. This EAC will replace the Technical Evaluation Committee ("TEC") and the Audit Committees that were in place for the 2012-2014 Framework.

2.5 Transition Plan of TEC Activities to the OEB

As outlined in the letter from the Board dated March 4, 2016 (EB-2015-0245), the TEC evaluation activities will be transitioned to the OEB under the new DSM evaluation governance structure. Further discussion with OEB Staff and the TEC has provided additional clarity and direction on the following specific projects:

- **Technical Reference Manual ("TRM") Development.** Development of the TRM with updated measures and input assumptions is mostly completed and the TEC will continue to finalize the TRM. The management of the online portion of the TRM has been transitioned to OEB Staff,

[3] Incremental costs include capital, cost of removal less salvage value, installation, operating and maintenance and/or fuel costs.
[4] By definition of the TRC test, incentive costs provided to program participants are benefits to participants and are not included as TRC costs.

who will post the final TRM online when it is available. The utilities will continue to manage any remaining contractual obligations and payments related to the TRM.

- **Custom Project Net-to-Gross Study.** Following input from the TEC on a draft work plan prepared by the project consultant currently under contract, this study will be transitioned to OEB Staff. The utilities will continue to manage contractual obligations and payments associated with this project. OEB Staff will assume oversight of the study and will confirm the completion of major milestones for the utilities to process payments of consultant's invoices.
- **Boiler Baseline Study.** The TEC will select the Boiler Baseline proponent with input from OEB Staff. This will be the last order of business for the TEC on this project. The utilities will take over administrative responsibility and accountability for the study following selection of proponent. The EAC will provide input to the utilities on the study, as appropriate.
- **Persistence Study.** OEB Staff will be responsible for the procurement process and management of the Persistence Study, including management of project deliverables and contractual obligations through to completion of the study, with input from the EAC.

2.6 Evaluation Advisory Committee

As detailed in the August 21, 2015 memo from the Board, the EAC provides input and advice as required throughout the DSM evaluation process. The EAC is comprised of:

- Experts representing non-utility stakeholders, with demonstrated experience and expertise in the evaluation of DSM technologies and programs, natural gas energy efficiency technologies, multi-year impact assessments, net-to-gross studies, free ridership analysis and natural gas energy efficiency persistence analysis;
- Expert(s) retained by the OEB;
- Representatives from the Independent Electricity System Operator (IESO);
- Representatives from each natural gas utility; and,
- Representatives from the Ministry of Energy (MOE) and the Environmental Commissioner of Ontario ("ECO"), who will participate as observers.

The OEB has appointed the following non-utility stakeholders as members of the EAC:

- Chris Neme, Energy Futures Group
- Jay Shepherd, Jay Shepherd Professional Corporation
- Marion Fraser, Fraser & Company

Non-utility stakeholders are expected to provide input and advice based on their experience and technical expertise and not to advocate position of parties they have represented before the OEB in various proceedings.

2.7 Audit of the 2015 DSM Results

Union's 2015 DSM results, as summarized in the DSM Annual Report are subject to an independent external audit. The intention of the audit is to have the Evaluation Contractor provide an opinion on whether the claimed DSM Utility Incentive amount, Lost Revenue Adjustment Mechanism Variance

Account (LRAMVA), and Demand Side Management Variance Account (DSMVA) have been correctly calculated using reasonable assumptions. The EAC, which includes utility representation as described in Section 2.6, provides input and plays an advisory role throughout the audit to facilitate the achievement of the audit objectives.

2.8 Input Assumptions for 2015 Scorecard Targets and Results

On March 27, 2015, Union Gas Limited and Enbridge Gas Distribution Inc. submitted a joint application (EB-2014-0354) that sought approval from the Board for new and updated DSM measures and input assumptions. On July 23, 2015 Union and Enbridge were granted approval of the new and updated DSM measures and input assumptions as set out in the joint application.

The input assumptions outlined in that filing were used in calculating the savings claims that comprise the 2015 DSM scorecard targets and results. This is consistent with Union's letter dated February 3, 2016 (EB-2015-0029) that provided written comments related to the calculation of target metrics and allocation of DSM Utility Incentive amounts. This letter states that "Union's 2015 results for the purpose of determining the 2015 DSM Utility Incentive will be based on the same input assumptions and net-to-gross adjustment factors used for setting Union's 2015 targets. These inputs were finalized in Union's 2014 DSM audit." The Board confirmed this approach as per its revised Decision issued on February 24, 2016 (EB-2015-0029).

3. OEB Data Reporting Requirements

As per section 14.2 of the Guidelines, Union's Annual Report includes the following key elements:

Key element	Table number
Annual and long-term DSM budgets ($/year, and $/6 years)	Table 3.0
Actual annual total DSM costs (including DSM budget[5], overheads, evaluation, DSM Utility Incentive, lost revenues) for each rate class dating back to 2007	Table 3.1
Historic actual annual DSM spending ($/year) dating back to 2007	Table 3.2
DSM spending as a percent (%) of distribution revenue	Table 3.3
Historic annual DSM Utility Incentives amounts available and earned ($/year) dating back to 2007	Table 3.4
DSM Utility Incentive earned as a percent (%) of DSM budget[6]	Table 3.5
Annual and long-term natural gas savings targets (m^3/year, and m^3/6 years)	Table 3.6
Total annual and cumulative gross and net natural gas savings (m^3) for each year of the DSM framework (2015 to 2020)	Table 3.7
Total historic annual and cumulative gross and net natural gas savings (m^3) dating back to 2007	Table 3.8 – Table 3.9
Total annual and cumulative gross and net natural gas savings (m^3) from 2007 to the reporting year as a percent of total annual natural gas sales	Table 3.10 – Table 3.11
Actual annual gas operating revenue ($/year)	Table 3.12
Actual annual operating revenue less cost of natural gas commodity ($/year)	Table 3.12
Total cost of gas ($ million/year)	Table 3.12
Total natural gas sales (m^3/year)	Table 3.13
Number of customers, broken out by rate class and by customer type (i.e., residential, low-income, commercial and industrial, relative to the DSM programs offered by the gas utility) per year	Table 3.14 and Table 3.15

[5] As the request is for actual costs, Union interprets this request to be 'DSM Spending' rather than 'DSM budget'.
[6] Union interprets this request as requesting values as a percentage of 'DSM Spending' rather than 'DSM budget'.

Table 3.0 - Annual and long-term DSM budgets ($000/year, and $000/6 years)

$000/yr.	2015	2016	2017	2018	2019	2020	Total ($/6 years)
Residential	$ 3,163	$ 8,612	$ 11,369	$ 13,908	$ 13,908	$ 13,908	$ 64,867
Commercial / Industrial	$ 10,859	$ 19,316	$ 22,035	$ 22,726	$ 22,403	$ 22,403	$ 119,743
Low-Income	$ 6,839	$ 11,407	$ 12,343	$ 13,571	$ 14,145	$ 15,005	$ 73,310
Large Volume	$ 4,534	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 24,534
Market Transformation	$ 1,379	$ 1,703	$ 2,338	$ 2,338	$ 2,338	$ 2,338	$ 12,434
Performance-Based Conservation	$ 0	$ 548	$ 843	$ 1,088	$ 833	$ 1,053	$ 4,365
Portfolio Level Research, Evaluation and Administration[1,2]	$ 4,717	$ 11,235	$ 5,642	$ 5,642	$ 5,642	$ 5,642	$ 38,520
Inflation	$ 2,497						$ 2,497
Total	**$ 33,988**	**$ 56,821**	**$ 58,570**	**$ 63,272**	**$ 63,269**	**$ 64,350**	**$ 340,270**

1 – 2015 value also includes budgets for the Achievable Potential Study, Future Infrastructure Planning Study and DSM Tracking and Reporting System Upgrades.
2 – 2016-2020 values also include budgets for pilots and DSM Tracking and Reporting System Upgrades.

Table 3.1 - Actual annual total DSM costs (including DSM spend, overheads, evaluation, DSM Utility Incentive, lost revenues) for each rate class dating back to 2007 ($000/year)

$000/yr.	2007	2008	2009	2010	2011	2012	2013	2014	2015
M1	NA	$ 12,107	$ 12,743	$ 11,348	$ 11,498	$ 13,502	$ 13,657	$ 15,415	$ 16,752
M2	$ 11,619	$ 2,487	$ 2,022	$ 2,118	$ 4,097	$ 4,968	$ 5,818	$ 6,728	$ 4,958
M4	$ 1,488	$ 1,353	$ 828	$1 ,098	$ 1,817	$ 3,319	$ 3,244	$ 3,296	$ 3,648
M5	$ 295	$ 1,044	$ 1,226	$ 1,086	$ 3,150	$ 2,660	$ 3,484	$ 2,394	$ 1,421
M7	$ 886	$ 116	$ 256	$ 1,474	$ 1,304	$ 538	$ 571	$ 2,143	$ 3,371
T1	$ 3,147	$ 3,988	$ 5,596	$ 3,964	$ 7,749	$ 6,111	$ 2,265	$ 1,078	$ 892
T2	NA	NA	NA	NA	NA	NA	$ 3,365	$ 2,875	$ 2,674
Rate 01	$ 2,229	$ 2,162	$ 2,093	$ 1,869	$ 3,050	$ 3,532	$ 3,560	$ 4,161	$ 3,555
Rate 10	$ 1,612	$ 1,371	$ 2,293	$ 510	$ 1,109	$ 1,939	$ 1,637	$ 1,613	$ 953
Rate 20	$ 323	$ 496	$ 771	$ 881	$ 1,030	$ 1,607	$ 1,573	$ 1,791	$ 1,006
Rate 100	$ 1,535	$ 4,542	$ 3,950	$ 4,471	$ 1,614	$ 2,305	$ 1,828	$ 1,517	$ 804
Total	**$ 23,134**	**$ 29,666**	**$ 31,778**	**$ 28,818**	**$ 36,417**	**$ 40,481**	**$ 41,001**	**$ 43,011**	**$ 40,035**

Table 3.2 - Historic actual annual DSM spending[1] ($000/year) dating back to 2007

$000/yr.	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total	$ 16,132	$ 20,259	$ 22,038	$ 21,607	$ 27,971	$ 31,322	$ 32,839	$ 33,714	$ 32,393

1 – Includes direct, indirect and DSMVA.

Table 3.3 - DSM spending as a percent (%) of distribution revenue[1]

%	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total	2%	3%	3%	3%	4%	4%	4%	4%	4%

1 – Distribution revenue is equal to the gas distribution margin, and is the gas sales and distribution revenue less the cost of gas where gas sales and distribution revenue is the sum of the delivery revenue and gas supply revenue and earning sharing, if applicable.

Table 3.4 - Historic annual DSM Utility Incentives amounts available and earned dating back to 2007 ($000/year)

$000/yr.	2007	2008	2009	2010	2011	2012	2013	2014	2015
DSM Utility Incentive Earned	$ 6,234	$ 8,696	$ 8,751	$ 6,576	$ 7,634	$ 8,210	$ 7,784	$ 8,988	$ 7,472
DSM Utility Incentive Available	$ 8,500	$ 8,696	$ 8,922	$ 8,939	$ 9,243	$ 10,450	$ 10,682	$ 10,820	$ 11,002

Table 3.5 - DSM Utility Incentive earned as a percent (%) of DSM spend[1]

%	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total	39%	43%	40%	30%	27%	26%	24%	27%	23%

1 – Includes direct, indirect and DSMVA.

Table 3.6 - Annual and long-term natural gas savings targets (m^3/year, and m^3/6 years) [1]

Scorecard	2015	2016	2017	2018	2019	2020
Resource Acquisition	816,561,818	1,214,104,360	1,496,939,054[2]	1,700,748,492[2]	1,715,289,268[2,3]	1,749,595,053[2,3]
Low-Income	43,600,000	56,642,187	64,186,528[2]	71,499,683[2]	76,151,889[2,3]	83,580,811[2,3]
Large Volume	1,236,097,404	1,058,588,072	996,825,303[2]	1,005,036,313[2]	1,040,552,894[2,3]	1,034,420,933[2,3]

1 – Values are cumulative gas savings at the target (100%) band for programs launched in indicated year.
2 – Target is formulaic based on performance in previous year(s). Draft value presented here assumes Union achieves 100% of its cumulative gas savings target in previous year(s) and spends 100% of its budget.
3 – Target setting methodology for 2019 and 2020 assumes same approach as outlined in Decision for 2016-2018 scorecards.

Table 3.7 - Total annual and cumulative gross and net natural gas savings (10^3m^3) for 2015

10^3m^3	Annual Gas Savings		Cumulative Gas Savings	
	Gross	Net	Gross	Net
Resource Acquisition	108,356	56,240	1,737,648	919,157
Low-Income	2,356	2,310	53,041	52,181
Large Volume	144,457	66,528	1,691,807	779,428
Total	**255,169**	**125,077**	**3,482,496**	**1,750,765**

Table 3.8 - Total historic annual gross and net natural gas savings (10^3m^3) dating back to 2007

10^3m^3	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Net Annual Natural Gas Savings	55,854	61,852	92,604	121,116	139,027	137,438	179,967	131,825	125,077
Total Gross Annual Natural Gas Savings	Not reported for 2007 – 2011					282,177	370,474	267,465	255,169

Table 3.9 - Total historic cumulative gross and net natural gas savings (10^3m^3) dating back to 2007

10^3m^3	2007-2011	2012	2013	2014	2015
Total Net Cumulative Natural Gas Savings	Not reported for 2007-2011	2,336,351	2,820,834	1,889,459	1,750,765
Total Gross Cumulative Natural Gas Savings	Not reported for 2007-2011	4,777,826	5,752,390	3,752,366	3,482,496

Table 3.10 – Total annual gross and net natural gas savings from 2007 to the reporting year as a percent of total annual natural gas sales[1]

%	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total annual net natural gas savings as a percent of total annual natural gas sales	0.42%	0.47%	0.75%	0.95%	1.02%	1.03%	1.29%	0.93%	0.93%
Total annual gross natural gas savings as a percent of total annual natural gas sales	Not reported for 2007 – 2011					2.11%	2.65%	1.88%	1.90%

1 – Total natural gas sales include rate classes subject to DSM costs only.

Table 3.11 - Total cumulative gross and net natural gas savings from 2007 to the reporting year as a percent of total annual natural gas sales[1]

%	2007-2011	2012	2013	2014	2015
Total cumulative net natural gas savings as a percent of total annual natural gas sales	Not reported for 2007-2011	17.44%	20.16%	13.30%	13.06%
Total cumulative gross natural gas savings as a percent of total annual natural gas sales	Not reported for 2007-2011	35.67%	41.11%	26.42%	30%

1 – Total natural gas sales include rate classes subject to DSM costs only.

Table 3.12 - Actual annual gas operating revenues ($M/year)

$M/yr.	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gas Sales and Distribution Operating Revenue	$ 655	$ 675	$ 658	$ 699	$ 713	$ 727	$ 772	$ 778	$ 800
Commodity cost of gas	$ 1,156	$ 1,177	$ 1,026	$ 794	$ 755	$ 638	$ 849	$ 977	$ 875
Total	**$ 1,811**	**$ 1,852**	**$ 1,684**	**$ 1,493**	**$ 1,468**	**$ 1,365**	**$ 1,621**	**$ 1,755**	**$ 1,675**

Table 3.13 - Total natural gas sales for rate classes subject to DSM costs (10^3m^3/year)

10^3m^3/yr.	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total	13,158,018	13,231,158	12,327,846	12,778,870	13,654,990	13,396,120	13,992,688	14,204,104	13,404,980

Table 3.14 - Number of customers broken out by customer type per year

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Residential	916,119	931,175	943,129	957,061	969,416	983,542	998,051	1,013,433	1,026,656
Low-Income[1]	258,392	262,639	266,011	269,940	273,425	277,409	281,501	285,840	289,570
Commercial	114,325	115,091	115,403	116,304	116,735	117,518	118,643	119,755	120,237
Industrial	523	520	495	485	475	478	480	466	457
Wholesale	5	5	5	5	5	6	5	5	5
Total	1,289,364	1,309,430	1,325,043	1,343,795	1,360,056	1,378,953	1,398,680	1,419,499	1,436,924

1 – Low-Income customers are estimated to be 22% of all Residential customers.

Table 3.15 - Number of customers broken out by rate class per year

	2007	2008	2009	2010	2011	2012	2013	2014	2015
General Service									
M1	NA	999,490	1,011,147	1,025,698	1,037,146	1,050,659	1,064,399	1,078,289	1,089,633
M2	989,531	5,990	6,566	6,607	6,637	6,689	6,723	6,940	7,752
01	296,979	301,020	304,583	308,846	313,633	319,027	325,057	331,780	336,857
10	2,326	2,405	2,247	2,154	2,160	2,094	2,016	2,019	2,220
Total	**1,288,836**	**1,308,905**	**1,324,543**	**1,343,305**	**1,359,576**	**1,378,469**	**1,398,195**	**1,419,028**	**1,436,462**
Contract									
M4	157	155	145	130	132	143	149	154	159
M7	9	9	6	6	5	4	4	28	28
20	57	57	52	51	49	48	48	48	47
100	16	20	16	16	14	15	14	11	11
T1	53	53	53	53	56	59	38	36	37
T2	NA	NA	NA	NA	NA	NA	22	22	22
M5	128	125	124	130	124	123	111	82	75
Total	**420**	**419**	**396**	**386**	**380**	**392**	**386**	**381**	**379**
Non-DSM Rate Classes									
M9	2	2	2	2	2	2	2	2	2
M10	3	2	2	2	2	3	2	2	2
T3	1	1	1	1	1	1	1	1	1
25	96	101	98	99	94	86	94	85	78
30	1	0	1	0	1	0	0	0	0
77	1	0	0	0	0	0	0	0	0
Total	**1,289,360**	**1,309,430**	**1,325,043**	**1,343,795**	**1,360,056**	**1,378,953**	**1,398,680**	**1,419,499**	**1,436,924**

4. 2015 DSM Program Results Summary

Union's DSM program generated 1,750,765,480 cumulative m³ in natural gas savings for customers. As illustrated in Figure 4.0, the 2015 Commercial / Industrial program delivered the largest portion of savings, followed by the 2015 Large Volume, Residential and Low-Income programs respectively.

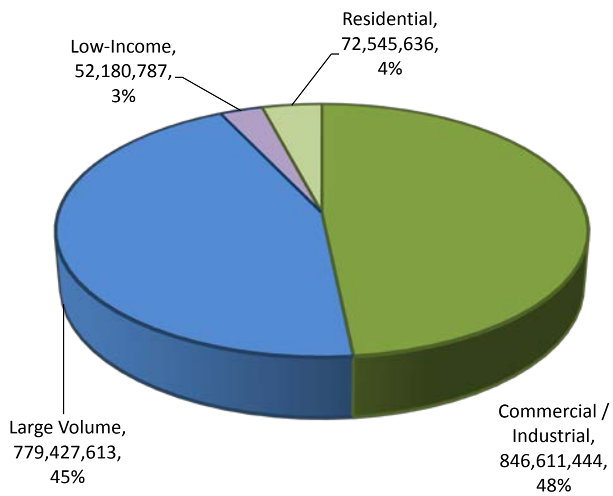


Figure 4.0 - Major Drivers in Natural Gas Savings (Cumulative m^3 and Percentage)

Table 4.0 summarizes Union's DSM results by program for 2015, including annual and cumulative natural gas savings, number of units, expenditures, and the associated net TRC and TRC ratio.

Table 4.0 - 2015 Program Results

Program	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Units	Expenditures	Net TRC	TRC Ratio
Residential	4,368,514	72,545,636	22,294	$5,450,210	-$921,126	0.94
Commercial / Industrial	51,871,279	846,611,444	3,630	$11,368,397	$106,869,166	3.23
Low-Income	2,309,842	52,180,787	1,603	$7,701,035	$552,817	1.07
Large Volume	66,527,557	779,427,613	150	$3,209,716	$113,820,506	6.97
Optimum Home	0	0	0	$1,405,340	$0	NA
Program Subtotal	**125,077,193**	**1,750,765,480**	**27,677**	**$29,134,697**	**$220,321,362**	**3.44**
Portfolio Costs				$3,044,068		
Portfolio Total				**$32,178,766**[7]	**$217,424,127**	**3.33**

[7] Does not include incremental DSM spend on DSM tracking and reporting system upgrades – see Table 4.1.

DSM costs are detailed on a program level in Table 4.1.

Table 4.1 - 2015 Direct DSM Program Costs

Program	Administration	Evaluation	Promotion	Incentives	2015 Total
Residential	$ 527,197	$ 397,650	$ 972,997	$ 3,552,367	$ 5,450,210
Commercial/ Industrial	$ 2,924,084	$ 100,200	$ 796,336	$ 7,547,777	$ 11,368,397
Low-Income	$ 859,796	$ 196,171	$ 1,195,605	$ 5,449,463	$ 7,701,035
Large Volume	$ 863,933	$ 122,498	$ 4,134	$ 2,219,151	$ 3,209,716
Optimum Home	$ 386,703	$ 0	$ 282,464	$ 736,172	$ 1,405,340
Program Total	**$ 5,561,713**	**$ 816,519**	**$ 3,251,535**	**$ 19,504,930**	**$ 29,134,697**
Portfolio Costs					
Research					$ 329,116
Evaluation					$ 525,012
Administration					$ 2,189,940
Portfolio Total					**$ 3,044,068**
Subtotal	**$ 5,561,713**	**$ 816,519**	**$ 3,251,535**	**$ 19,504,930**	**$ 32,178,766**
Incremental DSM Project Spend[8]					$ 213,879
Total 2015 DSM Spend	**$ 5,561,713**	**$ 816,519**	**$ 3,251,535**	**$ 19,504,930**	**$ 32,392,645**

Net annual and cumulative savings[9] are provided in Table 4.2.

Table 4.2 - 2015 Net Natural Gas Savings

Program	Offering	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)
Residential	Energy Savings Kit	1,179,468	14,800,935
	Home Reno Rebate	3,189,046	57,744,701
Residential Total		**4,368,514**	**72,545,636**
Commercial/Industrial	Prescriptive	9,283,248	182,411,887
	Custom	42,588,031	664,199,557
Commercial/Industrial Total		**51,871,279**	**846,611,444**
Low-Income	Affordable Housing Conservation	874,226	16,333,361
	Home Weatherization Program	1,435,616	35,847,426
Low-Income Total		**2,309,842**	**52,180,787**
Large Volume	Rate T1	8,842,211	121,416,767
	Rate T2	50,153,666	603,578,141
	Rate 100	7,531,680	54,432,706
Large Volume		**66,527,557**	**779,427,613**
Optimum Home	Optimum Home	0	0
Optimum Home Total		**0**	**0**
Portfolio Total		**125,077,193**	**1,750,765,480**

[8] Incremental spend was on DSM Tracking and Reporting System Upgrades.
[9] Gross annual and cumulative gas savings total 255,168,761 m^3 and 3,482,495,645 m^3 respectively. Gross savings refer to the results of Union's 2015 DSM programs without the exclusion of free riders.

5. Resource Acquisition Scorecard

Union has three performance metrics on its resource acquisition scorecard with results attributable to programs addressing the residential and commercial/industrial markets. Resource acquisition programs are programs that seek to achieve direct, measureable savings for customers through the installation of energy efficient equipment and/or energy management systems. These programs also help identify and implement process improvements and/or operation and maintenance activities.

For residential customers, these programs are oriented toward offering incentives for installing energy efficient water or space heating equipment or home building envelope upgrades.

Programs designed for commercial customers include incentives to invest in energy efficient technologies geared for new and existing commercial buildings, such as the purchase and installation of efficient heating, ventilating and air conditioning ("HVAC") systems, and custom solutions specific to the customer's building and/or process needs. Due to the unique nature of industrial customers, solutions for these customers tend to be custom designed and engineered to meet the requirements of the customer's facility.

Union recognizes the inherent value contained in the educational content of its programs and continues to develop and refine the customer awareness and educational components of its resource acquisition programs.

Table 5.0 presents the results of the resource acquisition scorecard, which illustrates an achievement of 131% of the overall scorecard target, resulting in a DSM Utility Incentive of $4.443 million.

Table 5.0 - 2015 Resource Acquisition Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	612,421,364	816,561,818	1,020,702,273	90%	919,157,080	125%	113%
Deep Savings – Residential	934	1,245	1,556	5%	2,529	306%	15.3%
Deep Savings - C/I	7.88%	8.88%	9.88%	5%	8.08%	60%	3%
						Total Scorecard Target Achieved	***131%***
						Scorecard Incentive Achieved	***$ 4,443,225***

Homes were included in the Residential Deep Savings scorecard metric only if they a) achieve a minimum gas savings of 11,000 cumulative m^3 (based on HOT2000 software used in EnerGuide mode), and b) implement a minimum of two major measures. In addition, the aggregate of all of the homes counted towards the Residential Deep Savings metric must have achieved on average at least a 25% reduction in annual gas usage for space and water heating (also based on HOT2000 software used in EnerGuide mode). Free ridership and spillover do not get included in the calculations for this metric.

Commercial/Industrial Deep Savings calculations are based on the percentage of baseline consumption achieved within all Commercial/Industrial custom projects undertaken in the program year. Union has calculated this metric by comparing the forecast weather normalized annual gas savings for all Commercial/Industrial custom projects against the actual consumption of the participants in those projects for the immediately preceding year. Actual 2014 consumption data for commercial customers with weather sensitive loads has been weather normalized for this calculation, whereas industrial process demands do not fluctuate as a result of weather and therefore have not been weather normalized. For any customer who completed a Commercial/Industrial custom project and also had a prescriptive measure installed, the savings relating to the prescriptive measure have also been included for the purpose of calculating the normalized annual gas savings. Savings associated with custom projects for new construction were not included in this metric.

Table 5.1 presents the results of the Residential and Commercial/Industrial resource acquisition programs. The total spend includes all program costs including incentives.

Table 5.1 - 2015 Resource Acquisition Program Results

Program	Offering	Units	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Residential	Energy Savings Kit	19,753	1,179,468	14,800,935	$ 5,450,210	$ -921,126	0.94
	Home Reno Rebate	2,541	3,189,046	57,744,701			
Commercial/ Industrial	Prescriptive	3,042	9,283,248	182,411,887	$ 4,071,045	$ 20,453,077	2.81
	Custom	588	42,588,031	664,199,557	$ 7,297,352	$ 86,416,088	3.35
2015 Resource Acquisition Total		**25,924**	**56,239,793**	**919,157,080**	**$ 16,818,608**	**$ 105,948,039**	**2.68**

5.1 Residential Program

Residential offerings are designed to achieve savings related to space and water heating for Union's residential individually metered residences. These offerings are marketed to residential customers and are delivered through a variety of channels including third party delivery agents. Strategic efforts to cost effectively promote energy efficiency within Union's residential customer base, included working with new and existing HVAC contractors and service organizations, as well as offering customer incentives. In 2015, Union focused on the Energy Saving Kit ("ESK") offering (Section 5.1.1) and the Home Reno Rebate ("HRR") offering (Section 5.1.2).

Table 5.2 shows the results of the Residential program and Table 5.3 breaks down the total spend into its components.

Table 5.2 - 2015 Residential Program Results

Program	Offering	Units	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Residential	Energy Savings Kit	19,753	1,179,468	14,800,935	$ 5,450,210	$ -921,126	0.94
	Home Reno Rebate	2,541	3,189,046	57,744,701			
2015 Residential Total		**22,294**	**4,368,514**	**72,545,636**	**$ 5,450,210**	**$ -921,126**	**0.94**

Table 5.3 - 2015 Residential Program Spend

Item	Total
Incentives	$ 3,552,367
Administration	$ 527,197
Evaluation	$ 397,650
Promotion	$ 972,997
2015 Total Residential Program Spend	**$ 5,450,210**

Table 5.4 shows the calculation of the Residential program's TRC ratio.

Table 5.4 - 2015 Residential Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 13,982,611	$ 13,005,895	$ 976,717	1.08
Residential Administration		$ 527,197		
Residential Evaluation		$ 397,650		
Residential Promotion		$ 972,997		
Residential Program Total	**$ 13,982,611**	**$ 14,903,738**	**$ -921,126**	**0.94**

5.1.1 Energy Savings Kit Offering

In 2015, Union distributed 19,753 ESKs and 1,240 programmable thermostats. Union is exiting the ESK and Programmable Thermostat offerings after 2015 as a result of the Board decision on Union's 2015-2020 DSM Plan (EB-2015-0029).

ESKs are pre-packaged measures designed to reduce a customer's energy demand and water consumption.

Each ESK contains the following components:

- Energy efficient showerhead (1.25 GPM)
- Energy efficient kitchen aerator (1.50 GPM)
- Energy efficient bathroom aerator (1.0 GPM)
- Pipe wrap (two 1 meter lengths)
- 1 roll of Teflon tape for ease of showerhead installation
- ESK Installation Guide and MyAccount paperless brochure
- $25 Programmable Thermostat rebate coupon

Target Market

The ESK offering is targeted to Union residential customers who have not previously received a kit and who live in detached, semi-detached houses or individually metered row townhouses. Customers must also have a natural gas water heater. To be eligible for a programmable thermostat, customers must have a natural gas furnace.

Market Incentive

All water saving measures in the ESK are provided at no cost to the customer. A $25 rebate coupon for the programmable thermostat is included in the ESK.

Market Delivery

Union distributed ESKs using the two delivery methods outlined below.

ESK Door-to-Door Distribution Initiative
A door-to-door distribution approach was the primary delivery method used to reach customers who had not yet received an ESK. Door-to-door distribution made participation simple and easy for customers. Union's delivery agent deployed technicians in field to visit pre-identified customers with free ESKs in the following cities:

- Burlington
- Hamilton
- London
- Milton
- Oakville
- Waterloo
- Windsor

A week prior to field visits, Union mailed a marketing promotional postcard to each pre-identified customer notifying them that Union would be in their neighbourhood delivering a free ESK through its delivery agent over the next few days (Figure 5.0).

Figure 5.0 - Marketing Promotional Postcard for Door-to-Door Distribution

Delivery agent technicians wore a uniform and were equipped with an identification badge that also featured the Union Gas logo. Customers that received an ESK were asked to sign a customer acknowledgment form for tracking and reporting purposes. If a customer was not home, a door hanger was left behind to encourage customers to call a toll free number or go to www.uniongas.com/esk to order an ESK. A total of 12,963 ESKs were delivered through the door-to-door channel.

Bill Insert Coupons and Online Initiative

As a secondary delivery approach, Union provided its customers bill inserts (Figure 5.1) in July and August 2015 and paperless e-bill images in May, June and August 2015 to raise awareness of its ESK offering. The bill inserts and e-bill images provided information on the components of the ESK and directed customers to Union's website where an ESK could be ordered online. Alternatively, the customer could complete the ESK coupon on the bill insert and send it to Union by mail.

In 2015, customers received a total of 6,630 ESKs by ordering online and 160 by mail-in.

Figure 5.1 - ESK Bill Insert Promotional Material

The results for each delivery channel are shown in Table 5.5.

Table 5.5 - 2015 ESK Distribution Summary by Channel

	Door-to-Door	Online Requests	Coupon Mail-in Requests	Total
Units	12,963	6,630	160	19,753

Programmable Thermostat

As part of the ESK offering, Union continued to promote a $25 on-bill rebate for the purchase and installation of a programmable thermostat to its customers. This rebate, offered in the form of a coupon, was distributed through:

- Bill inserts (Figure 5.2)
- ESK insert
- Union's website

Figure 5.2 - Programmable Thermostat Bill Insert

In order to receive the on-bill rebate, customers are required to submit their active Union account number on the completed coupon indicating whether they are replacing a non-programmable thermostat and provide proof of purchase for the programmable thermostat.

5.1.2 Home Reno Rebate Offering

The HRR offering encourages homeowners to install two or more measures in their homes to:

- Achieve significant energy and money savings each year;
- Put a stop to costly home energy loss;
- Enjoy a home that is warmer in the winter and cooler in the summer;
- Avoid unsightly mould and condensation that can be caused by poor insulation; and,
- Improve health through better indoor air quality.

Homes must achieve a minimum natural gas savings of 11,000 lifetime m^3 (based on pre-installation and post-installation energy modelling using HOT2000 software in EnerGuide mode) and implement a minimum of two qualifying measures. These are tracked as 'Deep Savings Homes'.

Target Market

The HRR offering targets Union's residential customers who own a detached, semi-detached or duplex home with a natural gas heating system. In 2015, HRR was offered to all residential customers within Central and Southwestern Ontario.

Market Incentive

Table 5.6 outlines the measures of the HRR offering with the corresponding criteria and incentive.

Table 5.6 - HRR Offering Rebates*

Measure	Criteria		Incentives
Attic Insulation	Increasing attic insulation to at least R50 from R12 or less	$	500
	Increasing attic insulation to at least R50 from R13 to R25	$	250
	Increasing cathedral/flat roof insulation by at least R14	$	500
Basement Insulation	Adding at least R23 to 100% of basement	$	1,000
	Adding at least R12 to 100% of basement	$	500
Crawl Space Insulation	Adding at least R23 to 100% of crawl space wall	$	800
	Adding at least R10 to 100% of crawl space wall	$	400
	Adding at least R24 to 100% floor above crawl space	$	450
Exterior Wall Insulation	Adding at least R9 to 100% of building to achieve a minimum of R12	$	1,500
	Adding at least R3.8 to 100% of building to achieve a minimum of R12	$	1000
Draft Proofing	Achieving 10% or more above base target	$	150
	Achieving base target	$	100
Furnace/Boiler	Replacing a low or mid-efficiency heating system with 95% AFUE or higher condensing natural gas furnace or 90% AFUE or higher ENERGY STAR® condensing gas boiler	$	500
Water Heater	Replacing a water heater with an ENERGY STAR and ecoENERGY-qualified instantaneous natural gas water heater with EF of 0.82 or higher	$	200
Window/Door/Skylight	For each window, door or skylight replaced with ENERGY STAR-models	$	40

*Eligibility criteria required customers to complete pre and post audits, for which they were eligible for a $500 incentive.

Market Delivery

In 2015, Union continued to partner with Service Organizations ("SOs") for the delivery of the HRR offering. Services provided by the Service Organizations included managing a toll-free number, administering pre and post-audits, and tracking and reporting results. The service organizations were:

- Amerispec of Canada
- Barrier Sciences Group
- BuyWise Consulting
- Direct Energy
- Eco Advantage Energy Advisors
- Energuy Canada
- EnerTest Corporation
- Green Communities Canada (REEP, Green Venture and ELORA Environment)
- Ridge Energy Consultants
- Canada Energy Audit

Customers have the option to choose the suppliers and installers for measure upgrades, or complete the installations themselves.

Local Newsprint, Radio and Online Marketing

Union launched local newsprint campaigns targeting customers to generate awareness on the benefits and cost savings associated with home renovations. The newsprint ads directed customers to call one of the service organizations and/or to visit Union's website for additional details. The newsprint campaign ran in Brantford, Burlington, Chatham, London, Waterloo, Windsor, Hamilton, Guelph and Oakville.

Union also launched a 30-second radio ad that ran in Brantford, Hamilton, London, Waterloo, Windsor and Chatham, as well as a geo-coded online marketing campaign that ran on Kijiji (www.Kijiji.ca), Style at Home (www.styleathome.com) and Rogers Home Channel (www.rogers.com) (Figure 5.3).

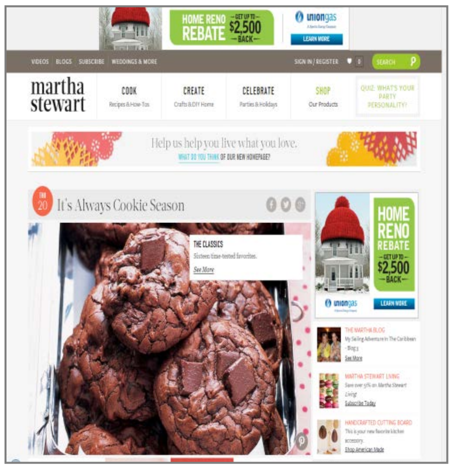


Figure 5.3 - HRR Online Advertising

Customer Brochure

A customer brochure was used by service organizations during their customer calls to explain the offering and as a leave behind for customer reference (Figure 5.4).

Figure 5.4 - HRR Customer Brochure

Door Hangers

Door hangers were used by service organizations and sales teams to promote the offering during their visits. After a visit, the service organization representatives would distribute the door hangers to other homes on the same street (Figure 5.5).

Figure 5.5 - HRR Door Hangers

Website and Bill Inserts

In 2015, Union utilized its owned media channels to promote the program and direct customers to participating Certified Energy Advisors to schedule a pre-renovation energy assessment. This includes the Union's website (www.uniongas.com/homereno) and bill inserts promoting the HRR offering to customers in Central and Southwestern Ontario.

5.1.3 Education and Awareness

Education and awareness efforts in the residential sector affecting consumer decisions are crucial to the success of Union's DSM programs. Union targets educational outreach to customers to empower them to manage their energy costs. In 2015, Union continued to disseminate educational materials through a variety of media:

- Union's interactive website and MyAccount
- Wise Energy Guides
- *InTouch* Monthly Newsletter
- Residential HVAC Newsletter (GasFacts) and Website

Residential Energy Efficiency Website

Energy efficiency, environmental stewardship and conservation are a central focus of Union's website. Under the residential section of the site, there is a dedicated Energy Conservation menu heading (http://www.uniongas.com/residential/save-money-energy) with the following sub-sections:

- **Rebates & Promotions:** Information on Union rebates and promotions to help customers save money and energy;
- **Upgrades & Renovations:** Information about do-it-yourself projects and upgrades to help customers reduce heating and cooling operating costs;
- **Tips to Save Money:** Tips and videos to help customers manage home energy usage; and
- **Energy Saving Resources:** Link to resources about energy efficiency labels and conservation websites.

Features found on the site in 2015 included:

- Online videos (topics include ESKs, draft proofing, and programmable thermostats);
- A downloadable programmable thermostat rebate coupon;
- Downloadable educational materials; and
- An overview of energy efficiency rebate programs offered in the province, as well as links to third party organizations involved in energy conservation.

MyAccount

MyAccount is Union's online account management tool for residential and small business customers. After logging into MyAccount, customers can access personalized tools to help them better understand their energy use including:

- An archive containing 24 months of natural gas use and billing history;
- A "compare bills" feature to graph consumption or bill amounts from two or more months; and
- A download feature to export energy data into a spreadsheet or energy management software.

Wise Energy Guide

In 2015, Union continued to distribute copies of the Wise Energy Guide to customers (Figure 5.6). The guide includes up-to-date tips and solutions to reduce heat loss, suggestions to solve moisture problems, natural gas equipment options, and an easy-to-use checklist to assist customers to achieve greater energy efficiency in the home. The primary distribution method is Union's website, where customers can view a digital copy or order a printed version.

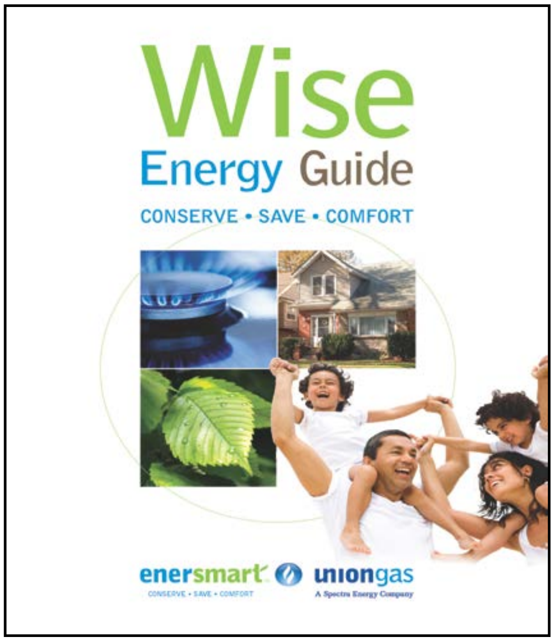


Figure 5.6 - Wise Energy Guide

***intouch* Monthly Newsletter**

Union continues to distribute the monthly *intouch* residential customer newsletter both in print and online (Figure 5.7). The newsletters include educational messages about energy efficiency, natural gas safety and the environmental and financial savings related to using natural gas.

Feature topics included:

- The importance of annual equipment inspections;
- The importance of caulking and weather stripping;
- How to avoid high natural gas bills; and
- Energy conservation programs available.

JANUARY 2015

intouch
customer information newsletter

Get paid to save

Steps to protect against carbon monoxide

Cut energy costs for good

This year, take advantage of Union Gas programs and incentives that can help make your home more energy efficient and keep more money in your pocket. Use less, pay less – it's just that simple.

Home Reno Rebate: Get up to $2,500 back on energy-saving home improvements that will reduce your gas bill by up to 20 per cent every year.

Free Energy Saving Kit: Save up to $100 a year in water-heating costs by installing an energy-efficient showerhead, kitchen and bathroom tap aerators and two metres of pipe wrap – all free from Union Gas.

Programmable Thermostat: Get a $25 credit on your gas bill for a simple home improvement that will save you up to $100 year on heating costs.

For more tips and tools to reduce your energy bills all year long, visit uniongas.com/savemoney.

Our new website is just what you asked for!

We've redesigned our website, making it easier to find money-saving tips and all the information you need about natural gas products, incentives and managing your gas account. **Check out the** new features at uniongas.com/residential:
- Clean, uncluttered design
- Easy-to-navigate content flow
- Clear links and key messages

uniongas
A Spectra Energy Company

Figure 5.7 - *intouch* Newsletter

Residential HVAC Newsletter

In 2015, Union continued to target residential HVAC contractors through the GasFacts newsletter. This newsletter provides updates to the HVAC community related to Union's energy efficiency programs, codes and standards, recalls and manufacturers' notifications, as well as rebate offers from Union and third party organizations.

Dedicated HVAC Webpage

The HVAC partners section of the Union website has been designed to inform HVACs and the industry of relevant information, updates, codes and standards, and links to Union's conservation programs. The website hosts past GasFacts editions as well as FAQs, rebate and incentive information, equipment and technical support and other information.

5.1.4 Lessons Learned

ESK and Programmable Thermostat Offering

- ***Union is exiting the offering***

  Union is exiting the ESK and Programmable Thermostat offerings after 2015 as a result of the Board's decision on Union's 2015-2020 DSM Plan. During the delivery of these offerings, Union learned that they were a valuable means of promoting energy efficiency to its residential customers.

Home Reno Rebate Offering

- ***HRR offering promotion can be a benefit to HVAC sales***
  Union has learned that some contractors may be reluctant to refer customers to the HRR offering because they feel it will impact their ability to close the sale in a timely manner. Others are promoting the HRR offering aggressively and are benefitting from higher sales of energy efficient heating systems utilizing the rebates offered through the HRR offering.

  Union has been actively engaged in promoting the HRR offering to contractors, both through the Residential Account Managers and education sessions. Continued promotion to contractors to address their concerns and demonstrate the benefits of promoting the HRR offering will be a continued focus in the future.

- ***Townhouses are an untapped market***
  In prior program years, Union had exclusively targeted single detached homes for the HRR offering. Union has since learned that semi-detached homes and side-by-side duplexes were an untapped market. In 2015, these homes were made eligible for the program and over 100 of these homes participated.

The HRR offering is successful and creates significant deep savings for participating homeowners. The HRR program offering will continue into 2016.

5.2 Commercial/Industrial Program

A portfolio of energy efficient technology related incentives were available to Commercial/Industrial (“CI”) customers in 2015. Union uses the EnerSmart Business brand platform to promote the adoption of high efficiency natural gas technologies, processes, energy audits, surveys, studies and customer education. Union’s CI Program is divided into two offerings: prescriptive and custom.

Program savings results, budget spend, and program TRC are presented in Tables 5.7, 5.8 and 5.9 below.

Table 5.7 - 2015 Commercial/Industrial Program Results

Program	Offering	Units	Annual Natural Gas Savings (m^3)	Cumulative Natural Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Commercial/ Industrial	Prescriptive	3,042	9,283,248	182,411,887	$ 4,071,045	$ 20,453,077	2.81
	Custom	588	42,588,031	664,199,557	$ 7,297,352	$ 86,416,088	3.35
2015 Commercial/Industrial Total		**3,630**	**51,871,279**	**846,611,444**	**$ 11,368,398**	**$ 106,869,165**	**3.23**

Table 5.8 - 2015 Commercial/Industrial Program Spend

Item		Total
Incentives	$	7,547,777
Administration	$	2,924,084
Evaluation	$	100,200
Promotion Costs	$	796,336
2015 Total Commercial/Industrial Program Spend	**$**	**11,368,397**

Table 5.9 - 2015 Commercial/Industrial Program Cost Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 154,864,976	$ 44,175,191	$ 110,689,786	3.51
Administration		$ 2,924,084		
Evaluation		$ 100,200		
Promotion		$ 796,336		
Commercial/Industrial Program Total	**$ 154,864,976**	**$ 47,995,811**	**$ 106,869,166**	**3.23**

5.2.1 Prescriptive and Quasi-Prescriptive Offering

Union continues to offer DSM prescriptive and quasi-prescriptive measures to more than 120,000 CI customers. These customers are made up of office, retail, multi-unit residential, foodservice, hotel/motel, manufacturing, agriculture, warehouse, entertainment & recreation, and education & healthcare segments. All of these segments fall within CI rate classes M1, M2, M4, M5, M7, R01, R10 and R20.

- **Prescriptive Measures:** These measures have pre-determined deemed savings based on the size and classification of the equipment.
- **Quasi-Prescriptive Measures:** These measures have one or more variable inputs that need to be known for each installation in order to determine natural gas savings. An example of an input is the size or rating of the equipment (e.g. CFM or BTU).

Target Market

Union continues to approach segments within the CI market uniquely based on the business/industry type. Segmenting based on business type means that Union targets each segment with customized communications. This approach allows Union to use resources more effectively in order to educate business customers about potential energy savings. Segmenting based on business type also provides Union with market insights, allowing for a better understanding of Union's CI customer base and barriers for DSM uptake.

Market Incentive

In 2015, Union offered prescriptive incentives as outlined in Table 5.10 as well as additional incentives discussed below.

Table 5.10 - Commercial/Industrial Prescriptive Offering Incentives

Initiative	Measure	Customer Incentive	Service Provider	Distributor Incentive
Water Heating	Condensing Gas Water Heaters - 100, 500 & 1,000 gal/day/tank	$ 350	$ 100	$ 50
	Laundry Washing Equipment with Ozone - ≤ 120 lbs & 100,000 - 199,999 lbs/yr	$ 1,000	$ 100	
	Laundry Washing Equipment with Ozone - ≤ 120 lbs & ≥ 200,000 lbs/yr	$ 1,500	$ 100	
	Laundry Washing Equipment with Ozone - > 120 lbs & ≥ 260,000 lbs/yr	$ 6,000	$ 100	
	Energy Star Dishwasher - Stationary Rack & Under counter	$ 100	$ 50	
	Energy Star Dishwasher - Rack Conveyor - Single & Multi Tank	$ 400	$ 50	
Space Heating	Air Curtains - ≥ 48ft^2 and < 96ft^2 – Pedestrian	$ 250	$ 100	
	Air Curtains - ≥ 96ft^2 – Pedestrian	$ 500	$ 100	
	Air Curtains - ≥ 64ft^2 and < 96ft^2 - Shipping and Receiving	$ 1,000	$ 100	
	Air Curtains - ≥ 80ft^2 and < 100ft^2 - Shipping and Receiving	$ 1,000	$ 100	
	Air Curtains - ≥ 100ft^2 - Shipping and Receiving	$ 1,500	$ 100	
	Condensing Boiler - ≤ 299 MBtu/hr	$ 600	$ 100	$ 50
	Condensing Boiler - 300 to 999 MBtu/hr	$ 1,500	$ 100	$ 50
	Condensing Boiler - ≥ 1,000 MBtu/hr	$ 4,500	$ 100	$ 50
	Condensing Rooftop Units (MUA) Improved efficiency 1,000 – 4,999 CFM	$ 500	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + 2 speed 1,000 – 4,999 CFM	$ 1,000	$ 100	
	Condensing Rooftop Units (MUA) Improved efficiency ≥ 5,000 CFM	$ 1,200	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + VFDs 1,000 – 4,999 CFM	$ 1,400	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + 2 speed ≥ 5,000 CFM	$ 1,800	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + VFDs ≥ 5,000 CFM	$ 2,600	$ 100	
	Destratification Fan	$ 1,300	$ 100	
	ERV - ≤ 1,999 CFM	$ 600	$ 100	$ 50
	ERV - ≥ 2,000 CFM	$ 1,500	$ 100	$ 50
	HRV Multi Family, Health Care, Nursing	$ 400	$ 100	$ 50
	HRV 500 - 1,999 CFM - Hotel, Rest, Retail, Rec, School, Off, Warehouse, Man	$ 400	$ 100	$ 50
	HRV ≥ 2,000 CFM - Hotel, Rest, Retail, Rec, School, Off, Warehouse, Man	$ 700	$ 100	$ 50
	Infrared Heating*	$ 300	$ 100	$ 50
	Demand Control Ventilation (DCV) Retail, Rooftop Unit (RTU)/MUA < 5,000 sq ft	$ 150	$ 50	
	DCV Retail RTU/MUA ≥ 5,000 sq ft	$ 350	$ 50	
	DCV Office RTU/MUA < 2,500 sq ft	$ 100	$ 50	
	DCV Office RTU/MUA ≥ 2,500 sq ft	$ 200	$ 50	
Commercial Kitchen	Cooking Equipment - Energy Star Fryer	$ 200	$ 50	
	DCKV Fast Food - ≤ 4,999 CFM	$ 1,200	$ 100	
	DCKV Full Menu - 5,000 – 9,999 CFM	$ 3,000	$ 100	
	DCKV Dinner House - 10,000 – 15,000 CFM	$ 4,000	$ 100	

*Service Provider Incentive to HVAC contractors only.

National Account Multi Unit Incentive

National Account customers are those that have multiple property locations throughout Union's franchise with similar design and use, such as retail chains, property management firms and foodservice chains. National Account customers have the ability to install various different energy efficient technologies within numerous locations across Union's franchise. Recognizing that this customer group has a greater number of savings opportunities, Union continued to offer a multi-unit installation bonus incentive in 2015:

- 25% incentive increase on 6-30 installations per National Account
- 50% incentive increase on 30 or more installations per National Account

Hotel and Motel Ozone Laundry Incentive
Hotel and motel customers are sometimes reluctant to install ozone laundry due to low awareness of the technology's benefits and its high costs. Union continued to offer the following additional incentive to hotel and motel customers who participated in the Ozone Laundry initiative in 2015:

- \$200 per unit – Washer Extractor ("WE") < 120 lbs capacity & 100,000 - 199,000 lbs laundry/year
- \$500 per unit – WE < 120 lbs capacity & >200,000 lbs laundry/year
- \$800 per unit – WE > 120 lbs capacity & > 260,000 lbs laundry/year

Market Delivery

To reach CI customers, Union continued to implement a combination of the following approaches:

- **Direct Sales Approach.** With this approach, Union works directly with the end-use customer to provide education on potential options to improve the energy efficiency of their facilities, offerings available to facilitate those options, and how the application process works. The direct sales approach requires working with multiple contacts within an organization as well as service providers, manufacturers and distributors who are instrumental in affecting a decision to install energy efficiency technologies;
- **Mass Market Approach.** Union uses a number of mass marketing techniques to target the end-use customer such as the Union webpage, bill inserts, direct mails, email blasts, and advertising. Union also uses event based marketing including tradeshows, customer workshops and other similar events to reach a large number of customers and industry partners; and
- **National Account Approach.** Union's National Account managers communicate and influence end-use customers who make decisions using a top-down, centralized approach. National Account customers are those that have multiple property locations throughout Union's franchise with similar design and use, such as retail chains, property management firms and foodservice chains.

Not only does Union reach and influence the market through the above direct sales, mass market and National Account approaches, but support is also provided through a network of industry partners. These industry partners specify or install energy efficient equipment and/or directly educate or influence Union's customers to adopt natural gas energy efficient equipment. Maintaining and cultivating relationships with each of the following industry partners ensures that they are informed of Union's programs and that they can present the savings, benefits and incentives to customers:

- **Service Providers.** Architectural consultants, builders, HVACs, engineering consultants and energy service companies all carry significant influence with end-use customers;
- **Associations.** Associations align with segment-specific approaches to market and provide industry insight necessary to design programs that resonate with customers and drive action;
- **Manufacturers.** Manufacturers of the technologies that Union promotes provide insight into product benefits, as well as effective methods of influencing the market; and
- **Distributors.** Distributors influence the market and their contractor customers. Contractors then influence the end-use customers installing the equipment.

By employing various market approaches and tailoring initiatives to specific business segments, Union is able to ensure communication with customers is relevant to their needs. For this report, prescriptive and quasi-prescriptive measures are grouped as Water Heating, Space Heating, and Kitchen initiatives.

5.2.1.1 Water Heating Initiative

The Water Heating initiative is designed to reduce a customer's energy use and water consumption. In 2015, Union offered incentives for the following technologies:

- **Condensing Gas Water Heater.** High efficiency gas water heaters that operate at 95% thermal efficiency. This thermal efficiency is higher than that of conventional tank type water heaters, which operate at 80% efficiency. Installation of high efficiency gas water heaters results in faster hot water cycle times and therefore reduces building operating and energy costs; and
- **Ozone Laundry**. A piece of auxiliary equipment added onto a new or existing commercial washing machine that reduces the amount of hot washing and drying times required to achieve the same standard of cleaning.

Target Market

Within the Water Heating initiative, there are specific target markets depending on the technology:

- Condensing gas water heaters were targeted to multi-unit residential, foodservice, education, entertainment, recreation, and healthcare customers; and
- Ozone laundry was marketed to customers with large volumes of laundry such as hotels, motels, laundry services and long-term care facilities.

Market Incentive

The following incentives were offered to the end-use customer:

- Condensing gas water heater: $350 per unit
- Ozone laundry
    - Ozone WE =< 60 lbs cap & 100,000 to 199,999 lbs/yr: $1,000 per unit
    - Ozone WE =< 60 lbs cap & =>200,000 lbs/yr: $1,500 per unit
    - Ozone WE > 60 lbs and =< 120lbs cap & => 200,000 lbs/yr: $1,500 per unit
    - Ozone WE > 120 lbs and < 500lbs cap & > 260,000 lbs/yr: $6,000 per unit

Union offered a special segment-specific additional incentive of $250 per unit to hotel/motel customers and $800 per unit to laundromat customers with large laundry facilities to encourage uptake of ozone laundry.

Market Delivery

Water heating marketing efforts included promotion through direct sales, mass marketing, bill inserts and National Accounts. In 2015, Union continued to collaborate with technology manufacturers and service providers to effectively reach and influence early technology adopters, primarily in the National Account, hotel/motel and long-term care markets. Union's Business webpage (www.uniongas.com/business) offered online education tools and resources that helped inform customers on how to manage energy use. Union also exhibited at tradeshows and association events, such as PM Expo, to target National Account retail and hotel/motel customers and promote water heating measures. Multi-family customers also remained a focus with exhibits at various local property manager associations and tradeshows in London, Waterloo and Hamilton.

5.2.1.2 Space Heating Initiative

The Space Heating initiative is designed to stimulate customer action towards retiring older inefficient space heating equipment and installing new energy efficient space heating equipment. In 2015, Union offered incentives for the following:

- **Air Curtains**. This technology delivers a controlled stream of air that separates the indoor and outdoor environment. Air curtains reduce infiltration of cold or hot outside air through doorways, significantly reducing natural gas heating in winter and air conditioning in summer. Air curtains are often used where doors stay open for long periods of time. Typical examples include shipping docks and retail or office entrances;
- **Condensing Boilers**. Condensing boilers recover energy that would normally be discharged into the atmosphere through a flue. This improves heating efficiency by approximately 15-20% compared to conventional boilers, resulting in reduced gas bills. They also require less space, offering more flexibility in small environments;
- **Condensing Make-Up Air Units ("MUAs")**. These units are indirect gas fired and provide fresh air to common areas in commercial buildings. The majority of furnaces built into rooftop units are mid efficiency units with efficiencies ranging from 78% to 82%. Condensing technology offers improved efficiencies of 90% and above. A high 'turn down' feature results in lower operating costs, better control, and increased comfort. There are three sub-categories for this technology:
    - Improved efficiency
    - Efficiency + 2 speed
    - Efficiency + Variable Frequency Drives ("VFDs")
- **Destratification Fans**. Large downdraught destratification fans bring heat down from the ceiling to mix with cooler floor temperature air, which helps create a comfortable temperature where it is most needed. Facilities with large stratified temperature differences have the greatest potential for energy savings;

- **Energy Recovery Ventilation ("ERV") and Heat Recovery Ventilation ("HRV")**. ERVs capture heat and moisture, while HRVs capture heat. The recovered heat energy from the indoor air is used to heat air entering the building. ERVs and HRVs reduce the energy use associated with heating the space and related energy costs, and make the ventilation system operate more efficiently;
- **Infrared Heaters**. Infrared heaters help customers conserve energy and money, as they deliver heat directly to where it is needed instead of heating the air within a space, like traditional forced air heating systems. This technology is especially beneficial in large volume buildings that do not require a steady state of heat or where there is a large amount of air exchange, such as near a loading dock; and
- **Demand Control Ventilation ("DCV")**. This technology uses carbon dioxide sensors designed to control the amount of air exchanged (fresh air coming in, stale air leaving the building) based upon occupancy. Occupancy is measured by the amount of carbon dioxide in the air through sensors that control the amount of air exchanged from the rooftop/MUA units.

Target Market

Within the Space Heating initiative, there are specific target markets depending on the technology as detailed below:

- Air curtains were targeted to warehouse, retail and manufacturing segments;
- All CI customers were eligible for the condensing boiler measure;
- Condensing MUAs were targeted primarily to multi-unit residential and healthcare segments as well as all other segments where the technology is appropriate;
- Destratification fans were targeted to warehouse, manufacturing and retail customers whose facilities have high ceilings;
- All CI customers were eligible for ERVs/HRVs provided that an engineer stipulates that it is not a code requirement;
- Infrared heaters were targeted to warehouse, agriculture, retail and manufacturing customers; and
- DCV were targeted to office and retail customers.

Market Incentive

The incentives in Table 5.11 were offered to the CI customer.

Table 5.11 - Commercial/Industrial Space Heating Initiative Incentives

Measure	Customer Incentive ($ per Unit)[1]
Air Curtains (Shipping Doors)	$ 1,000 - $ 1,500
Air Curtains (Pedestrian Doors)	$ 250 - $ 500
Condensing Boilers	$ 600 - $ 4,500
Condensing MUAs (Improved Efficiency)	$ 500 - $ 1,200
Condensing MUAs (Efficiency + 2 Speed)	$ 1,000 - $ 1,800
Condensing MUAs (Efficiency + VFDs)	$ 1,400 - $ 2,600
Destratification Fans	$ 1,300
ERVs	$ 600 - $ 1,500
HRVs	$ 400 - $ 700
Infrared Heaters	$ 300
DCV retail RTU/MUA < 5,000 sq ft	$ 150
DCV retail RTU/MUA ≥ 5,000 sq ft	$ 350
DCV office RTU/MUA < 2,500 sq ft	$ 100
DCV office RTU/MUA ≥ 2,500 sq ft	$ 200

1 – Incentive varies with size of equipment.

Market Delivery

In 2015, promotion of space heating technologies included direct sales, mass marketing, bill inserts and National Account market approaches. Focus was on building and maintaining relationships with industry partners to ensure education and awareness of Union's programs. In addition, the Union business webpage offered educational tools to help the mass market learn how to manage its energy use. Union also participated in segment specific tradeshows, workshops and industry events to highlight available incentives.

5.2.1.3 Commercial Kitchen Initiative

The Commercial Kitchen initiative is designed to encourage food establishment owners and operators to install high efficiency technologies that are designed to reduce hot water consumption and natural gas use. In 2015, Union offered incentives for the following:

- **Energy Star Fryers**. Energy Star rated fryers are 20-50% more efficient than traditional cooking equipment;
- **Demand Control Kitchen Ventilation ("DCKV")**. Traditional ventilation systems operate at only one speed, whereas the speed of DCKV systems automatically respond to changes in cooking volume and heat, resulting in much greater efficiency. The prescriptive savings for DCKV were based on three ranges of total range hood exhaust: 0 – 4,999 CFM, 5,000 – 9,999 CFM, and 10,000 – 15,000 CFM; and
- **Energy Star Dishwashers**. Energy Star rated commercial dishwashers reduce energy and water consumption and improve performance. On average, they are 25% more energy efficient and 25% more water efficient than standard models. Models include under counter, stationary and conveyor.

Target Market

Energy Star fryers, DCKV, and Energy Star dishwashers were targeted to the following commercial kitchen customer segments: foodservice, hotel/motel, education and healthcare.

Market Incentive

- Energy Star fryers: $200 per unit
- DCKV
  - Up to 4,999 CFM: $1,200 per unit
  - 5,000 to 9,999 CFM: $3,000 per unit
  - 10,000 to 15,000 CFM: $4,000 per unit
- Energy Star dishwasher
  - Under counter and stationary rack: $100 per unit
  - Rack conveyor: $400 per unit

Market Delivery

Commercial kitchen marketing efforts included promotion through direct sales, targeted direct market communication such as bill inserts (Figure 5.8), participation at tradeshows and a National Accounts approach. The National Accounts approach in the foodservice segment focused on program uptake from select foodservice organizations within Union's franchise. To further enhance these efforts, Union focused on continued relationship management with manufacturers to support awareness of Union's offerings and to ensure that the program offering was being promoted to their customers.

Figure 5.8 - DCKV Brochure

2015 Prescriptive and Quasi-Prescriptive Offering Highlights

Marketing Initiatives

- Union developed a case study featuring one of its commercial national account customers to demonstrate how the decision to install energy efficient technology can lead to energy savings for retail and office customers. The case study highlighted air curtains and DCV and provided information on project costs, energy savings and payback. This case study was included in the "Small Business Energy Saving Guide "Helping Businesses Save Energy" published by the Ministry of Energy.

Program education and awareness

- Union partnered with several associations, including the Association of Municipalities of Ontario ("AMO") and sponsored the Local Authority Services ("LAS") Workshops across Union's franchise. Workshops featured information on understanding energy and value of energy efficiency projects. Sessions targeted decision makers within the public sector; and
- Union published a bi-monthly newsletter called Energylink delivered with the customer bill. This newsletter featured information on energy efficient equipment, savings and incentives available

from Union. The newsletter also provided the customer with information to help manage their account online through MyAccount.[10]

Focus on associations

- Industry associations are a credible source of information that members trust. In 2015, Union partnered with over 25 key associations to communicate the benefits of its energy efficiency programs. Union's participation included presentations at association events, exhibiting at tradeshows and sponsorship;
- Union is an active participant and supporter of energy improvement initiatives across its franchise. Union's employees strive to volunteer their time and expertise to improve upon the communities within which they work and live. Specifically, Union is a proud sponsor of the Race to Reduce and its expansion into Union's franchise areas of Burlington, Oakville, Milton and Hamilton. The Race to Reduce is a program that promotes collaboration between office building landlords and tenants to encourage energy saving behaviour; and
- Union also partnered with the City of Greater Sudbury for the development of its "EarthCare EcoGuide". The guide was developed specifically for businesses in the Sudbury area to educate and promote energy efficiency programs, natural gas, electricity and water.

5.2.2 Custom Offering

Union also focuses on advancing customer energy efficiency and productivity by providing a mix of custom incentives, education and awareness to CI customers across all segments. The objective of the Custom offering is to generate long-term and cost effective energy savings for Union's customers.

Target Market

The Custom offering covers opportunities where energy savings are linked to unique building specifications, design concepts, processes and new technologies that are outside the scope of prescriptive and quasi-prescriptive measures. The offering and incentives are targeted directly to the end user, while trade allies involved in the design, engineering and consulting communities assist to expand the message of energy efficiency.

Market Incentive

Various incentives are available for custom participants specific to education and audit assessments, and the resource acquisition incentive value for projects is \$0.10 per annual m^3 of natural gas saved.

Market Delivery

There are numerous components to the Custom offering, many of which involve customer education designed to increase awareness of energy efficiency opportunities and benefits. These include the following:

[10] MyAccount provides anytime access to historical consumption information, bills and payments.

Customer Engagement - Communication and Education
Union provided education, training and technical expertise and offered a wide variety of materials aimed at building an increased awareness of energy efficiency opportunities and benefits.

Engineering Feasibility and Process Improvement Studies
Union supported the completion of studies to identify and quantify potential energy savings measures. Furthermore, Union supported comprehensive process improvement studies to determine and assess financial costs and benefits of energy efficiency opportunities, supporting the customer's internal decision making process.

Operation and Maintenance
Union's O&M custom projects are those for which Union works with the customer to identify and incent projects that the customer would not have otherwise completed that are related to the repair, replacement, or optimization of an existing piece of equipment or system.

New Equipment and Processes
Union provided financial incentives to support the installation of new equipment and processes, which result in saving natural gas, energy efficiency gains and/or improvements in the productivity of customer's operations. These incentives were available for customers with or without an engineering feasibility or process improvement study.

Energy Management
Union provided financial incentives to support the installation of energy meters, monitoring and management systems, allowing customers to manage the energy intensity of their operations actively and continuously.

2015 Custom Offering Highlights

Union continues to utilize a rigorous quality control process for all custom projects. Each custom project is assessed by Union's internal project review and verification Quality Assurance/Quality Control ("QA/QC") team prior to external verification and audit. The review is conducted by engineers within Union's custom CI project team. The custom project team reviews and confirms the calculated savings through evaluation of project and customer-specific factors including:

- Reasonableness of base case assumptions;
- Confirmation of high-efficiency case assumptions;
- Reasonableness of project life assumptions (EUL);
- Confirmation of "other" factors affecting gas demand (e.g. production and weather); and
- Confirmation of customer project costs.

Union uses standard calculators to estimate natural gas savings for a selection of commercial custom projects. The standard calculators used in 2015 were:

- Formula 1 laundry
- Destratification fan
- Make-up air VFD retrofit
- Make-up air
- High extraction washer (>300G)
- Hot water heating
- Roof insulation
- Boiler combustion control
- Window
- Dock door seals

Performance Based Conservation Pilot

The Performance Based Conservation ("PBC") pilot was launched in 2015 with CI customers. It is a data-driving pilot for customer engagement, project identification and energy savings verification. PBC takes a holistic approach to energy conservation and management and drives continuous improvement. Its activities focus on benchmarking, targeting and identifying the highest savings potential based on market segment.

The pilot is led by the Toronto Region Conservation Authority and Enerlife Consulting. Project Partners include: Union, Enbridge, IESO, Halton Hills Hydro, Milton Hydro, Brampton Hydro One, Region of Peel Water, Halton Region Water, and the Real Property Association of Canada (REALpac).

Pilot goals are to:

- Enroll up to 150 buildings
- Quantify energy (electricity and gas) and water savings opportunities
- Identify high-potential buildings
- Determine facility-specific conservation measures
- Make the case for implementing energy efficiency projects
- Monitor and verify performance improvements

Energy Pathfinder Initiative

The Energy Pathfinder Initiative is a pilot project initiated by the Canadian Manufacturers and Exporters ("CME") in collaboration with ICF International, Union, Enbridge, IESO and Hydro One Networks Inc. The project is designed to explore, define and quantify the opportunity for optimizing end-use operations and energy intensive processes, and to develop best practices for energy optimization and waste energy reduction within the Ontario manufacturing sector.

5.2.3 Education and Awareness

Union offers a wide variety of materials and workshops aimed at building awareness for energy efficiency in the customer's facility. The focus is on educating the customer and their employees on how to identify energy conservation opportunities and supply them with the resources to research and evaluate possible solutions. For example, Union supported the Canadian Healthcare Engineering Society ("CHES") in its initiative to educate healthcare officials interested in energy planning and opportunity identification. Other specific customer education and awareness efforts included:

Canadian Boiler Society ("CBS") Educational Days: High Performance Boiler Solutions that Improve Your Bottom Line

Union partnered with the Canadian Boiler Society to deliver educational forums in London, Burlington, and Toronto to over 60 attendees (Figure 5.9). Information shared with participants included common boiler solutions to increase energy efficiency and how to save natural gas, with a focus on boiler selection and sizing, operation and maintenance, burner upgrades for lower emissions, and improved performance.

Figure 5.9 - Educational Day Brochure

Conferences and Seminars

To further educate and engage customers, Union participated in energy conservation panel discussions and presented at a number of conferences throughout 2015, including:

- Consortium for Energy Efficiency ("CEE") Industry Partners Meeting
- Energy 2015: Competitive Advantage through Energy with CME
- Canadian Boiler Society Technology Day Seminars/Conference
- Canadian Healthcare Engineering Society Conference
- SWITCH Ontario Hot Mix Producers Association Meeting

Union sponsored energy conservation seminars in 2015, including:

- Union's Taking Charge of Electricity Costs Webinar and Meeting
- Union's Managing Energy 2015 Conference
- Union's Large CI Customer Conference
- Union's Greenhouse Growers Luncheon
- Energy Monitoring Targeting and Reporting ("MT&R") Workshop

***GasWorks* Newsletter**

GasWorks is a technology and energy conservation newsletter targeted to large users of natural gas. *GasWorks* provides industry trends, technology and energy efficiency information to help businesses improve process productivity, enhance reliability of equipment and control energy expenses. The newsletter provides links to Union's website and energy efficiency programming as well as various tools, calculators, an online resource library, and an "Ask an Expert" service to provide technical advice.

5.2.4 Lessons Learned

Prescriptive and Quasi-Prescriptive Offering

- ***Channel partners play an important role***
  Channel partners including service providers, distributors and design architects play a vital role in the decision making process for the purchase of energy efficient technology. Union will continue to develop and enhance its relationships with channel partners to better understand and reach small to medium-size business customers.

- ***Opportunities to increase energy efficiency awareness will be explored***
  Awareness of energy efficiency continues to be lower in small to mid-size CI customer segments, specifically non-account managed customers. For the purpose of improving overall energy efficiency literacy in the CI market and to drive participation in DSM programming, Union will continue to explore opportunities to provide targeted education and awareness strategies.

Custom Offering

- ***IR Poly Project funding is being discontinued***
  An assessment of current greenhouse market practices in Union's franchise has indicated that infrared polyethylene (IR Poly) roof membranes have now become standard practice for new and existing greenhouse projects. Recognizing this successful transformation in the greenhouse market, Union discontinued its custom IR Poly incentives for greenhouses at the end of Q3 2015.

- ***Project basecase documentation has been augmented***
  For the 2015 program year, Union has implemented a formalized basecase documentation form to be filled out by participating customers. This form will augment Union's existing basecase documentation. The form explicitly documents each customer's basecase practices, absent Union's influence.

Union will continue to offer its CI prescriptive and custom offerings in 2016.

6. Low-Income Scorecard

Low-income programs are similar in nature to resource acquisition programs, but are separated to recognize the specific needs of this customer group. They may result in lower TRC net savings than non-low-income programs although they provide various other benefits that are difficult to quantify.[11] These programs also more adequately address the challenges involved in identifying and providing DSM programs that meet the special needs of this consumer segment. Like resource acquisition programs, low-income programs seek to achieve direct, measureable savings customer-by-customer and involve the installation of energy efficient equipment.

Table 6.0 presents the results of the Low-Income Scorecard. Union achieved 140% of the overall scorecard target, resulting in a DSM Utility Incentive of $2.463 million.

Table 6.0 - 2015 Low-Income Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings from Single Family (m^3)	19,500,000	26,000,000	32,500,000	60%	35,847,426	176%	105%
Cumulative Natural Gas Savings from Multi-Family (m^3)	13,200,000	17,600,000	22,000,000	40%	16,333,361	86%	34%
				Total Scorecard Target Achieved			*140%*
				Scorecard Utility Incentive Achieved			*$ 2,462,534*

The Single Family metric consists of cumulative natural gas savings from the Home Weatherization Program ("HWP") offering. The Multi-Family metric consists of cumulative natural gas savings from the Affordable Housing Conservation ("AHC") offering.

6.1 Low-Income Program

The Low-Income program is designed to reduce the energy burden facing low-income single family and multi-family dwelling customers. In 2015, Union's low-income single family HWP offering consisted of building envelope measures. Details for this offering are located in section 6.1.1. Union's multi-family market AHC offering provided municipalities and social and assisted housing owners with enhanced incentives on all multi-family prescriptive and custom measures currently offered in the Commercial/Industrial program. Details of this offering are located in section 6.1.2.

Table 6.1 shows the results of the Low-Income program. The total spend for the Low-Income program is administered on a program level. Table 6.2 breaks down the total spend into its components.

[11] These various benefits not captured by the traditional net TRC savings measure may include reduction in arrears management costs, increased home comfort, improved safety and health of residents, avoided homelessness and dislocation, and reductions in school dropouts from low-income families.

Table 6.1 - 2015 Low-Income Program Results

Program	Offering	Units	Annual Natural Gas Savings (m^3)	Cumulative Natural Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Low-Income	Affordable Housing Conservation	131	874,226	16,333,361	$ 7,701,035	$ 552,817	1.07
	Home Weatherization Program	1,472	1,435,616	35,847,426			
2015 Low-Income Total		**1,603**	**2,309,842**	**52,180,787**	**$ 7,701,035**	**$ 552,817**	**1.07**

Table 6.2 - 2015 Low-Income Program Spend

Item	Total
Incentives	$ 5,449,463
Administration	$ 859,796
Evaluation	$ 196,171
Promotion	$ 1,195,605
2015 Total Low-Income Program Spend	**$ 7,701,035**

Table 6.3 shows the calculation of the Low-Income program's TRC ratio.

Table 6.3 - 2015 Low-Income Program Cost Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 8,878,229	$ 6,073,840	$ 2,804,389	1.46
Low Income Administration		$ 859,796		
Low Income Evaluation		$ 196,171		
Low Income Promotion		$ 1,195,605		
Low-Income Program Total	**$ 8,878,229**	**$ 8,325,413**	**$ 552,817**	**1.07**

6.1.1 Home Weatherization Program Offering

The HWP offering provides low-income customers living in single family homes with a free home energy audit and upgrades including attic insulation, wall insulation, basement insulation and draft proofing measures. Basic measures including showerheads, aerators, pipe insulation and programmable thermostats are provided to qualified customers at the time of the home energy audit if they have not previously received them.

Target Market

This offering targets customers who meet the following criteria:

- Income is at or below 135% Low-Income Cut-Off ("LICO"); and
- Occupants of a single/semi-detached, town/row house or low-rise multi-family housing (3 stories or less);

And are either:

- Private homeowners or tenants who pay their own gas bills; or
- Tenants residing in social and assisted housing, regardless of who pays the gas bills.

Income verification is required to participate in this offering.

In 2015 Union expanded the geographic reach of the HWP offering into smaller communities, like Ingersoll, Walkerton, Hanover, Wingham and Dunnville. Union also continued to focus on Southwestern Ontario communities, including Cambridge, Hamilton, Waterloo, Windsor, London, Grey Bruce County, Huron County, Sarnia and St. Thomas, as well as Northern Ontario communities, including Sudbury, Thunder Bay and North Bay, in addition to Belleville and Cobourg.

Market Incentive

The HWP offering is delivered at no cost to the customer. Customers participating in this program can receive all recommended thermal envelope upgrades as determined through the free energy audit at no cost. Customers can expect to reduce gas consumption, lower gas bills, and benefit from a quieter and more comfortable home.

Market Delivery

Union's main approach to delivering the HWP offering is to work with experienced and reliable delivery agents to perform energy audits and measure installation. Measures that are installed in the home are determined by a free home energy audit performed by a Certified Energy Auditor. Union installs all cost effective measures, while maintaining a portfolio TRC ratio of 0.7 or greater. After the measures are installed, a second home energy audit is conducted to verify the natural gas savings realized.

Union was successful in delivering the HWP offering to 386 homes in the social housing market and 940 homes in the private market for a total of 1,326 homes. Approximately 15% of the natural gas savings were derived from social housing and 85% from the private market.

Private Market Strategies

The private market has become the primary focus for the HWP offering. Union utilized traditional marketing strategies including direct mail, advertisements in community newspapers, door hangers and posters to attract new customers (Figure 6.0 and 6.1).

Figure 6.0 - HWP Offering Brochure

Union Gas program provides relief for Ontario residents

It seemed too good to be true. This past winter, McKellar homeowner Judith received a direct mail letter from Union Gas, offering to insulate her home free of charge. Skeptical but curious, she phoned about the program.

After a Union Gas contractor explained the details and income eligibility criteria for the utility's home weatherization program, Judith filled out an application, photocopied her Notice of Assessment from last year's tax return and mailed it in.

In a matter of days, she received a call from a certified energy adviser, Don Rutledge, to schedule an energy audit of her home. The audit revealed that the attic and basement of her 85-year-old house were under-insulated.

Over the past year, Don has helped over 125 area residents take advantage of the Union Gas weatherization program. He calculated the energy savings, submitted the work plan and within two weeks, Judith's basement walls were neatly clad in a blanket of R-12 insulation.

"The basement has always been quite cold in the winter and damp and humid in the summer," noted Judith. "I was amazed how almost immediately the basement felt much warmer."

The insulation contractor also added nine inches of cellulose fibre to the existing insulation in her attic.

For a retiree living on a fixed income, free home energy improvements worth $3,750, along with estimated savings of $250 in annual heating costs, provide welcome relief.

"I made sure my neighbour signed up for the program," she said.

To find out more about the Union Gas Home Weatherization Program go to uniongas.com/weatherization.

Figure 6.1 - Advertorial for the HWP Offering

Web Strategy

Union's HWP offering webpage

Union's HWP offering webpage (www.uniongas.com/weatherization) allows private homeowners, renters and social housing providers to explore the benefits of participating, and informs viewers on eligibility criteria and means of registration (Figure 6.2).

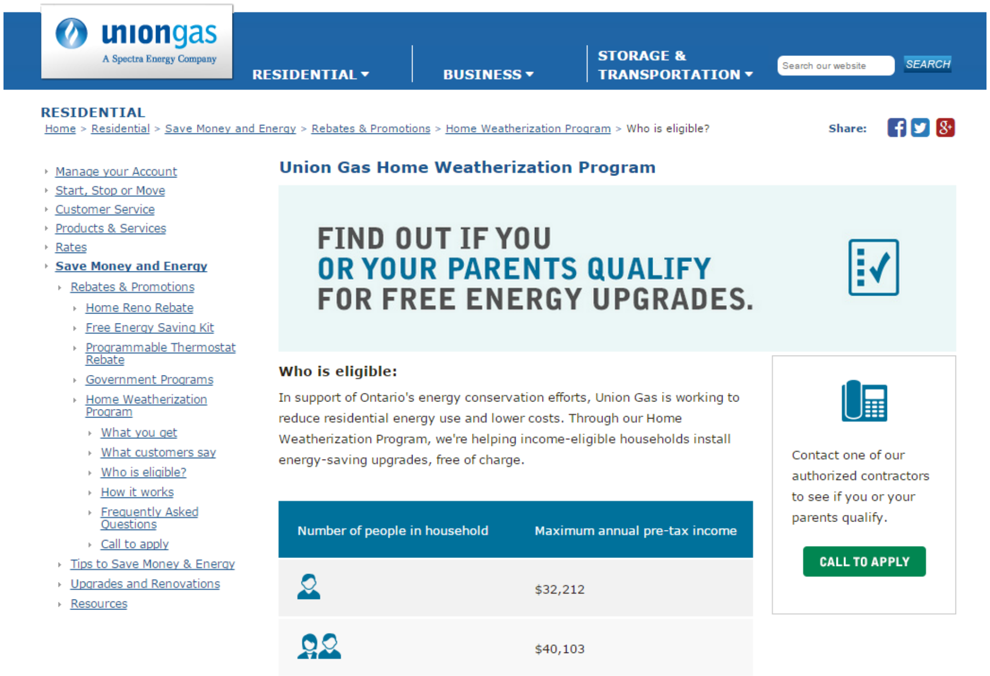


Figure 6.2 - HWP Offering Webpage

In 2015, Union's existing webpage was enhanced to allow customers to pre-qualify for the HWP offering online. Using the web tool, customers can initiate the approval process by answering initial screening questions to determine their eligibility for the offering (Figure 6.3).

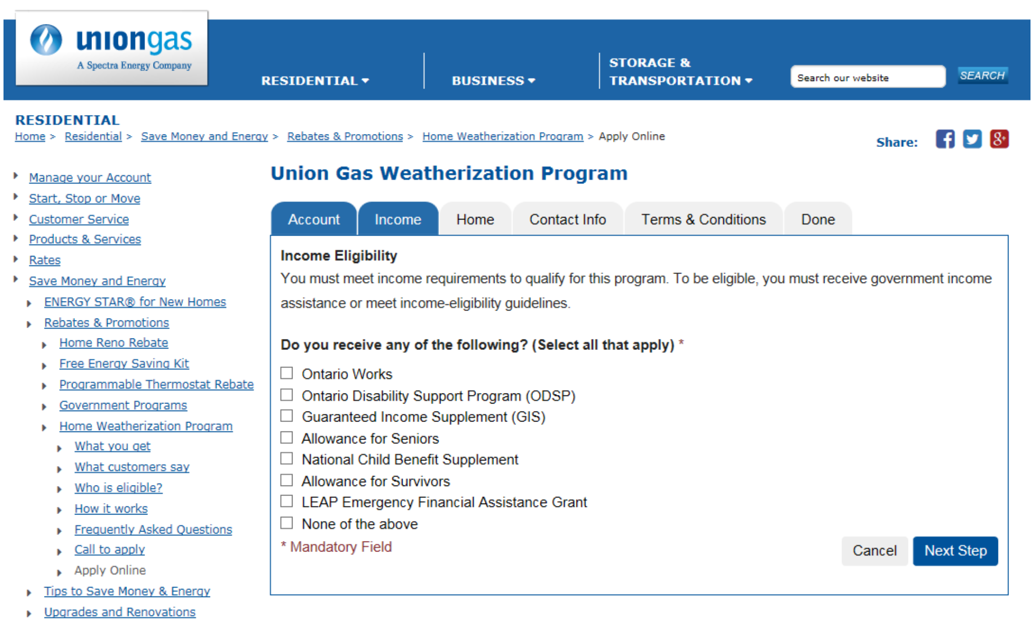


Figure 6.3 - HWP Online Qualification Tool

The new web qualification tool was launched in November 2015. During the December direct mail campaign, nearly one third of the customers chose to apply online, demonstrating the usefulness of additional application channels. Union will continue to utilize digital technology as a way to reach a broader private market segment. An additional benefit of the new online form is that it allows customers to submit information at a time that is most convenient for them, regardless of time of day. This information is then transmitted directly to the delivery agents for follow-up and further screening as required.

Partnership Strategies

Union works with several organizations in its franchise area to deliver the HWP offering to low-income customers.

Winter Warmth Emergency Assistance Program

Winter Warmth is coordinated and delivered to customers by the United Way through a network of community agencies across Union's franchise area. The Winter Warmth program provides low-income customers with one-time financial assistance if they are unable to pay their gas bill. To qualify, individuals must have a Union bill in arrears, have recently received a disconnection notice, and/or are experiencing personal circumstances that make it difficult to pay a current natural gas bill. Customers who are eligible for Winter Warmth funding are also income eligible for the HWP offering. In 2015, Union continued to support the Winter Warmth program by participating in webinars with the partner agencies to understand the fundamentals of the HWP offering, and provide marketing materials to customers applying for Emergency Assistance.

Partnership with the United Way

In 2015, Union continued to work with the United Way of Grey Bruce in establishing a partnership to identify leads in the Grey Bruce region. The United Way reviewed past applications for customers that would be eligible for the HWP offering that could be forwarded to the delivery agent for completion. Union continued to explore partnership opportunities with the United Way by participating in regional meetings with the Executive Directors to explore collaboration potential. Several United Way agencies have expressed interest in forming partnerships and discussions have started with United Way London and United Way Windsor.

Emerge Guelph

Emerge Guelph is a social and environmental organization that connects citizens to innovative solutions that maximize resource efficiency and community wellbeing. Home owners sign up for a free one-hour consultation where they are led through a structured interview about their home that identifies and recommends efficient retrofits and behavioural changes that save money and improve home comfort. As part of the process, the home is screened for eligibility in the HWP offering, and qualified applicant information is automatically forwarded to the delivery agent servicing the Guelph area.

Union Gas Customer Care Partnership

Union's Customer Contact Centre has daily contact with low-income customers in need of assistance with their bills. To increase awareness and encourage participation in the program, a group of customer service representatives have been trained to promote the HWP offering to customers. Customers are transferred to the appropriate delivery agent, or provided with a phone number to determine home eligibility.

Health and Safety

Union avoids disqualifying homes that have treatable environmental hazards within the building envelope. Hazards can include inadequate ventilation, combustion safety, mould, moisture, asbestos, vermiculite, excessive clutter, and lead paint. The issues are often the result of poor structural design, age of the home, as well as the inability of the homeowner to address maintenance concerns due to lack of time, knowledge, and money. In 2015, Union continued addressing treatable environmental hazards identified during the audit, prior to the commencement of any installation work.

6.1.2 Affordable Housing Conservation Offering

The AHC offering targets the multi-family social and assisted housing market with custom and prescriptive measures. In recognition of the limited capital available for upgrades in social housing, Union offers enhanced incentives for these providers to implement any energy efficient measures available to commercial multi-family customers. These improved incentives aim to help this market segment achieve greater long term energy and cost savings.

Target Market

There are two main target markets for the AHC offering:

- Social housing buildings; and
- Low-income market-rate buildings (as part of Union's demonstration initiative).

Social Housing Buildings

The AHC offering targets social and assisted housing providers that manage multi-family housing stock. Social and assisted housing is defined as housing developed, acquired or operated under a federal, provincial or municipally funded program.

Examples of social and assisted housing are:

- Non-profit corporations as outlined in the Social Housing Reform Act, 2000;
- Public housing corporations owned by municipalities directly or through Local Housing Corporations;
- Non-profit housing co-operatives as defined in the Co-operative Corporations Act, 1990;
- Non-profit housing corporations that manage or own rural and native residential housing; and
- Non-profit housing corporations that manage or own residential buildings developed under the AHC offering.

Union has established strong relationships with 27 municipal social housing providers in its franchise area. Union assists them to proactively plan their energy efficiency upgrades. The majority of these 27 municipal housing providers have participated in the AHC offering over the past three years. In 2015, Union continued to increase its focus on the 400+ smaller housing providers, including non-profit housing providers, low-income co-operative housing providers as well as faith- and ethnic-based providers. This targeted approach enabled Union to broaden its reach to low-income customers.

Low-Income Market-Rate Buildings
Market-rate buildings with low-income tenants have been identified as an area that is not addressed in the AHC offering social housing segment. As such, in 2015 Union ran a demonstration project to target a small number of these buildings. This demonstration project enabled Union to support a small number of private market apartment building owners with low-income tenants. Measures and incentives were offered to address energy efficient upgrades in these buildings, including all prescriptive and custom measures available in the AHC offering. The results of this demonstration project will help Union refine future delivery of this offering.

Market Incentive

Prescriptive Measures
The AHC offering includes all of the prescriptive measures offered to the multi-family segment within the standard Commercial portfolio. However, the incentive levels offered to the low-income sub-segment of the market are higher in recognition of the capital barriers that face this group. Participating social and assisted housing providers were responsible for sourcing service providers for installation of these measures. They received the appropriate incentives from Union upon project completion as outlined in Table 6.4 below. Service providers include architectural consultants, builders, HVACs, engineering consultants and energy service companies.

Table 6.4 - AHC Offering Incentives

Measure	End-user Incentive		Service Provider Incentive
Condensing Boiler – up to 299 MBtu/h	$ 0.10	per cumulative m^3	$ 100
Condensing Boiler – 300 to 999 MBtu/h	$ 0.10	per cumulative m^3	$ 100
Condensing Boiler – over 1,000 MBtu/h	$ 0.10	per cumulative m^3	$ 100
Condensing Gas Water Heater (High Volume)	$ 1,900	flat incentive	$ 100
Condensing Gas Water Heater (Low Volume)	$ 1,000	flat incentive	$ 100
ERV Multi-family	$ 0.10	per cumulative m^3	$ 100
HRV Multi-family	$ 0.10	per cumulative m^3	$ 100
MUA Unit Improved Efficiency	$ 0.10	per cumulative m^3	$ 100

Note: There is a prescriptive incentive cap of 50% of the eligible costs of the project.

Custom Initiative
Custom measures were also made available to social and assisted housing providers where there was an opportunity for significant energy savings. Participating social and assisted housing providers were responsible for driving the installation process for these measures and they received the incentives for participation as outlined below:

- $0.10 per cumulative m^3 of gas saved; and
- Incentive cap: 50% of the eligible costs of the project.

Building Assessments
Building assessments identify high-efficiency space heating, water heating and envelope upgrade opportunities in social and assisted housing multi-family buildings. Union offered social and assisted housing providers funding for a comprehensive building assessment service for their multi-family buildings. These assessments resulted in a report that identified prescriptive and custom measure upgrade recommendations. Multi-family site assessments were funded up to a maximum of $5,000 per site and up to a maximum of $25,000 per housing entity per year. Union follows existing commercial market protocols for assessing energy auditor reports and site assessment subsidization.

Basic Measure Installation Initiative
This initiative offers energy efficient showerheads and aerators. Union provides free installation of showerheads to eligible multi-unit social and assisted housing properties.

Market Delivery

Union focused its market delivery efforts on housing managers and decision makers within 27 municipal social housing providers in the Union franchise area. While the prospect of significant subsidization of capital expenditures through Union's offerings may seem like an easy decision, there are many barriers to adoption. Social housing managers are extremely busy, under resourced and face tight budget constraints. To maximize program adoption, Union took two main approaches for outreach: direct sales and association marketing.

Direct Sales
Union met directly with its customers in municipal and non-profit housing sectors to present Union's suite of offerings and to elicit participation. A sales package clearly and concisely conveyed the offerings available to all multi-family and single-family stock managed by the social and assisted housing provider (Figure 6.4).

Figure 6.4 - AHC Offering Sales Package

Qualified prescriptive and custom measures were identified by the housing provider and a building assessment was considered if there was potential to discover projects.

Social and assisted housing managers were responsible for sourcing contractors to implement prescriptive and custom measures, which were followed by the applicable incentive payment from Union.

Association Marketing
To support the direct sales efforts, Union developed and fostered relationships with relevant housing and social service associations while educating them on Union's suite of offerings in the social and assisted housing sector.

Partnership with the Ontario Non-Profit Housing Association ("ONPHA")
Union partnered with the ONPHA by sponsoring regional meetings in Hamilton, London, North Bay, Thunder Bay and Windsor to further promote energy conservation, in addition to placing advertisements in their bi-monthly newsletter Quick Connections. Moreover, Union sponsored and exhibited at the 2015 ONPHA tradeshow in Toronto, which provided the opportunity to promote the AHC offering. Union found that this partnership was an effective means of educating social and assisted housing providers on the cost benefits of Union's AHC offering for multi-unit properties in order to drive participation.

Partnership with Housing Services Corporation ("HSC")
HSC is a non-profit organization that delivers province-wide programs that benefit Ontario's affordable housing sector. HSC has been a long standing partner with Union in promoting Union's low-income program offerings. In 2015, Union was a key sponsor for the Measuring Matters Conference for the second year in a row. This conference provides practical energy efficiency solutions for social housing providers. Real-life case studies were used to illustrate how to reduce natural gas consumption by understanding and integrating energy benchmarking data, overcoming technical and organizational challenges, and maximizing human and financial resources. Several housing managers highlighted the AHC offering and discussed how their organization had participated and benefitted from significant natural gas savings in several multi-family buildings. The conference also provided Union with the opportunity to connect with housing providers.

6.1.3 Market Research

Consolidated Municipal Service Manager ("CMSM") Office and Non-profit/Co-op Housing Providers
In 2015, Union continued to enhance its understanding of Ontario's social housing landscape. Specifically, Union focused on the role of the CMSMs. The CMSMs manage the distribution of subsidies and technical services to all social housing providers in a given municipality, including municipal, non-profit and co-operative housing organizations. Within the offices, technical staff oversee the building condition assessments of the housing portfolios, so they have an understanding of the building condition as well as its financial viability. In 2015, Union continued to leverage CMSM relationships to gain insights into the social housing market structure, funding models, building condition assessments and decision making processes associated with the different types of housing.

6.1.4 Education and Awareness

Education has been, and will continue to be, an important part of the Low-Income program. Union recognizes that there is a need not only to provide conservation programs directed to low-income customers, but also to educate customers on the direct benefits of energy efficient behaviour. To date, Union has focused education efforts on private market customers through targeted education brochures and education workshops hosted at the community level.

In 2015, Union participated in a pilot of the Community Champions Workshop delivered by HSC. HSC's Community Champion Program supports the development of healthy, sustainable communities within Ontario's social housing sector by educating, engaging and supporting staff and residents in conservation activities. Participants receive valuable training on the benefits of energy conservation and community engagement. Training sessions address a variety of opportunities, including reducing energy and water consumption and minimizing waste. Union sponsored the first of four presentations by HSC staff at a social housing building for seniors. Union will evaluate this tenant education model to ensure it will deliver the appropriate program for low-income tenants in the franchise area.

6.1.5 Lessons Learned

HWP Offering

- ***Web strategy has been successful***
  In 2014, Union promoted the HWP offering through www.Kijiji.ca and the Weather Network. In 2015, an application form was added to the website to allow customers to continue to investigate the HWP offering through the internet. This has proved very successful as a touch point and Union will continue with this internet advertising in the future.

- ***Carbon monoxide detectors will be provided***
  To further promote energy conservation and health and safety, Union will begin providing a carbon monoxide detector in homes where there is not already one present as part of the HWP offering. This will enhance the HWP offering, and improve overall safety for the homeowner.

- ***Aerator installation will be offered***
  Some low income customers may lack the technical expertise or ability to install a kitchen or bathroom aerator that has been left behind for customer installation as part of the basic measures included in the HWP offering. As a result of Board Decision EB-2015-0029, Union was instructed to begin providing aerator installation services in 2016. This will remove installation as a barrier for the customer and guarantee that the benefits are achieved immediately.

AHC Offering

- ***Smaller housing organizations are an important sector***
  CMSMs manage the distribution of subsidies to all social housing providers within a given municipality, and are an important part of Ontario's social housing landscape. Union has learned that developing service manager relationships is important to reach more social housing

providers, especially smaller non-profit and co-operative housing providers that have yet to participate in the AHC offering.

In 2015, Union saw continued growth in participation by non-profit and co-operative housing providers – particularly smaller housing organizations. Union has learned that smaller housing organizations have proven to be an important sector and targeting them will enable Union to more fully service the social housing industry with high-efficiency energy incentives.

- ***Low-income market-rate multi-family demonstration project was successful***
  The low-income market-rate multi-family demonstration project that Union ran in 2015 was successful. Through project findings, Union has discovered a market demand for enhanced incentives for energy efficient space and water heating equipment among market-rate apartment buildings in Union's franchise area. Customer interactions have allowed Union to refine the AHC offering to this market segment for a future full program launch.

2015 was a successful year for the Low-Income program, resulting in significant natural gas savings in the social housing sector. While municipal social housing entities comprised the majority of AHC program participation, the non-profit and co-operative segment of market continues to grow. The Low-Income program is well positioned heading into 2016 – a year in which the current program is expected to explore new offerings.

7. Large Volume Scorecard (Rate T1, Rate T2/Rate 100)

The Large Volume scorecard consists of cumulative m^3 saved from customers within Rate T1, and Rate T2/Rate 100. Table 7.0 presents the results of the Large Volume scorecard. Union achieved below the threshold that earns a DSM Utility Incentive.

Table 7.0 - 2015 Large Volume Rate T1, Rate T2/Rate 100 Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Rate T2 / Rate 100 Cumulative Natural Gas Savings (m^3)	772,381,040	1,029,841,387	1,287,301,734	40%	658,010,847	28%	*11%*
Rate T1 Cumulative Natural Gas Savings (m^3)	154,692,013	206,256,017	257,820,021	60%	121,416,767	18%	*11%*
						Total Scorecard Target Achieved	***22%***
						Scorecard Utility Incentive Achieved	***$ 0***

7.1 Large Volume Program

Union continues to encourage the adoption of energy efficient equipment, technologies, and actions through direct customer interaction.

In Section 15.1 of the DSM Framework, the Board outlined that "the gas utilities should roll-forward their 2014 DSM plans, including all programs and parameters (i.e., budgets, targets, incentive structure) into 2015." As 2015 was a rollover of 2014 programs, the 2015 Large Volume program was consistent with the Large Volume DSM Plan for 2013-2014 (EB-2012-0337).[12] The Large Volume program is applicable to customers in Rate T1, and Rate T2/Rate 100 only.

The 2015 program continued to use a Direct Access budget mechanism for the customer incentive budget process for Rate T2/Rate 100 customers. This mechanism grants each customer direct access to the customer incentive budget they pay in rates. Customers must use these funds to identify and implement energy efficiency projects, or lose the funds which will consequently become available for use by other customers in the same rate class. This 'use it or lose it' approach ensures each customer has first access to the amount of incentive budget funded by their rates. The incentive approach for Rate T1 customers remains unchanged from the aggregate pool approach offered in 2014.

Union's Large Volume program is aligned under one brand platform, EnerSmart. This ensures a seamless, recognizable brand throughout Union's franchise. Large Volume custom projects are jointly delivered through Union's Account Managers and Project Managers. This approach is important to influencing the market and achieving successful implementation of the program.

[12] The Board rendered a decision on this filing on March 19, 2013.

The Account Manager's role is to work with assigned customers to gain in-depth knowledge of their business plans, particularly with respect to their energy use and needs. As Account Managers typically interact with multiple departments within the customer's organization (e.g. purchasing/procurement, plant operations, technical/engineering functions), they are uniquely positioned to identify customer-specific information, which is a critical input into the assessment of project savings opportunities.

The Project Managers (who are all engineers with a Professional Engineering designation in Ontario) work together with the Account Managers as well as third party engineers, equipment manufacturers and service providers as necessary to complete custom applications.

Table 7.1 shows the results of the Large Volume program and Table 7.2 breaks down the total spend into its components.

Table 7.1 - 2015 Large Volume Program Results

Program	Offering	Units	Annual Natural Gas Savings (m^3)	Cumulative Natural Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Large Volume	Rate T2	92	50,153,666	603,578,141			
	Rate 100	18	7,531,680	54,432,706	$ 3,209,716	$ 113,820,506	6.97
	Rate T1	40	8,842,211	121,416,767			
2015 Large Volume Total		**150**	**66,527,557**	**779,427,613**	**$ 3,209,716**	**$ 113,820,506**	**6.97**

Table 7.2 - 2015 Large Volume Program Spend

Item	Total
Incentives	$ 2,219,151
Administration	$ 863,933
Evaluation	$ 122,498
Promotion	$ 4,134
2015 Total Large Volume Rate T1, Rate T2 and Rate 100 Program Spend	**$ 3,209,716**

Table 7.3 shows the calculation of the Large Volume program's TRC ratio.

Table 7.3 - 2015 Large Volume Program Cost Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$132,897,217	$ 18,086,146	$114,811,071	7.35
Large Volume Administration		$ 863,933		
Large Volume Evaluation		$ 122,498		
Large Volume Promotion		$ 4,134		
Large Volume Rate T1, Rate T2 and Rate 100 Program Total	**$132,897,217**	**$ 19,076,711**	**$113,820,506**	**6.97**

7.1.1 Program Offerings

The large volume market is heterogeneous, with most projects tied directly to unique processes or technology requirements. Accordingly, all Large Volume projects are custom.

The Large Volume program goal is to generate long-term and cost-effective energy savings for Union's customers. The program components are outlined below.

Customer Engagement - Communication and Education

Union provided education, training and technical expertise and offered a wide variety of materials aimed at building an increased awareness of energy efficiency opportunities and benefits.

New Equipment and Processes

Union's role in promoting and implementing energy efficient options continued to help companies control energy costs and remain competitive in today's global economy. With the continual focus on cost reduction, many industrials lack the resources required to analyze potential energy saving opportunities. Union helps fill this gap with its reliable and knowledgeable Project Managers in conjunction with incentives designed to influence equipment choices.

Operations and Maintenance

Union works with the customer to identify and incent O&M custom projects that the customer would not have otherwise completed. Projects are related to the repair, replacement, or optimization of an existing piece of equipment or system.

Process Improvement Studies

Union provided customer incentives for conducting detailed engineering analysis and designing specific process equipment or operational improvements identified with or without a general plant audit. The program works to support performance testing and analyses of industrial boilers, total steam plants, thermal fluid heaters, vaporizers, furnaces and special process equipment. Testing identifies and quantifies energy saving opportunities, cost saving opportunities, implementation costs and payback periods as well as related environmental benefits.

Engineering Feasibility Studies

Engineering feasibility studies include an analysis of natural gas equipment as well as electricity, compressed air, water and wastewater. These feasibility studies helped customers formulate a priority list of energy efficiency projects geared to site-specific energy plans and budgets. As required, Union also assisted the customer's technical staff in generating business cases to enable the customer to secure corporate capital funding for energy efficient equipment and/or process changes.

Steam Trap Surveys

Steam trap surveys conducted by qualified service companies are designed to identify losses from steam distribution systems. Each survey identifies leaking, over-sized or under-sized, blocked and/or flooded traps, as well as the availability of performance improvements in condensate return systems.

Boiler Tune-ups
Union provided an incentive to large volume industrial customers for the optimization of their facilities' boiler air-to-fuel ratio, ensuring efficient combustion and natural gas savings.

Union continues to utilize a rigorous quality control process for all custom projects. Each custom project is assessed by Union's internal project review and verification QA/QC team prior to an external verification and audit. The review is conducted by engineers within Union's custom CI project team. The custom project team reviews and confirms the calculated savings through evaluation of project and customer-specific factors including:

- Reasonableness of base case assumptions;
- Confirmation of high-efficiency case assumptions;
- Reasonableness of project life assumptions (EUL);
- Confirmation of "other" factors affecting gas demand (e.g. production and weather); and
- Confirmation of customer project costs.

7.1.2 Large Volume Program Incentives

Table 7.4 and Table 7.5 show the incentive guidelines for the 2015 Large Volume Rate T1 and Rate T2/ Rate 100 offerings respectively.

Table 7.4 - 2015 Incentive Guidelines for Rate T1

Offer	Incentive
Engineering Feasibility Study	50% of the cost, up to $10,000
Process Improvement Study	66% of the cost, up to $20,000
Steam Trap Survey	50% of the cost, up to $6,000
New Equipment	$0.10 per cumulative m³, up to $40,000
Operations & Maintenance	$0.10 per cumulative m³, up to $20,000
Boiler Tune-Up	$250 per boiler
Meters – Gas/Steam/Hot-water	50% of the cost, up to $1,000 per meter
Infrared Polyethylene – IR Poly	$400 per growing acre

Table 7.5 - 2015 Incentive Guidelines for Rate T2/Rate 100

Offer	Incentive
Engineering Feasibility Study	50% of the cost, up to $10,000
Process Improvement Study	66% of the cost, up to $20,000
Steam Trap Survey	50% of the cost, up to $6,000
Direct Access Budget (DAB) New Equipment	$0.08 per cumulative m³, up to $40,000
Aggregate Pool Funded (LVAP) New Equipment	$0.05 per cumulative m³, up to $20,000
Direct Access Budget (DAB) Operations & Maintenance	$0.08 per cumulative m³, up to $20,000

Offer	Incentive
Aggregate Pool Funded (LVAP) Operations & Maintenance	$0.05 per cumulative m³, up to $10,000
Meters – Gas/Steam/Hot-water	50% of the cost, up to $1,000 per meter

7.1.3 Education and Awareness

Customers have told Union that they find significant value in the training and educational material provided.

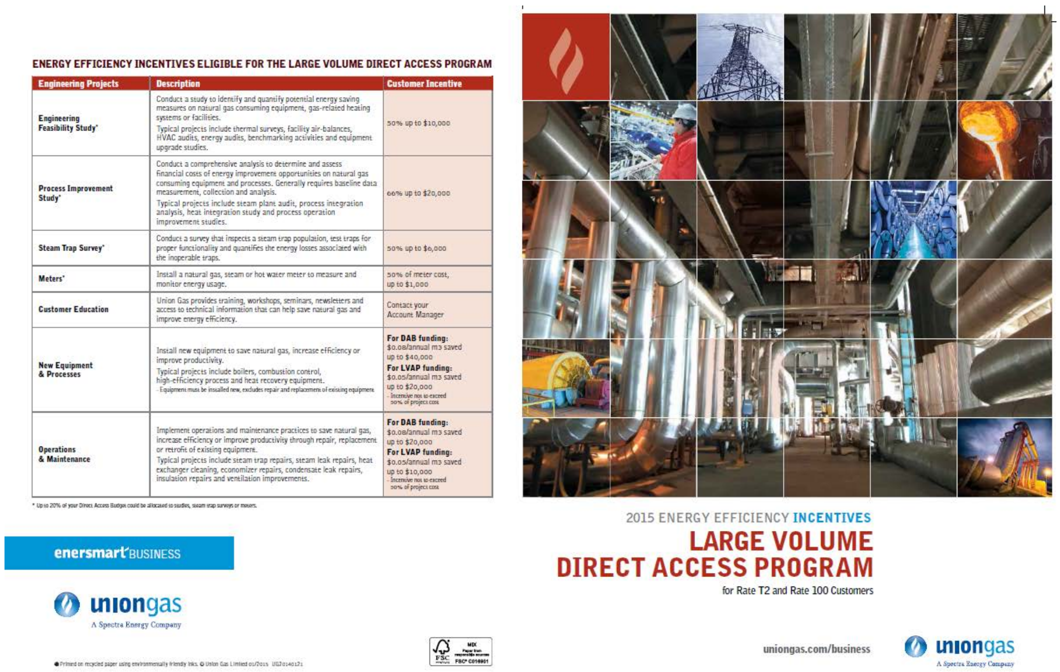
Union continues to expand and broaden distribution of the following educational and promotional tools, which contain information specifically geared towards Rate T1, Rate T2/Rate 100 customers:

- GasWorks newsletter;
- EnerSmart brochures;
- EnerCase reports;
- Workshops to promote the efficient use of natural gas and increase the awareness of energy savings opportunities;
- Sponsorship of specific educational forums; and
- Promotion and attendance at independent professional development groups, trade organizations, and government workshops.

As noted previously, *GasWorks* is a technology and energy conservation newsletter targeted to large users of natural gas. It provides industry trends, technology and energy efficiency information to help businesses improve process productivity, enhance reliability of equipment and control energy expenses. The newsletter provides links to Union's website and energy efficiency programming as well as various tools, calculators, an online resource library, and an "Ask an Expert" service to provide technical advice.

Union's webpage, dedicated to the EnerSmart program[13], contains an application form, technology information, conversion calculations, technical presentations from customer meetings, a series of links for additional references, and an expanding library of *EnerSmart* and *EnerCase* brochures (Figure 7.0 and Figure 7.1). These brochures include customer challenges and the solutions that Union provided.

[13] http://www.uniongas.com/business/save-money-and-energy



ENERGY EFFICIENCY INCENTIVES ELIGIBLE FOR THE LARGE VOLUME DIRECT ACCESS PROGRAM

Engineering Projects	Description	Customer Incentive
Engineering Feasibility Study*	Conduct a study to identify and quantify potential energy saving measures on natural gas consuming equipment, gas-related heating systems or facilities. Typical projects include thermal surveys, facility air-balances, HVAC audits, energy audits, benchmarking activities and equipment upgrade studies.	50% up to $10,000
Process Improvement Study*	Conduct a comprehensive analysis to determine and assess financial costs of energy improvement opportunities on natural gas consuming equipment and processes. Generally requires baseline data measurement, collection and analysis. Typical projects include steam plant audit, process integration analysis, heat integration study and process operation improvement studies.	66% up to $20,000
Steam Trap Survey*	Conduct a survey that inspects a steam trap population, test traps for proper functionality and quantifies the energy losses associated with the inoperable traps.	50% up to $6,000
Meters*	Install a natural gas, steam or hot water meter to measure and monitor energy usage.	50% of meter cost, up to $1,000
Customer Education	Union Gas provides training, workshops, seminars, newsletters and access to technical information that can help save natural gas and improve energy efficiency.	Contact your Account Manager
New Equipment & Processes	Install new equipment to save natural gas, increase efficiency or improve productivity. Typical projects include boilers, combustion control, high-efficiency process and heat recovery equipment. - Equipment must be installed new, excludes repair and replacement of existing equipment	**For DAB funding:** $0.08/annual m3 saved up to $40,000 **For LVAP funding:** $0.05/annual m3 saved up to $20,000 - Incentive not to exceed 50% of project cost
Operations & Maintenance	Implement operations and maintenance practices to save natural gas, increase efficiency or improve productivity through repair, replacement or retrofit of existing equipment. Typical projects include steam trap repairs, steam leak repairs, heat exchanger cleaning, economizer repairs, condensate leak repairs, insulation repairs and ventilation improvements.	**For DAB funding:** $0.08/annual m3 saved up to $20,000 **For LVAP funding:** $0.05/annual m3 saved up to $10,000 - Incentive not to exceed 50% of project cost

* Up to 20% of your Direct Access Budget could be allocated to studies, steam trap surveys or meters.

Figure 7.0 - EnerSmart Large Volume Brochure

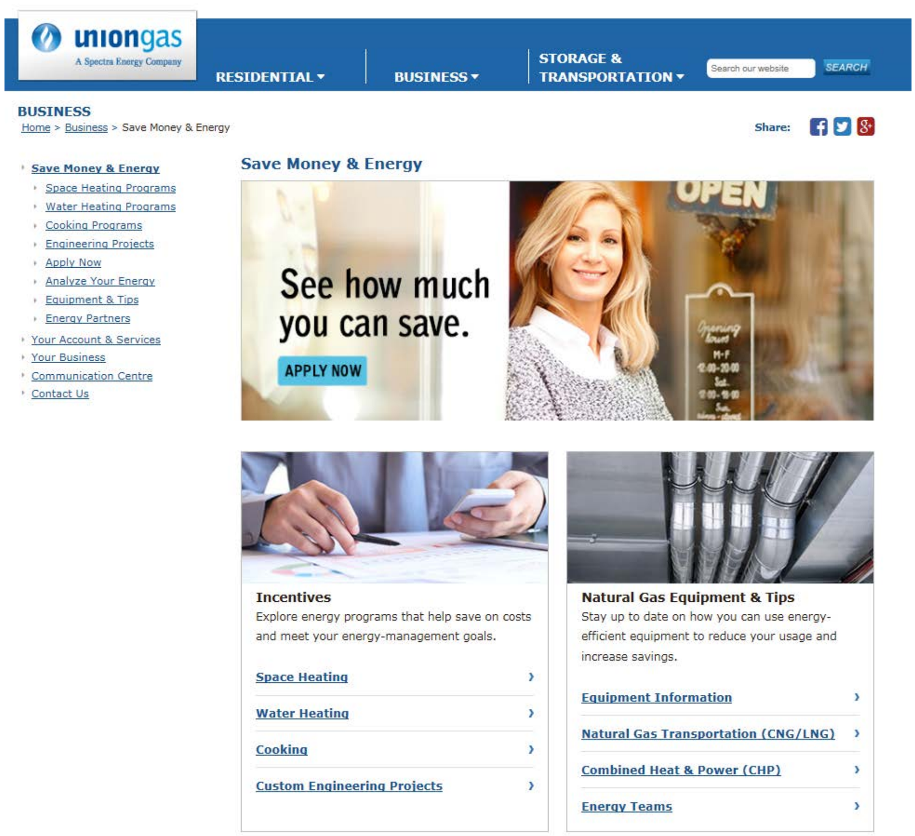


Figure 7.1 - *EnerSmart* Webpage

Union showcased its program offerings and industry knowledge by attending industry tradeshows. Table 7.6 lists the tradeshows specific to large volume customers that Union attended in 2015.

Table 7.6 - Industry Tradeshow Participation

Industry Tradeshow Attendance	Date
Canadian Boiler Society (“CBS”) Education Day	April and October 2015
CBS Tech Fair and Education	June 2015
Canadian Healthcare Engineering Society Conference	May 2015

Education does not stop with customer training and seminars. Union continues to provide highly valued energy expertise, technical support, and resources for Large Volume Rate T1, Rate T2/Rate 100 customers. As a leader in energy efficiency committed to working closely with government and professional organizations, Union understands the latest trends and technologies. This is not limited to potential solutions for individual customers, but also includes the co-benefit of shared learning. Some examples of industry partnerships include:

Consortium for Energy Efficiency (“CEE”)
Through this partnership, Union networked with efficiency program administrators from across the United States and Canada with a focus on developing common approaches to advancing energy efficiency.

Energy Solutions Centre (“ESC”)
Through the ESC, Union collaborated with energy utilities, municipal energy authorities, equipment manufacturers, and vendors to accelerate the acceptance and deployment of new energy efficient, gas-fuelled technologies.

Natural Resources Canada (“NRCan”)
Union’s involvement with NRCan includes participating in research activities, providing funding of industry-specific benchmark studies, and offering Union customers assistance in obtaining government funding for energy efficiency projects. Specific NRCan departments include:

- Office of Energy Efficiency (“OEE”)
- Canadian Industry Program for Energy Conservation (“CIPEC”)
- CANMET Energy Technology Centre

Canadian Boiler Society (CBS)
Union partnered with the Canadian Boiler Society to provide technical training to Union customers that will help them operate their equipment at optimum efficiency.

7.1.4 Lessons Learned

- ***Direct access budget observations***
  The Direct Access budget mechanism for Rate T2/Rate 100 was designed in consultation with large volume customers. The following outlines some key observations of the program in 2015:

  - 97% of Rate T2/Rate 100 customers (35 out of 36) participated by submitting energy efficiency plans;
  - 78% of Rate T2/Rate 100 customers (28 out of 36) submitted energy efficiency plans and at least one project;
  - 33% of Rate T2/Rate 100 customers (12 out of 36) utilized all of their budget;
  - 33% of Rate T2/Rate 100 customers (12 out of 36) received additional funding from the Aggregate Pool; and
  - Approximately 27% of the total Rate T2/Rate 100 program savings were funded by the Aggregate Pool.

- ***Project basecase documentation has been augmented***
  For the 2015 program year, Union has implemented a formalized basecase documentation form to be filled out by participating customers. This form will augment Union's existing basecase documentation. The form explicitly documents each customer's basecase practices, absent Union's influence.

- ***Project opportunities have decreased***
  Union's Large Volume customers completed fewer and smaller projects in 2015 relative to the prior three year average that was used to determine the target.

The Direct Access program for Union's large volume customers assisted customers in reducing gas consumption in their facilities. This was done by implementing energy efficiency projects such as process improvements, upgrading equipment to more efficient technologies and prioritizing maintenance activities. This program will continue to be offered to Union's large volume customers (Rate T2 and Rate 100) in 2016.

8. Market Transformation Scorecard

In 2015, Union continued its market transformation efforts on the Optimum Home program.

Table 8.0 presents the results of the market transformation scorecard. Union achieved over 150% of the overall scorecard target, resulting in a DSM Utility Incentive of $0.567 million.

Table 8.0 - 2015 Market Transformation Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Homes Built (>20% above OBC 2012) by Participating Builders	25%	30%	35%	100%	50.30%	306%	*306%*
						Total Scorecard Target Achieved	***150%[14]***
						Scorecard Utility Incentive Achieved	***$ 566,721***

The 'Homes Built (>20% above Ontario Building Code ("OBC") 2012) by Participating Builders' metric is calculated as the percentage of homes built by enrolled builders in 2015 to a 20% higher energy efficiency standard than the 2012 Ontario Building Code in relation to the total number of homes built in 2015 by builders who remain enrolled in the program. Only homes that have an activated gas service are included in this metric.

Table 8.1 breaks down the total spend for the Optimum Home program into its components.

Table 8.1 - 2015 Market Transformation Spend

Item	Total
Optimum Home Program Incentives	$ 736,172
Optimum Home Program Administration	$ 386,703
Optimum Home Program Evaluation	$ -
Optimum Home Program Promotion	$ 282,464
Total Market Transformation Spend	**$ 1,405,340**

8.1 Optimum Home Program

The Optimum Home program is based on a whole-home consultant approach. The objective of the Optimum Home program is to accelerate residential home builders' energy efficiency practices. The program seeks to address barriers to the wider adoption of high efficiency homes in residential new construction thereby avoiding lost opportunities in the residential market. Optimum Home examines all aspects of the builder's business in an attempt to create fundamental change toward energy efficient building practices.

[14] Scorecard is capped at 150%. Actual scorecard achievement is 306%.

The Optimum Home program was targeted to the top fifty most active builders in Union's franchise area based on the number of housing starts in Union's franchise in the prior calendar year. Builders that signed up for the Optimum Home program enter into a multi-year consulting process. This process partners participating builders with a leading building science expert who can provide cutting edge advice on how to build residential homes to 20% above current OBC 2012. These experts are the leading group of consultants in Ontario's residential building industry, which reinforces the value proposition for builders. They are Gord Cook, Al Schmidt, Michael Leo, Tex McLeod, and Andy Oding.

Advanced building practices are achieved through a process that identifies and addresses barriers to energy efficient construction. The consulting process deals with every aspect of the builder's business including marketing, sales, contracts, construction, services and trades.

The Optimum Home program recognizes that every builder is different. Consultants tailor their advice to suit each builder's individual needs. Consultants work with the builder to develop capacity within its organization to effectively build to a higher efficiency, and to understand opportunities to mitigate any incremental costs through business process improvements. The Optimum Home program consists of three phases:[15]

- **Phase One – Discovery.** Union pairs participating top builders with a leading building science consultant to develop a baseline by benchmarking current product and business practices and by conducting an on-site audit. The consultant will lead discussions on new technologies, building practices and options, resulting in a customized handbook of building specifications to assist the builder to build 20% above OBC 2012. The builder will then build at least one prototype home (Discovery Home) to meet this requirement. On behalf of the builder, a Certified Energy Advisor ("CEA") must demonstrate that the Discovery Home is indeed 20% above OBC 2012. Cost of this evaluation work is covered by the builder.
- **Phase Two – Production.** The builder will work with the consultant to test the new building specifications, examine lessons learned, establish training requirements, conduct training as required, commence building high performance housing stock to 20% above OBC 2012 and conduct performance testing of these houses.
- **Phase Three – Transformation.** The consultant will work with the builder towards full implementation of the new specifications as identified throughout the Optimum Home program process. The consultant sets out a sustainability plan to maintain momentum of building to the new level of efficiency in the future. A wrap up session is then held with the consultant, the builder and any trades people involved where significant gains, technological advancements, and efficiencies achieved as a result of the program are discussed. In 2015, as part of the wrap up session, Union began offering each builder up to four days of additional support with a building expert.

Between 2012 and 2014 Union successfully recruited twenty two of the top fifty builders in Union's franchise area into the program. By mid-2015, all twenty two builders completed Phase One and built a

[15] Up to 30 Consultant days are available to each builder over the three phases of the program.

Discovery Home that has been verified by a third party CEA to be 20% above OBC 2012. By the end of 2015, nineteen builders completed Phases Two and Three of the program. These builders along with their building science experts each held a wrap up session to discuss program accomplishments, lessons learned and how to maintain momentum in building high performance homes in the future. This included identifying any remaining internal barriers and challenges to incorporating the Optimum Home standard across the majority of their housing starts.

Target Market

The Optimum Home program targeted the top fifty builders in Union's franchise based on the previous year's housing starts.

The following groups play a role in influencing the level of high performance homes built by participating builders. Influencing these parties will help drive demand for high performance homes:

- New home buyers, who will ultimately purchase the higher efficiency homes; and
- Builder sales centres, who work on behalf of builders to promote and sell new homes directly to new home buyers. They greatly influence customers' choices and selection of upgraded features. Under the builder's direction, they will promote the features that they believe will generate the most customer interest.

Market Incentive

Builder Incentive

The Optimum Home program is delivered at no cost to the builder. The builder incentive for the original three program phases and new incremental engagement phase is outlined below. The incentives come in the form of consulting services, education and training. Union has also provided an incentive of $2,500 per builder in Phase One towards the cost of the prototype Discovery Home.

- Phase One – $30,000 per builder
- Phase Two – $30,000 per builder
- Phase Three – $15,000 per builder

Market Delivery

In 2015, Union continued to deliver the program through partnering building science experts coordinated by a third party vendor. Union also played a role by monitoring builder engagement, helping to troubleshoot issues as needed, and leveraging manufacturing and channel partner relationships to provide product knowledge and education.

Marketing Support

In Phase One, Union provided each participating builder with a press release/editorial and key message document that could be released to media at the opening and display of the builder's Discovery Home.

Banners were also provided for each Discovery Home site to attract customers and encourage them to ask for more information regarding high performance homes.

Each builder was encouraged to create its own high performance home promotion and market it to its customers as they moved through the program phases and into wider-scale production, supported by sales and marketing training through the program (Figure 8.0).

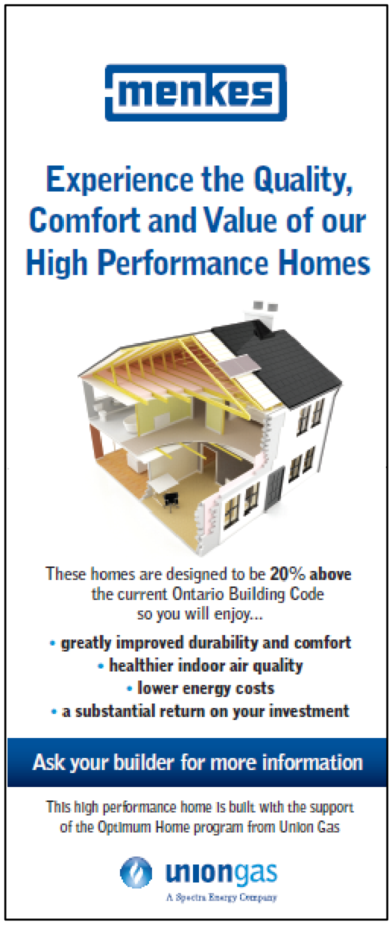


Figure 8.0 - Discovery Home Signage

Ontario Home Builders' Association ("OHBA") Partnership
As part of Union's ongoing commitment to the builder community, Union partnered with the OHBA. Support from the OHBA provided Union with the ability to enhance market intelligence related to energy efficiency, sustainability and better building in the new housing market. Since 2013 Union has been participating in the OHBA Builder Forums, and has attended various events throughout the year with the OHBA's local chapters.

8.2 Lessons Learned

- ***Builders learned the benefits of advanced innovative technologies***
  One of the key lessons learned from the Optimum Home program was the benefit of using new energy efficient technologies and building materials in home construction. Examples include:

- Optimum basement wall systems. Installing an optimal basement wall system was found to help eliminate moisture, mildew and rot in highly air tight homes creating a healthier, more comfortable living environment;
- Right sized furnaces. Right sized furnaces can be better suited to homes with higher air tightness and can help eliminate temperature stratification, providing a more comfortable and energy efficient living environment;
- Air barrier systems. Installing an advanced air barrier wall system can help bring superior air barrier performance while being easier and more efficient to install; and
- Infrared scanning to determine air leakage. Use of an advanced infrared scanning system can help identify areas in the construction where the most leakage was coming from. This proved to be an excellent tool to help improve air tightness.

- ***Sharing program knowledge across the greater building community is important***
  Union recognizes that in order for market transformation to be effective, program knowledge and experiences must be shared across the greater building community. To facilitate the sharing of best practices, Union is:

  - Planning builder forums across its franchise areas. These forums will provide information on how to build to a higher standard and serve as an opportunity to share lessons learned from builders who have been through the Optimum Home program.
  - Developing an online web section for builders, which includes:
    - How to get ready for the code change and stay ahead of the curve by building to a higher standard through programs like Energy Star for New Homes;
    - The value of these homes to new homebuyers, the community, and the environment and how it this value will continue to grow ; and
    - Lessons learned from other builders on how to use advanced technology and building practices while keeping costs low.

- ***Builders valued the consulting model***
  Many builders have expressed their appreciation for the consulting support that this program provided and found this to be effective in relation to programs that only focus on providing a financial incentive. They felt the consulting work provided by a lead consultant had a tremendous impact on their business.

- ***Consumer marketing***
  2015 Optimum Home results have shown that Union has had a tremendous impact on the supply side of the home builder market. Union has learned that most participating builders would like more support on the sales and marketing side to drive awareness, interest and demand from home buyers

In 2015, Union's main focus was to drive participating builders to construct a higher percentage of their stock to 20% above OBC 2012. Union exceeded its 2015 target with 50% of all homes built by participating builders constructed to 20% above OBC 2012. This program will continue in 2016 as per the Board's Decision on Union's 2015-2020 DSM Plan.

9. Lost Revenue Adjustment Mechanism Variance Account

The Board-approved Lost Revenue Adjustment Mechanism Variance Account (“LRAMVA”) allows Union to recover the lost distribution revenues associated with DSM activity.

For 2015, the LRAMVA amount of $0.170 million is based on 2015 delivery rates, December 2015 Input Assumptions filing (EB-2015-0344) and annual natural gas savings of 49.134 million m^3. The 2015 LRAMVA statement is detailed in Table 9.0 on the following page.

Table 9.0 - 2015 LRAMVA Statement

Rate class	January	February	March	April	May	June	July	August	September	October	November	December	Total Volumes (10^3 m^3) (a)	2015 Delivery Rates (\$/10^3 m^3) (b)	Revenue Impact (a) x (b)
	DSM Volumes (10^3 m^3)														
South															
M4 Industrial	3,202	1,890	165	409	202	309	167	251	351	311	57	141	7,456	10.41	$ 77,633
M5 Industrial	567	176	31	72	23	94	119	152	86	96	116	67	1,600	23.54	$ 37,670
M7 Industrial	4,243	1,424	129	862	661	176	380	419	385	589	258	-	9,527	3.47	$ 33,060
T1 Industrial	3,348	-	121	687	1,962	52	72	456	164	100	215	-	7,177	0.74	$ 5,304
T2 Industrial	8,265	-	-	601	291	478	-	946	2,501	895	4,162	466	18,605	0.08	$ 1,488
South Total	**19,625**	**3,490**	**446**	**2,631**	**3,140**	**1,109**	**739**	**2,224**	**3,488**	**1,990**	**4,808**	**674**	**44,365**		**$ 155,155**
North															
20 Industrial	358	-	103	35	-	96	113	415	39	60	113	-	1,332	5.40	$ 7,195
100 Industrial	-	-	223	14	-	2,497	37	25	463	113	63	-	3,437	2.19	$ 7,527
North Total	**358**	**-**	**326**	**49**	**-**	**2,593**	**150**	**441**	**503**	**173**	**176**	**-**	**4,769**		**$ 14,722**
Total	**19,983**	**3,490**	**772**	**2,681**	**3,140**	**3,702**	**889**	**2,665**	**3,991**	**2,163**	**4,984**	**674**	**49,134**		**$ 169,877**

10. DSM Utility Incentive

Union's 2015 results for each scorecard are presented in Tables 10.0, 10.1, 10.2, and 10.3 below.

Table 10.0 - 2015 Results - Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	612,421,364	816,561,818	1,020,702,273	90%	919,157,080	125%	113%
Deep Savings – Residential	934	1,245	1,556	5%	2,529	306%	15.3%
Deep Savings - C/I	7.88%	8.88%	9.88%	5%	8.08%	60%	3%
						Total Scorecard Target Achieved	***131%***
						Scorecard Utility Incentive Achieved	***$ 4,443,225***

Table 10.1 - 2015 Results - Low-Income Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings from Single Family (m^3)	19,500,000	26,000,000	32,500,000	60%	35,847,426	176%	105%
Cumulative Natural Gas Savings from Multi-Family (m^3)	13,200,000	17,600,000	22,000,000	40%	16,333,361	86%	34%
						Total Scorecard Target Achieved	***140%***
						Scorecard Utility Incentive Achieved	***$ 2,462,534***

Table 10.2 - 2015 Results - Large Volume Rate T1, Rate T2/Rate 100 Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Rate T2 / Rate 100 Cumulative Natural Gas Savings (m^3)	772,381,040	1,029,841,387	1,287,301,734	40%	658,010,847	28%	*11%*
Rate T1 Cumulative Gas Savings (m^3)	154,692,013	206,256,017	257,820,021	60%	121,416,767	18%	*11%*
						Total Scorecard Target Achieved	***22%***
						Scorecard Utility Incentive Achieved	***$ 0***

Table 10.3 - 2015 Results - Market Transformation Scorecard

Metrics	Metric Target Levels Lower Band	Target	Upper Band	Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
Homes Built (>20% above OBC 2012) by Participating Builders	25%	30%	353%	100%	50.30%	306%	*306%*
						Total Scorecard Target Achieved	***150%***[16]
						Scorecard Utility Incentive Achieved	***$ 566,721***

Union achieved a total of $7.472 million in DSM Utility Incentive as a result of its program performance results in 2015 as shown in Table 10.4.

Table 10.4 - Summary of 2015 DSM Utility Incentive Achieved

Scorecard		DSM Utility Incentive Achieved
Resource Acquisition	$	4,443,225
Large Volume Rate T1, Rate T2/Rate 100	$	-
Low-Income	$	2,462,534
Market Transformation	$	566,721
Total	**$**	**7,472,481**

[16] Scorecard is capped at 150%. Actual scorecard achievement is 306%.

The DSM Utility Incentive breakdown by rate class is shown in Table 10.5 below.

Table 10.5 - Breakdown of DSM Utility Incentive by Rate Class

Line No.	Rate Class		2015 Amount
	South		
1	M1	$	3,565,990
2	M2	$	1,230,083
3	M4	$	694,078
4	M5	$	236,532
5	M7	$	631,583
6	T1	$	0
7	T2	$	0
8		**$**	**6,358,266**
	North		
9	Rate 01	$	775,326
10	Rate 10	$	179,065
11	Rate 20	$	159,824
12	Rate 100	$	0
13		**$**	**1,114,215**
14	**Total**	**$**	**7,472,481**

11. Budget

Union's 2015 DSM Budget as approved by the Board was $33.988 million. The total spend for 2015 was $32.393 million.

Table 11.0 tracks the variance between 2015 spend and budget. Total DSMVA amount is -$0.195 million.

Table 11.0 - Summary of 2015 Spend and Budget

	2015 Spend	2015 Budget	Variance	Budget Transfers	DSMVA
	A	B	C=A-B	D	E=C-D
Program Budget					
Resource Acquisition Scorecard					
Residential Program Incentives/Promotion/Admin	$ 5,052,560	$ 3,403,420	$ 1,649,140	$ (96,447)	$ 1,745,588
Residential Evaluation	$ 397,650	$ 21,660	$ 375,990	$ 375,990	$ 0
Commercial/Industrial Incentives/Promotion/Admin	$11,268,197	$ 11,045,951	$ 222,246	$ 222,246	$ 0
Commercial/Industrial Evaluation	$ 100,200	$ 64,980	$ 35,220	$ 35,220	$ 0
IEMS	$ 0	$ 649,797	$ (649,797)	$ (349,797)	$ (300,000)
Large Volume Scorecard (Rate T1, T2/R100)					
Large Volume T1 Incentives/Promotion	$ 477,540	$ 1,304,404	$ (826,864)	$ 0	$ (826,864)
Large Volume T2/R100 Incentives/Promotion	$ 1,745,745	$ 2,580,302	$ (834,557)	$ 0	$ (834,557)
Large Volume T1/T2/R100 Administration	$ 863,933	$ 981,748	$ (117,815)	$ 0	$ (117,815)
Large Volume T1/T2/R100 Evaluation	$ 122,498	$ 43,319	$ 79,179	$ 79,179	$ 0
Low-Income Scorecard					
Low-Income Program Incentives/Promotion/Admin	$ 7,504,864	$ 7,363,016	$ 141,848	$ (192,388)	$ 334,235
Low-Income Evaluation	$ 196,171	$ 43,319	$ 152,852	$ 152,852	$ 0
Market Transformation Scorecard					
Optimum Home Incentives/Promotion/Admin	$ 1,405,340	$ 1,493,642	$ (88,302)	$ (88,302)	$ 0
Programs Sub-total	$29,134,697	$ 28,995,558	$139,139	$ 138,553	$587
Portfolio Budget					
Research	$ 329,116	$ 829,796	$ (500,680)	$ (90,980)	$ (409,700)
Evaluation	$ 525,012	$ 1,049,519	$ (524,507)	$ (524,507)	$ 0
Administration	$ 2,189,940	$ 1,713,006	$ 476,934	$ 476,934	$ 0
Portfolio Sub-total	$ 3,044,068	$ 3,592,321	$ (548,253)	$ (138,553)	$ (409,700)
Incremental DSM Projects 2015 Budget Spend					
Achievable Potential Study, Future Infrastructure Planning Study, DSM Tracking and Reporting System Upgrades	$ 213,879[17]	$ 1,400,000	$ (1,186,121)	$ 0	$ (1,186,121)
Total 2015 DSM Budget	$32,392,645	$ 33,987,879	$ (1,595,234)	$ 0	$ (1,595,234)
Incremental DSM Projects not included in rates					$ 1,400,000
Total 2015 DSMVA					$ (195,234)

[17] Spend in 2015 was on DSM Tracking and Reporting System Upgrades only.

12. 2016 Scorecards

Union's 2016 Resource Acquisition, Low-Income and Performance-Based scorecards are set as outlined in Schedule C of the Board's Decision on Union's 2015-2020 DSM Plan (EB-2015-0029).

The 2016 Large Volume scorecard is based on Union's 2013-2015 DSM program results as outlined on page 52 of the Decision.

Table 12.0 – 2016 Large Volume Scorecard Target Setting Methodology

	Metric Target Levels			
Metrics	**Lower Band**	**Target**	**Upper Band**	**Weight**
Rate T2/Rate 100 Cumulative Natural Gas Savings (m^3)	75% of target	Three-year rolling average (2013-2015) Rate T2/Rate 100 cost effectiveness[1] x 2016 budget without overheads x 1.1 x 0.75	150% of target	100%

1 – Cost effectiveness is the final verified metric achievement used for LRAMVA purposes divided by final actual program spend for that year.

The 2016 Large Volume scorecard is as shown in Table 12.1.

Table 12.1 – 2016 Large Volume Scorecard

	Metric Target Levels			
Metrics	**Lower Band**	**Target**	**Upper Band**	**Weight**
Rate T2/Rate 100 Cumulative Natural Gas Savings (m^3)	853,079,252	1,137,439,002	1,706,158,503	100%

The 2016 Market Transformation scorecard is derived as outlined in Schedule C of the Decision.

Table 12.2 – 2016 Market Transformation Scorecard Target Setting Methodology

		Metric Target Levels			
Programs	**Metrics**	**Lower Band**	**Target**	**Upper Band**	**Weight**
Optimum Home	Homes Built (>20% above OBC 2012) by Participating Builders	75% of Target	2015 Actuals + 20%	150% of Target[1]	50%
Commercial New Construction	New Developments Enrolled by Participating Builders	6	8	12	50%

1 – 2016 Optimum Home upper band metric is capped at 100% of homes built (>20% above OBC 2012).

The 2016 Market Transformation scorecard is as shown in Table 12.3.

Table 12.3 – 2016 Market Transformation Scorecard

		Metric Target Levels			
Programs	**Metrics**	**Lower Band**	**Target**	**Upper Band**	**Weight**
Optimum Home	Homes Built (>20% above OBC 2012) by Participating Builders	53%	70%	100%	50%
Commercial New Construction	New Developments Enrolled by Participating Builders	6	8	12	50%

13. 2015 Avoided Costs

The avoided costs for 2015 are found in Table 13.0.

Table 13.0 - 2015 Avoided Costs

	Gas Avoided Costs					
	Residential and Commercial				Industrial	
	Baseload ($/m³)		Weather Sensitive ($/m³)		Baseload ($/m³)	
	Rate	NPV	Rate	NPV	Rate	NPV
1	0.21378	0.21378	0.22071	0.22071	0.20537	0.20537
2	0.19684	0.39992	0.20449	0.41409	0.20114	0.39558
3	0.19620	0.57537	0.20266	0.59532	0.19798	0.57263
4	0.20730	0.75067	0.21387	0.77618	0.20911	0.74947
5	0.23174	0.93599	0.23841	0.96684	0.23358	0.93626
6	0.25035	1.12531	0.25714	1.16130	0.25222	1.12700
7	0.24863	1.30312	0.25553	1.34404	0.25053	1.30616
8	0.25157	1.47324	0.25859	1.51891	0.25350	1.47760
9	0.26925	1.64543	0.27639	1.69566	0.27122	1.65104
10	0.25862	1.80184	0.26588	1.85646	0.26063	1.80866
11	0.27435	1.95873	0.28173	2.01757	0.27639	1.96672
12	0.27612	2.10806	0.28363	2.17096	0.27819	2.11717
13	0.29855	2.26074	0.30618	2.32755	0.30065	2.27093
14	0.30166	2.40663	0.30941	2.47718	0.30380	2.41785
15	0.32465	2.55510	0.33253	2.62926	0.32682	2.56732
16	0.32743	2.69671	0.33545	2.77434	0.32964	2.70988
17	0.33257	2.83272	0.34072	2.91369	0.33482	2.84681
18	0.33925	2.96393	0.34755	3.04810	0.34154	2.97890
19	0.35307	3.09306	0.36150	3.18031	0.35540	3.10888
20	0.36264	3.21848	0.37122	3.30870	0.36501	3.23512
21	0.37758	3.34197	0.38630	3.43504	0.37998	3.35940
22	0.38851	3.46213	0.39738	3.55794	0.39096	3.48031
23	0.39977	3.57905	0.40878	3.67750	0.40225	3.59796
24	0.41135	3.69282	0.42052	3.79380	0.41388	3.71243
25	0.42328	3.80352	0.43260	3.90695	0.42585	3.82381
26	0.43556	3.91125	0.44503	4.01702	0.43817	3.93219
27	0.44820	4.01608	0.45783	4.12410	0.45086	4.03764
28	0.46121	4.11809	0.47101	4.22828	0.46392	4.14024
29	0.47461	4.21736	0.48457	4.32963	0.47736	4.24009
30	0.48840	4.31396	0.49853	4.42823	0.49120	4.33724

	Water and Electricity Avoided Costs			
	Residential/Commercial/Industrial			
	Water ($/m³)		Electricity ($/kWh)	
	Rate	NPV	Rate	NPV
1	0.56824	0.56824	0.11280	0.11280
2	0.57778	1.11462	0.11470	0.22127
3	0.58749	1.63998	0.11663	0.32556
4	0.59736	2.14514	0.11859	0.42584
5	0.60739	2.63087	0.12058	0.52227
6	0.61760	3.09792	0.12260	0.61499
7	0.62797	3.54701	0.12466	0.70414
8	0.63852	3.97882	0.12676	0.78986
9	0.64925	4.39402	0.12889	0.87228
10	0.66016	4.79326	0.13105	0.95154
11	0.67125	5.17714	0.13325	1.02774
12	0.68253	5.54625	0.13549	1.10102
13	0.69399	5.90117	0.13777	1.17148
14	0.70565	6.24244	0.14008	1.23922
15	0.71751	6.57058	0.14244	1.30436
16	0.72956	6.88610	0.14483	1.36700
17	0.74182	7.18949	0.14726	1.42723
18	0.75428	7.48121	0.14974	1.48514
19	0.76695	7.76170	0.15225	1.54082
20	0.77984	8.03141	0.15481	1.59436
21	0.79294	8.29075	0.15741	1.64584
22	0.80626	8.54011	0.16006	1.69535
23	0.81980	8.77988	0.16274	1.74294
24	0.83358	9.01043	0.16548	1.78871
25	0.84758	9.23211	0.16826	1.83272
26	0.86182	9.44526	0.17109	1.87503
27	0.87630	9.65022	0.17396	1.91572
28	0.89102	9.84729	0.17688	1.95484
29	0.90599	10.03679	0.17985	1.99246
30	0.92121	10.21899	0.18287	2.02863

The inflation rate used in Table 13.0 is 1.68%. The discount factor is 5.75%.

Glossary of Terms

Audit The Audit is an annual process to assess the results of Union's DSM results and ensure that they are accurate. The Ontario Energy Board will be responsible for retaining the auditor, also known as the Evaluation Contractor.

Avoided Costs Avoided costs are a measurement of the reduction in the delivered costs of supplying all resources (natural gas, electricity and water) to customers as a consequence of a program.

Base Case The base case is a projection of the future without the effects of the utility's DSM program. The difference between the base case and the energy efficient case represents the saving attributable to the energy efficient measure.

Building Envelope The building envelope refers to the exterior surfaces (such as walls, windows, roof and floor) of a building that separate the conditioned space from the outdoors.

Channel Partner A Channel Partner is a company that, in the course of its business, can influence consumers to choose gas over competing fuels, or one method of increasing energy efficiency over another. Examples of Channel Partners include appliance retailers, HVAC contractors, engineers and architects.

Cost Effectiveness Cost effectiveness refers to the analysis that determines whether or not the benefits of a project/measure are greater than the costs. It is based on the net present value of savings over the equipment life of the measures.

Demand Side Management ("DSM") DSM is the modification in end-use customer demand for natural gas through conservation programs. While the focus of Union's DSM is natural gas savings and the reduction in greenhouse gases emissions, it may also result in the saving of a number of other resources such as electricity, water, propane, and heating fuel oil.

Demand Side Management Incentive Deferral Account ("DSMIDA") The account to record the DSM Utility Incentive amount earned by Union as a result of its DSM programs.

Demand Side Management Variance Account ("DSMVA") The account used to track the variance between actual DSM spending by rate class versus the budgeted amount included in rates by rate class. Union may record in the DSMVA in any one year, a variance amount of no more than 15% above its DSM budget for that year.

Direct Access ("DA") Budget Mechanism The DA budget mechanism is offered to Union's largest industrial customers (Rate T2 and Rate 100). It provides each customer dedicated access to the customer incentive budget they pay in their rates to support energy efficiency projects and studies on an annual basis.

Discount Rate The interest rate used to calculate the net present value of expected yearly benefits and costs.

DSM Utility Incentive The incentive available to Union for achieving Board approved performance targets.

Effective Useful Life ("EUL") EUL is the length of time that a piece of equipment or measure is anticipated to last and perform as expected.

Evaluation Contractor ("EC") The Evaluation Contractor is the independent third party auditor that will carry out the evaluation and audit processes of Union's DSM programs. The Evaluation Contractor is retained by the Ontario Energy Board.

Evaluation and Audit Committee ("EAC") The Evaluation Advisory Committee (EAC) will be formed to provide input and advice to the OEB on the evaluation and audit of DSM results. The EAC will consist of representatives from Union, Enbridge, non-utility stakeholders, independent experts, staff from the Independent Electricity System Operator (IESO), and observers from the Environmental Commissioner of Ontario and the Ministry of Energy, all working with OEB Staff.

Evaluation, Measurement & Verification ("EM&V") The activities undertaken to assess the implementation and performance of a program.

Free Ridership Free riders are program participants who would have installed the energy efficient measure without the influence of Union's DSM programs. Free rider rates are estimated based on research, market penetration studies or through negotiations in prior evaluation processes. The free rider rates are applied to the gross program savings results to derive actual savings.

Incentive An incentive is a payment from Union to DSM participants to encourage participation in a DSM program.

Incremental Cost The incremental cost is the difference in price between the high efficiency case and the base case.

Input Assumptions Assumptions such as operating characteristics and associated units of resource savings for a list of DSM technologies and measures. These cover a range of typical DSM activities, measures and technologies with residential, low-income, commercial and industrial applications.

Lifetime Cumulative cubic meters ("cumulative m^3") Total natural gas savings over the effective useful life of a DSM measure. Frequently used at the measure or program level and can also summarize the benefits of an entire portfolio.

Lost Revenue Adjustment Mechanism Variance Account ("LRAMVA") The LRAMVA is the Board's approved method by which utilities recover the lost distribution revenues associated with DSM activity. These lost revenues are calculated for contract rate classes impacted by DSM energy efficiency programs.

Market Transformation Market Transformation facilitates fundamental changes that lead to greater market shares of energy efficient products and services.

Measure A measure is any particular energy efficient technology (e.g. a low-flow showerhead, an energy recovery ventilator, condensing boiler, etc.).

National Account National Account customers are those customers that have multiple property locations and are similar in design and use. National Account customers include retail chains, property management firms and foodservice chains.

Net Present Value ("NPV") The NPV is the sum of the discounted yearly benefits arising from an investment over the lifetime of that investment.

Net-to-Gross Ratio Gross impacts are the program impacts prior to accounting for program attribution effects. These attribution effects are free ridership and spillover. Net impacts are the program impacts once program attribution effects have been accounted for. The net-to- gross ratio is defined as 1 – (free ridership ratio) + (spillover ratio).

Offering A DSM offering exists where there are either bundles of energy efficiency measures or performance/maintenance based enhancements to existing measures marketed together (e.g. energy savings kits, home retrofit measures, custom equipment/process/O&M) or where support is delivered through a suite of services (e.g. customer engagement, site energy assessments, etc.).

Participants The units used by Union to measure participation in its DSM programs. Participant units of measurement include customers, projects and measures or technologies installed. Not all participants result in energy savings.

Persistence Persistence is the extent to which a DSM measure remains installed and performing as originally predicted. Persistence of DSM savings takes into account how long a DSM measure is kept in place relative to its useful life, the net impact of the measure relative to the base case scenario, and the impact of technical degradation.

Prescriptive Offering A prescriptive DSM offering is a natural gas savings measure/technology that is based on previously substantiated and pre-approved inputs. Prescriptive DSM measures apply to all of Union's customer market segments including residential, low-income, commercial and industrial.

Program A program is the utility specific approach to providing one or more DSM offerings to customers.

Program Costs DSM program include the following components:

- Development and Start-up
- Promotion
- Delivery
- Evaluation, Measurement and Verification ("EM&V") and Monitoring
- Administration

Of the above costs, only start-up, promotion, delivery, and a portion of the evaluation and verification costs are applicable to individual programs. Other costs related to the design and deliveries of DSM programs are appropriately considered at the DSM portfolio level. These include development, a portion of the evaluation costs, monitoring, tracking and administration costs.

Program Evaluation Program evaluation refers to activities related to the collection, analysis, and reporting of data for purposes of measuring program impacts from past, existing or potential program impacts.

Resource Acquisition Programs that seek to achieve direct, measurable savings customer-by-customer through the incenting/promotion of specific energy efficiency upgrades.

Social and Assisted Housing Residential social housing includes all non-profit housing developed, acquired or operated under a federal, provincial or municipally funded program including shelters and hostels.

Spillover Spillover effects refer to customers that adopt energy efficiency measures because they are influenced by a utility's program related information and marketing efforts, but do not actually participate in the program.

Technical Evaluation Committee ("TEC") The TEC consists of seven individuals: three intervenors members selected by intervenors, a representative from Union, a representative from Enbridge, and two independent members with technical and other relevant expertise. The goal of the TEC was to establish DSM technical and evaluation standards for natural gas utilities in Ontario.

Total Resource Cost Test ("TRC") The TRC Test provides a measure of the benefits and costs that accrue as a result of the installation of a DSM measure.

Trade Allies Trade allies include organizations (e.g. architectural and engineering firms, building contractors, appliance manufacturers and dealers, and banks) that influence the energy-related decisions of customers who might participate in DSM programs.

Units Units provided within report tables can represent different items, such as the number of measures installed or homes retrofitted, depending on the program being reported on. Units are not equivalent to the number of participants since a single participant can install several units.

Appendix A Input Assumptions

The input assumptions that were used to calculate the savings claims that comprise the 2015 DSM scorecard targets and results can be found at the following link (EB-2014-0354):

http://www.rds.oeb.ca/HPECMWebDrawer/Record?q=CaseNumber=eb-2014-0354&sortBy=recRegisteredOn-&pageSize=400

ONTARIO GAS DSM EVALUATION CONTRACTOR

2015 Natural Gas Demand Side Management Annual Verification

Ontario Energy Board

Date: October 12, 2017

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AUDIT OPINION

The Evaluation Contractor team (DNV GL, Itron, and Dunsky) provides the following opinion on the utility-achieved savings, lost revenue, and shareholder incentive for the calendar year ended December 31, 2015. Our opinion stems from our review of the program documentation, utility shareholder incentive calculations, and lost revenue calculations as set forth in the report that follows. It is also based on the information available at the time that this report was published.

In our opinion, the following figures are reasonable, subject to the qualifications given above.

Definition	Union Result	Enbridge Result
Shareholder Incentive	$7,039,894	$6,489,467
Lost Revenue	$151,791	$16,155
Verified Net Cumulative Savings	1,137,825,562 m^3	547,755,978 m^3
Total Dollars Spent (not reviewed)	$32,178,766	$35,779,973
Cost Effectiveness (TRC test)	2.9	2.2

1 Executive Summary

This document has been prepared for the Ontario Energy Board (OEB) and outlines the results of the annual verification of Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) programs[1] delivered in 2015. These verifications were conducted by the Evaluation Contractor (EC) team.

The annual verification assembles the results of all evaluation studies conducted on the 2015 programs and applies them to the savings and scorecard metrics reported by the utilities. For programs or metrics where no recent studies have been performed, the EC team conducts a due diligence review to verify the savings or metrics reported by the utilities.

The overall objectives of the evaluations are to:

- Provide an independent opinion on whether the Lost Revenue Adjustment Mechanism (LRAM), DSM Variance Account (DSMVA), and DSM Shareholder Incentive (DSMSI) have been calculated correctly using the most appropriate information.
- Recommend future evaluation research opportunities to enhance the future natural gas savings estimates and other assumptions used to calculate DSMSI and LRAM amounts.
- Recommend changes to improve input assumptions, verification procedures, and the overall verification process.

1.1 Method summary

To verify the utility scorecard metrics discussed in the following sections, the EC conducted the activities listed below. To prepare for the program-specific activities, the EC requested tracking data and, where necessary, documentation for a sample of projects or participants from the utilities. The EC completed program-specific verifications and used the results to calculate the DSMSI and LRAM for both Enbridge and Union. We also calculated cost-effectiveness and reported program spending. The verification activities included:

- **Custom project savings:** Apply the results of the completed custom project savings verification (CPSV) of custom commercial, industrial, and Large Volume programs, which included a free ridership component, and include a provisional estimate for spillover.
- **Prescriptive project savings:** Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for the full population of measures.
- **Residential home retrofit projects:** Verify the savings for a sample of participants.
- **RunitRight projects:** Verify the savings for a sample of participants.
- **Market transformation projects:** Confirm participation status and program qualification for all non-savings metrics.

[1] Throughout this report, the word "program" is used to reflect the OEB's understanding of a program. The utilities define it differently. See APPENDIX M for additional detail.

- **Other projects:** Confirm the number of residential deep savings participants, the percent of C&I whole-building energy use saved by C&I program participants for Union, and the percent of Part 3 Low Income participants in the Low Income Building Management Performance program for Enbridge.

1.2 Results

Table 1-1, Table 1-2, and Table 1-3 show the Union verified savings, DSMSI, and LRAM results, respectively. Table 1-4 shows the cost-effectiveness ratio results for Union, and Table 1-5 shows the net present value for Union. Table 1-6 through Table 1-10 show the same information for Enbridge. All utility-defined programs pass the TRC, TRC-Plus, and PAC tests.

Table 1-1. Union verified savings results

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition						
Home Reno Rebate	69,321,370	58,923,165	98%	85%	67,934,943	57,744,701
Energy Savings Kit	22,398,052	19,567,373	75%	88%	16,882,059	14,800,935
Total Residential	91,719,422	78,490,538	92%	86%	84,817,002	72,545,636
C&I Custom	1,473,918,718	678,002,610	98%	44%	1,443,912,081	635,817,233
C&I Prescriptive	208,919,006	182,411,887	100%	87%	208,919,006	182,411,887
Total C&I	1,682,837,724	860,414,497	98%	50%	1,652,831,087	818,229,120
Total Resource Acquisition	**1,774,557,146**	**938,905,035**	**98%**	**51%**	**1,737,648,089**	**890,774,755**
Large Volume						
Large Volume	1,253,971,028	578,023,195	135%	12%	1,691,806,721	194,870,020
Total Large Volume	**1,253,971,028**	**578,023,195**	**135%**	**12%**	**1,691,806,721**	**194,870,020**
Low Income						
Single Family (Part 9)	33,505,239	33,504,841	107%	100%	35,847,824	35,847,426
Multi-family (Part 3)	17,840,732	16,948,695	96%	95%	17,193,011	16,333,361
Total Low Income	**51,345,971**	**50,453,536**	**103%**	**98%**	**53,040,835**	**52,180,787**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
†These values are rounded.

Table 1-2. Union DSMSI results

Scorecard	Draft Utility-Reported DSMSI*	DSMSI
Resource Acquisition	$4,776,312	$4,010,638
Low Income	$2,192,257	$2,462,534
Large Volume	$0	$0
Market Transformation	$566,721	$566,721
Total	**$7,535,290**	**$7,039,894**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.

Table 1-3. Union LRAM results

Rate Class	Utility-Reported Draft LRAM	Verified LRAM
M4 Industrial	$77,105	$73,713
M5 Industrial	$38,366	$36,565
M7 Industrial	$33,512	$31,937
T1 Industrial	$2,789	$777
T2 Industrial	$1,050	$389
20 Industrial	$7,002	$6,845
100 Industrial	$5,578	$1,565
Total	**$165,411**	**$151,791**

Table 1-4. Union summary of cost-effectiveness ratio results

Scorecard	Draft using Utility-Reported Savings*			Final Verified Ratio		
	TRC	TRC-Plus**	PAC**	TRC	TRC-Plus	PAC
Residential Resource Acquisition	1.2	3.0	8.0	1.0	1.2	2.3
Commercial and Industrial Resource Acquisition	2.9			3.3	3.8	12.0
Low Income	1.0	1.1	0.9	1.3	1.4	1.1
Large Volume	4.7	5.4	26.3	6.0	6.9	10.2
Total Portfolio	**2.9**	**3.3**	**8.1**	**2.9**	**3.3**	**6.8**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results for the entire Resource Acquisition scorecard. Union only reported TRC in its filings for 2015.

Table 1-5. Union summary of cost-effectiveness net present value results

Scorecard	Draft Net Present Value (M$) using Utility-Reported Savings*			Final Verified Net Present Value (M$)		
	TRC	TRC-Plus**	PAC**	TRC	TRC-Plus	PAC
Residential Resource Acquisition	96.7	120.4	117.9	0.4	2.6	6.8
Commercial and Industrial Resource Acquisition				105.4	128.0	124.7
Low Income	(0.02)	1.0	(1.1)	1.7	3.1	0.6
Large Volume	70.2	83.6	81.1	27.6	32.6	29.4
Total Portfolio	**166.9**	**205.1**	**197.9**	**135.2**	**166.3**	**161.5**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

Table 1-6. Enbridge verified savings results

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate**†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition						
Home Energy Conservation	120,488,487	102,415,214	100%	85%	120,488,487	102,415,214
Total Residential	120,488,487	102,415,214	100%	85%	120,488,487	102,415,214
C&I Custom	812,730,242	558,925,884	95%	31%	773,928,967	240,326,475
C&I Prescriptive	128,765,764	106,286,730	98%	85%	125,724,435	106,455,571
Total C&I	941,496,006	665,212,614	96%	39%	899,653,401†	346,782,045†
Total Resource Acquisition	**1,061,984,493**	**767,627,828**	**96%**	**44%**	**1,020,141,888**	**449,197,259**
Low Income						
Single Family (Part 9)	28,410,725	28,343,978	99%	100%	28,067,264	28,132,657
Multi-family (Part 3)	69,505,240	69,226,782	101%	100%	70,147,603	70,426,062
Total Low Income	**97,915,965**	**97,570,760**	**100%**	**100%**	**98,214,867**	**98,558,719**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
†These values are rounded.
** The gross realization rate for C&I prescriptive, single family low income, and multi-family low income includes the removal rate for some measures, which was previously included in the net-to-gross adjustment. See APPENDIX C for more detail.

Table 1-7. Enbridge DSMSI results

Scorecard	Draft Utility-Reported DSMSI*	DSMSI
Resource Acquisition	$6,482,744	$2,632,886
Low Income	$1,724,691	$1,745,422
Residential Savings by Design	$1,076,493	$1,076,493
Commercial Savings by Design	$418,269	$418,269
Home Labelling	$616,397	$616,397
Total	**$10,318,594**	**$6,489,467**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.

Table 1-8. Enbridge LRAM results

Rate Class	Draft Utility-Reported LRAM*	LRAM
110	$18,795	$11,662
115	$6,478	$2,836
135	$330	$239
145	$2,267	$834
170	$953	$584
Total	**$28,822**	**$16,155**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.

Table 1-9. Enbridge summary of cost-effectiveness ratio results

Scorecard	Draft using Utility-Reported Savings*			Final Verified Ratio		
	TRC**	TRC-Plus	PAC	TRC	TRC-Plus	PAC
Resource Acquisition	3.3	3.8	6.0	2.3	2.7	2.7
Low Income	2.1	2.5	2.5	1.7	2.0	1.9
Total Portfolio	**3.1**	**3.6**	**5.2**	**2.2**	**2.6**	**2.5**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Enbridge only reported TRC-Plus and PAC in its filings for 2015.

Table 1-10. Enbridge summary of cost-effectiveness net present value results

Scorecard	Draft Net Present Value (M$) using Utility-Reported Savings*			Final Verified Net Present Value (M$)		
	TRC**	TRC-Plus	PAC	TRC	TRC-Plus	PAC
Resource Acquisition	123.2	149.7	120.4	50.1	61.8	40.9
Low Income	9.2	11.8	10.7	6.0	8.1	6.2
Total Portfolio	**132.4**	**161.6**	**131.1**	**56.1**	**69.9**	**47.1**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Enbridge only reported TRC-Plus and PAC in its filings for 2015.

1.3 2015 annual verification recommendations

This section contains a summary of the recommendations from the EC's 2015 annual verification efforts, shown in the tables below. In the tables, the primary outcomes of the recommendation are classified into three categories: reduce costs (evaluation or program or both), improve savings accuracy, and decrease risk (multiple types of risk are in this category including risk of adjusted savings, risk to budgets or project schedules, and others). The complete findings, recommendations, and outcomes of the 2015 annual verification efforts and other evaluations conducted on 2015 programs are found in section 5.

Table 1-11. Summary of recommendations that apply to the overall annual verification

#	Overall Annual Verification Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
O1A	Consider investing in a relational program tracking database.	✓	✓		✓	✓	✓
O1B	Enbridge should include site-level information for all measures installed through the program.		✓			✓	✓
O2A	Deliver tracking data in a single flat file.	✓	✓		✓	✓	✓
O2B	Consider investing in a relational program tracking database.	✓	✓		✓	✓	✓
O3A	Develop and maintain an electronic summary of the TRM.	✓	✓	✓	✓	✓	✓
O3B	Track prescriptive savings using unique measure descriptions that map to electronic TRM.	✓	✓	✓	✓	✓	✓

Table 1-12. Summary of recommendations that apply to RunitRight

#	RunitRight Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
RR1	Consider adding independent variables to the regression to account for school breaks.		✓			✓	
RR2A	Consider including the date when each activity was implemented.		✓			✓	
RR2B	Provide information on both the baseline and installed case.		✓			✓	
RR2C	Increase the level of documentation when a single change results in a significant portion of savings.		✓			✓	
RR3A	Consider including a basic description of all end-use equipment served by the gas meter.		✓			✓	
RR3B	Consider using engineering calculations to estimate electricity savings.		✓			✓	
RR3C	Consider reviewing the process for selecting the HDD reference temperature.		✓			✓	

Table 1-13. Summary of recommendations that apply to simulation modeling

#	Simulation Modeling Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
SM1	Provide simulation file and output to the evaluation team.	✓	✓		✓		✓
SM2	Provide more explicit support for major measure installations.	✓	✓				✓
SM3	Consider reviewing and modifying program processes to avoid data entry or outdated simulation result errors.	✓	✓		✓	✓	✓
SM4	Consider funding a study to verify the models produced by the utility agents.			✓		✓	

Table 1-14. Summary of recommendations that apply to cost-effectiveness

#	Cost-effectiveness Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
CE1	Allocate “sector”-level administrative costs and overhead to each individual program and report program-level cost-effectiveness results.	✓	✓		✓		✓
CE2	Use a consistent real discount rate of 4% when using real streams of benefits and costs.	✓	✓		✓		✓
CE3	Explore the possibility of better defining water avoided costs.	✓	✓	✓	✓		✓
CE4	Work towards better uniformity in methods and assumptions.	✓	✓	✓	✓		✓

Table 1-15. Summary of recommendations that apply to other areas

#	Other Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
OR1	When the C&I deep savings metric is used, deliver monthly billing data for each C&I participant.	✓					✓
OR2	Provide a detailed explanation for the DSMSI calculation.	✓	✓		✓		✓

2 Introduction

This document has been prepared for the Ontario Energy Board (OEB) and outlines the results of the annual verification of Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand side management (DSM) programs[2] delivered in 2015. These verifications were conducted by the OEB's Evaluation Contractor (EC) team of DNV GL, Itron, and Dunsky.

The annual verification assembles the results of all evaluation studies conducted on the 2015 programs and applies them to the savings and scorecard metrics reported by the utilities. For programs or metrics where no recent studies have been performed, the EC team conducts a due diligence review to verify the savings or metrics reported by the utilities.

The overall objectives of the evaluations are to:

- Provide an independent opinion on whether the Lost Revenue Adjustment Mechanism (LRAM), DSM Variance Account (DSMVA), and DSM Shareholder Incentive (DSMSI) have been calculated correctly using the most appropriate information.
- Recommend future evaluation research opportunities to enhance the future natural gas savings estimates and other assumptions used to calculate DSMSI and LRAM amounts.
- Recommend changes to improve input assumptions, verification procedures, and the overall verification process.

The LRAM, DSMVA, and DSMSI are based on the following metrics:

- LRAM: the verified natural gas energy savings (in annual cubic meters) by rate class and the cost (the delivery rate) of the natural gas by rate class for the program year.
- DSMVA: the actual money collected, by rate class, for implementing DSM programs during the program year and the actual DSM costs incurred by the programs.
- DSMSI: the actual program achievements compared to the scorecard metrics for that program, the weight placed on each metric within each scorecard, and the maximum incentive achievable for that scorecard.

Therefore, the information that was verified for 2015 includes the program natural gas savings and the program achievements compared to the scorecard metrics. The EC also reported the money spent by the programs but did not conduct a full financial audit of the reported amounts. The OEB may conduct financial audits of the gas utilities DSM spending as it sees fit. The verified savings and program achievements were used to confirm the LRAM and DSMSI amounts.

2.1 Background

Enbridge and Union deliver energy efficiency programs under the Demand Side Management Framework for Natural Gas Distributors (2015-2020)[3] developed by the OEB. For the 2015 program year, both utilities "rolled-over" their 2014 plans into 2015 to allow them a smooth evolution into the new DSM framework.

[2] Throughout this report, the word "program" is used to reflect the OEB's understanding of a program. The utilities define it differently. See APPENDIX M for additional detail.

[3] EB-2014-0134

In April 2016, the OEB hired the EC team to develop an overall evaluation, measurement, and verification (EM&V) plan and lead an annual verification of the reported utility DSM achievements. This report is a result of that annual verification.

Under the EM&V plan, a DNV GL-led team of DNV GL, Itron, and Stantec conducted a custom project savings verification (CPSV) and net-to-gross (NTG) study of the 2015 program year.[4] This report includes the results of that study. A spillover study of 2013-2014 programs has also been initiated; however, the results from that effort are not available for this report. Instead, a provisional value has been included in the NTG value based on secondary source research. See APPENDIX N for more information.

The OEB formed an evaluation advisory committee (EAC) to provide input and advice to the OEB and the EC on the evaluation and audit of DSM results. The EAC consists of representatives from the utilities, non-utility stakeholders, independent experts, staff from the Independent Electricity System Operator (IESO), and observers from the Environmental Commissioner of Ontario and the Ministry of Energy. The DNV GL team received feedback from the EAC throughout the CPSV/NTG study[5] and received comment, advice, and input on the results of this annual verification. We thank them for their involvement.

2.2 Method summary

To verify the utility scorecard metrics discussed in the following sections, the EC conducted the activities outlined in Table 2-1 and Table 2-2. To prepare for the program-specific activities, the EC requested tracking data and, where necessary, documentation for a sample of projects or participants from the utilities. For all programs, the EC first reviewed the reported savings and metrics from the gas utilities' tracking data and compared them to the summarized information in the gas utilities' draft annual report to ensure consistency. We also recreated the reported LRAM and DSMSI values using the reported savings and scorecard achievements to confirm that the calculations were done correctly.

Once the program-specific verifications were completed, the EC assembled the verified scorecard results and calculated the verified LRAM, DSMSI, and cost-effectiveness results. We also documented recommendations that may improve the annual verification process going forward. The full annual verification EM&V plan is embedded in APPENDIX N. The results presented in this report are based on data collected from:

- Union and Enbridge tracking databases (Round 1 of data requests)
- Union and Enbridge project documentation (Round 2 of data requests)
- The results of the CPSV / NTG study

The two data and documentation requests are explained in detail in APPENDIX A. A description of the data received is explained in detail in APPENDIX B. The recommendations related to these activities are listed in section 5.

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[4] "2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation". Prepared for the Ontario Energy Board. August 15, 2017.

[5] Throughout the rest of this report, "CPSV/NTG" is used to refer to the study that resulted in custom program savings verification and net-to-gross results; however, not all aspects of the study were applied to all programs in the study. The Low Income participants were not included in the NTG portion of the study; pre-stipulated NTG results continue to be used for those measures. The Run it Right participants were not included in the CPSV portion of the study; verified gross savings were produced during the annual verification.

Table 2-1. Union 2015 annual verification activities, by scorecard

Program	Metrics	Activity
Resource Acquisition	Cumulative natural gas savings Number of residential deep savings participants Average percent of whole building energy use saved by the program	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for the full population of measures. Verify the savings for a sample of home retrofit participants. Confirm that the necessary factors (such as NTG assumptions) were applied correctly. Apply the results of the CPSV / NTG study. Verify the number of residential deep savings participants by reviewing the detailed documentation for a sample of participants. Collect the annual billing information for the full population of C&I deep savings participants and compare the verified energy savings to the annual energy use to confirm the percent of whole building natural gas use saved.
Large Volume	Cumulative natural gas savings	Confirm that the necessary factors (such as NTG assumptions) were applied correctly. Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for the full population of measures. Apply the results of the CPSV / NTG study.
Low Income	Cumulative natural gas savings	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for the full population of measures. Verify the savings for a sample of home retrofit participants. Confirm that the necessary factors (such as NTG assumptions) were applied correctly. Apply the results of the CPSV / NTG study.
Optimum Home	Percent of homes built by participating builders that are 20% more efficient than OCB	Review the program tracking data. Confirm the participation status of one builder, and confirm the program qualification of one home.

Table 2-2. Enbridge 2015 annual verification activities, by scorecard

Program	Metrics	Activity
Resource Acquisition	Cumulative natural gas savings Number of residential deep savings participants	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for the full population of measures. Verify the savings for a sample of home retrofit participants. Confirm that the necessary factors (such as NTG assumptions) were applied correctly. Apply the results of the CPSV / NTG study. Conduct a desk review of a sample of RunitRight participants to verify the reasonableness of the claimed savings. Verify the number of residential deep savings participants by reviewing the detailed documentation for a sample of participants.
Low Income	Cumulative natural gas savings Percent of Part 3 participants enrolled	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for the full population of measures. Verify the savings for a sample of home retrofit participants. Confirm that the necessary factors (such as NTG assumptions) were applied correctly. Apply the results of the CPSV / NTG study. Review documentation to confirm the Part 3 participant Low Income scorecard metric.
RSBD	Builders enrolled Number of efficient homes	Review the program tracking data. Confirm the participation status of one residential builder and the program qualification of one home.
CSBD	Number of developments	Review the program tracking data. Confirm the participation status of one commercial builder and the program qualification of one development.
Home Labelling	Number of listings represented by realtors Number of ratings performed	Review the program tracking data. Confirm the participation status of one realtor, and the ratings reported by that realtor.

3 Union Gas Limited

This section reports on the results of the annual verification and scorecard achievements of Union's 2015 DSM programs.

3.1 Scorecard achievements

Union has four scorecards: Resource Acquisition, Large Volume, Low Income, and Market Transformation. Table 3-1 shows an overview of the programs included in each scorecard. For a discussion of the calculations behind the DSMSI and LRAM, see APPENDIX J.

Table 3-1. Overview of Union 2015 programs by scorecard

Scorecard	Programs
Resource Acquisition	Commercial and Industrial Custom Commercial and Industrial Prescriptive Energy Savings Kit Home Reno Rebate
Large Volume	Large Industrial – T1, T2, R100
Low Income	Home Weatherization Program Affordable Housing Conservation (Multi-family custom and prescriptive)
Market Transformation	Optimum Home

Table 3-2 shows the Union scorecard for 2015, including the target metrics, reported achievement, weight, and maximum shareholder incentive. These were the metrics reviewed as part of the annual verification. The recommendations related to these activities are listed in section 5.

Table 3-2. Union's reported, unverified 2015 achievement, target, weight, and maximum shareholder incentive by scorecard

Scorecard	2015 Target	2015 Reported Achievement	Weight	Maximum Shareholder Incentive (if 150% of target achieved)
Union				
Resource Acquisition	816,561,818 CCM	938,905,035 CCM	90%	$5,761,833
	1,245 deep savings participants	2,537 participants	5%	
	8.88% of C&I whole building natural gas use saved	8.24% saved	5%	
Large Volume	206,256,017 Rate 1 CCM	78,919,835 CCM	60%	$1,862,877
	1,029,841,387 Rate T2/100 CCM	499,103,360 CCM	40%	
Low Income	26,000,000 single family CCM	33,504,841 CCM	60%	$2,810,129
	17,600,000 multi-family CCM	16,948,695 CCM	40%	
Market Transformation	30% of homes built by participating builders were 20% more efficient than OBC	50% of homes	100%	$566,721
TOTAL				**$11,001,560**

3.1.1 Resource Acquisition

This section summarizes the results of the EC's review of the Union Resource Acquisition scorecard. The metrics for the Resource Acquisition scorecard include:

- Total cumulative natural gas savings
- Number of residential deep savings participants
- The average percentage of C&I whole building energy use saved

To verify the natural gas savings, the EC team reviewed each program independently. The programs that contribute energy savings to the Resource Acquisition scorecard are shown in Table 3-3. The table also shows the appendix that has the detailed explanation of the verification activities for each program.

Table 3-3. Union Resource Acquisition programs and report location of detailed verification

Program	Location of Detailed Explanation	Description of Detailed Explanation
Residential Program		
Energy Savings Kit	APPENDIX E	How ESK savings were verified
Home Reno Rebate	APPENDIX D	How home retrofit program savings were verified
Commercial/Industrial Program		
Commercial and Industrial Custom	APPENDIX H APPENDIX N	How CPSV / NTG results and spillover are applied for annual verification
Commercial and Industrial Prescriptive	APPENDIX C	How prescriptive savings were certified

At a high level, the EC completed the following activities to produce verified savings for each Resource Acquisition program:

- **Energy Savings Kit:** The EC reviewed the per-unit savings to ensure that the approved values were used. We then applied adjustment factors from a previously-conducted verification study to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.
- **Home Reno Rebate:** The EC sampled 25 participants and reviewed the program documentation to confirm that the model savings matched the tracking data. We calculated an adjustment factor and applied it to the tracking savings to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.
- **Commercial and Industrial Custom:** The EC conducted site verifications as part of the CPSV / NTG study. We also did secondary source research to estimate spillover. We applied the results to produce verified savings for the following sectors:
  - Agriculture and Greenhouse
  - Commercial and Institutional Buildings
  - Industrial
- **Commercial and Industrial Prescriptive:** The EC confirmed energy savings for the population of measures by recreating the program tracking data using program-assumed quantities and approved energy savings per unit to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.

Table 3-4 shows the gross and net cumulative natural gas savings (CCM), as reported by the utility and verified by the EC. The tables also show the realization rates (RR) of the savings, both in terms of gross savings (those savings which were found to be in place upon the EC's review) and net savings (those savings which have been adjusted to exclude free riders and include spillover).[6] The commercial and industrial custom program has been expanded to more refined sector subsets to match those in the utility-reported tracking data.

Table 3-4. Union's verified 2015 Resource Acquisition savings

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition						
C&I Prescriptive	208,919,006	182,411,887	100%	87%	208,919,006	182,411,887
C&I Custom Ag and Greenhouse	611,477,005	281,279,422	97%	44%	592,368,700	262,534,051
C&I Custom Comm & Inst Buildings	268,582,354	123,547,883	89%	47%	239,199,444	112,642,330
C&I Custom Industrial	593,859,359	273,175,305	103%	43%	612,343,937	260,640,852
Energy Savings Kit	22,398,052	19,567,373	75%	88%	16,882,059	14,800,935
Home Reno Rebate	69,321,370	58,923,165	98%	85%	67,934,943	57,744,701
Total	**1,774,557,146**	**938,905,035**	**98%**	**51%**	**1,737,648,089**	**890,774,755†**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
†These values are rounded.

To verify the number of residential deep savings participants, the EC followed the process outlined in Table 3-5 and described in APPENDIX D. The EC found 2,529 qualifying deep savings participants compared to 2,537 reported by the program.

[6] The current spillover estimate is a provisional value based on secondary source research. There is a spillover study in progress. but the results are not ready.

Table 3-5. Union deep savings participant verification activities and outcomes

Verification Activity	Outcome
Confirm that two major measures were installed for each sampled site.	Confirmed for 6 of 25 sites using the supplied photos. For the remaining sites, photos only verified one major measure.*
Calculate verified cumulative savings for each sampled site and confirm over 11,000 cumulative m^3.	Three of 25 sites did not have cumulative savings over 11,000 cumulative m^3 but were identified as deep savings participants.
Calculate the average percent reduction across the sample and confirm greater than 25%.	By assuming that the total natural gas consumption was equal to the space and water heat consumption, we were able to calculate an average savings reduction of 29%.
Apply the gross realization rate to the population and determine the number of qualifying deep savings participants.	The EC found 2,529 qualifying deep savings participants compared to 2,537 reported by the program.

*Despite the low confirmation rate, the EC did not adjust the outcome based on the initial review. Though the activity did not confirm that there were two major measures, it also did not confirm that there were not. It's likely that the second major measure was more difficult to visually confirm, such as air sealing.

To verify the percentage of whole-building C&I savings, the EC:

- Confirmed the calculation method in the Union tracking data
- Updated savings based on the CPSV and prescriptive certification
- Calculated the verified result.

With the adjustment factors applied, the resulting scorecard metric is 8.08% of whole building energy use saved.

3.1.2 Large Volume

This section summarizes the results of the EC's review of the Union Large Volume scorecard. The metrics for the Large Volume scorecard are total cumulative natural gas savings by two different rate categories.

To verify natural gas savings, the EC reviewed the prescriptive and custom savings for Large Volume independently. Table 3-6 shows the appendix that has the detailed explanation of the verification activities for each type of project.

Table 3-6. Union Large Volume location of detailed verification

Program	Location of Detailed Explanation	Description of Detailed Explanation
Large Volume (custom projects)	APPENDIX H APPENDIX N	How CPSV / NTG results and spillover are applied for annual verification
Large Volume (prescriptive projects)	APPENDIX C	How prescriptive savings were certified

At a high level, the EC completed the following verification activities for each Large Volume program:

- **Custom Projects:** The EC conducted site verifications as part of the CPSV / NTG study. We also did secondary source research to estimate spillover. We applied the results to produce verified gross and net savings.

- **Prescriptive Projects:** The EC confirmed energy savings for the population of measures by recreating the program tracking data using program-assumed quantities and approved energy savings per unit to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.

Table 3-7 shows the gross and net cumulative natural gas savings (CCM), as reported by the utility and verified by the EC. The tables also show the realization rates (RR) of the savings, both in terms of gross savings (those savings which were found to be in place upon the EC's review) and net savings (those savings which have been adjusted to exclude free riders and include spillover).[7] The program has been expanded to more refined rate subsets.

Table 3-7. Union's verified 2015 Large Volume savings

Program	Draft Utility-Reported Savings		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Large Volume						
Large Industrial-T1	171,240,007	78,919,835	154%	13%	263,624,641	33,725,518
Large Industrial-T2	1,002,106,837	462,016,235	131%	11%	1,309,850,111	147,448,803
Large Industrial-R100	80,624,184	37,087,125	147%	12%	118,331,969	13,695,699
Total	**1,253,971,028**	**578,023,195**	**135%**	**12%**	**1,691,806,721**	**194,870,020**

† These values are rounded.

3.1.3 Low Income

This section summarizes the results of the EC's review of the Union Low Income scorecard. The metrics for the Low Income scorecard include total cumulative natural gas savings for single family and multi-family participants separately.

To verify energy savings, the EC team reviewed the prescriptive and custom savings for Low Income independently. Table 3-8 shows the appendix that has the detailed explanation of the verification activities for each type of project.

Table 3-8. Union Low Income programs and location of detailed verification

Program	Location of Detailed Explanation	Description of Detailed Explanation
Single Family Program		
Home Weatherization Program	APPENDIX D	How home retrofit program savings were verified
Affordable Housing Conservation Program		
Low Income Multi-family (custom projects)	APPENDIX H	How CPSV / NTG results are applied for annual verification
Low Income Multi-family (prescriptive projects)	APPENDIX C	How prescriptive savings were certified

At a high level, the EC completed the following verification activities for each Low Income program:

- **Multi-family Custom Projects:** The EC conducted site verifications as part of the CPSV and NTG study and applied the results to produce verified gross and net savings.

[7] The current spillover estimate is a provisional value based on secondary source research. There is a spillover study in progress. but the results are not ready.

- **Multi-family Prescriptive Projects:** The EC confirmed energy savings for the population of measures by recreating the program tracking data using program-assumed quantities and approved energy savings per unit to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.
- **Home Weatherization:** The EC sampled 25 participants and reviewed the program documentation to confirm that the model savings matched the tracking data. We calculated an adjustment factor and applied it to the tracking savings to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.

Table 3-9 shows the gross and net cumulative natural gas savings (CCM), as reported by the utility and verified by the EC. The tables also show the realization rates (RR) of the savings, both in terms of gross savings (those savings which were found to be in place upon the EC's review) and net savings (those savings which have been adjusted to exclude free riders and include spillover).

Table 3-9. Union's verified 2015 Low Income savings

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Low Income						
Low Income Multi-family	17,840,732	16,948,695	96%	95%	17,193,011	16,333,361
Home Weatherization	33,505,239	33,504,841	107%	100%	35,847,824	35,847,426
Total	**51,345,970**	**50,453,536**	**103%**	**98%**	**53,040,835**	**52,180,787**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
†These values are rounded.

3.1.4 Market Transformation

This section summarizes the results of the EC's review of the Union Market Transformation scorecard. The metric for the Market Transformation scorecard is the percentage of homes built to Optimum Home standard by participating builders. The Optimum Home standard is greater than 20% above the Ontario Building Code 2012 (OBC). Union reported an achievement of 50.3% of homes built by participating builders, which was confirmed by the EC. The detailed verification efforts are described in APPENDIX I.

3.2 Program spending and cost-effectiveness

This section reports on Union's program spending and cost-effectiveness.

3.2.1 Program spending

The Union tracking database included a sheet that reported program spending by scorecard. Table 3-10 shows the Union budget for the portfolio overall. Additional spending detail is in APPENDIX L.

Table 3-10. Union portfolio budget overall

Spending Area	OEB-Approved Budget	Actual Spending	Difference ($)	Difference (%)
Programs Sub-total	$28,994,667	$29,134,697	($140,030)	9%
Research	$829,564	$329,116	$500,448	57%

Evaluation	$1,049,409	$525,012	$524,397	46%
Administration	$1,713,277	$2,189,940	($476,663)	38%
Total DSM Budget	**$32,588,000**	**$32,178,766**	**$409,234**	**7%**

3.2.2 Cost-effectiveness

Table 3-11 and Table 3-12 show summary results for the TRC, TRC-Plus, and PAC tests, including the cost-benefit ratio and the net present value. Additional detail is shown in APPENDIX M. While there is a general drop in cost-effectiveness results following the verification of savings, almost all OEB-defined programs still pass the cost-effectiveness threshold for all three tests. The only exception is the Home Reno Rebate program, which was not cost-effective when using draft utility reported savings, before any verification-related adjustment.[8] When the utility definition of program is used (see APPENDIX M), the threshold is always exceeded.

Table 3-11. Union summary of cost-effectiveness ratio results

Scorecard	Draft using Utility-Reported Savings*			Final Verified Ratio		
	TRC	TRC-Plus**	PAC**	TRC	TRC-Plus	PAC
Residential Resource Acquisition	1.2	3.0	8.0	1.0	1.2	2.3
Commercial and Industrial Resource Acquisition	2.9			3.3	3.8	12.0
Low Income	1.0	1.1	0.9	1.3	1.4	1.1
Large Volume	4.7	5.4	26.3	6.0	6.9	10.2
Total Portfolio	**2.9**	**3.3**	**8.1**	**2.9**	**3.3**	**6.8**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

Table 3-12. Union summary of cost-effectiveness net present value results

Scorecard	Draft Net Present Value (M$) using Utility-Reported Savings*			Final Verified Net Present Value (M$)		
	TRC	TRC-Plus**	PAC**	TRC	TRC-Plus	PAC
Residential Resource Acquisition	96.7	120.4	117.9	0.4	2.6	6.8
Commercial and Industrial Resource Acquisition				105.4	128.0	124.7
Low Income	(0.02)	1.0	(1.1)	1.7	3.1	0.6
Large Volume	70.2	83.6	81.1	27.6	32.6	29.4
Total Portfolio	**166.9**	**205.1**	**197.9**	**135.2**	**166.3**	**161.5**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

As very low net-to-gross factors were applied to the Large Volume program, the TRC, TRC-Plus, and PAC net values dropped significantly. It is interesting to note that because both savings and costs are affected by the net-to-gross factor, the impact on the TRC and TRC-Plus ratios is far less significant. In addition, a high realization rate (135%) was applied to Union's Large Volume savings, resulting in an increase of the TRC-Plus ratio, even with a net-to-gross factor of only 12%.

[8] The Home Reno Rebate program is not required to be cost effective; only the utility-defined Residential program must be cost effective.

3.3 DSMSI and LRAM

This section reports on the results of the DSMSI and LRAM calculations. The recommendations related to these activities are listed in section 5. Table 3-14 shows the verified savings results for the Union portfolio.

Table 3-13. Union verified savings results

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition						
Home Reno Rebate	69,321,370	58,923,165	98%	85%	67,934,943	57,744,701
Energy Savings Kit	22,398,052	19,567,373	75%	88%	16,882,059	14,800,935
Total Residential	91,719,422	78,490,538	92%	86%	84,817,002	72,545,636
C&I Custom	1,473,918,718	678,002,610	98%	51%	1,443,912,081	635,817,233
C&I Prescriptive	208,919,006	182,411,887	100%	87%	208,919,006	182,411,887
Total C&I	1,682,837,724	860,414,497	98%	50%	1,652,831,087	818,229,120
Total Resource Acquisition	**1,774,557,146**	**938,905,035**	**98%**	**51%**	**1,737,648,089**	**890,774,755**
Large Volume						
Large Volume	1,253,971,028	578,023,195	135%	12%	1,691,806,721	194,870,020
Total Large Volume	**1,253,971,028**	**578,023,195**	**135%**	**12%**	**1,691,806,721**	**194,870,020**
Low Income						
Single Family (Part 9)	33,505,239	33,504,841	107%	100%	35,847,824	35,847,426
Multi-family (Part 3)	17,840,732	16,948,695	96%	95%	17,193,011	16,333,361
Total Low Income	**51,345,971**	**50,453,536**	**103%**	**98%**	**53,040,835**	**52,180,787**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
†These values are rounded.

3.3.1 DSMSI

The EC gathered the verified scorecard achievements from section 3.1 and compared them to the defined upper and lower bands in the Union DSMSI calculation (see APPENDIX J for a description of the DSMSI calculation), shown in Table 3-14. The verified program achievements were entered into the Union tracking workbook DSMSI calculator, which was verified by the EC.

Table 3-14. Union's 2015 scorecard targets, lower band, upper band, and weight

Scorecard	Lower Band	2015 Target	Upper Band	Verified Achievement	Weight
Union					
Resource Acquisition	612,421,364 CCM	816,561,818 CCM	1,020,702,273 CCM	890,774,755 CCM	90%
	934 participants	1,245 deep savings participants	1,556 participants	2,529 participants	5%
	7.88%	8.88% of commercial whole building natural gas use saved	9.88%	8.08%	5%
Large Volume	154,692,013 CCM	206,256,017 Rate 1 CCM	257,820,021 CCM	33,725,518 CCM	60%
	772,381,040 CCM	1,029,841,387 Rate T2/100 CCM	1,287,301,734 CCM	161,144,502 CCM	40%
Low Income	19,500,000 CCM	26,000,000 single family CCM	32,500,000 CCM	35,847,426 CCM	60%
	13,200,000 CCM	17,600,000 multi-family CCM	22,000,000 CCM	16,333,361 CCM	40%
Market Transformation	25%	30% of homes built by participating builders were 20% more efficient than OBC	35%	50.3%	100%

The resulting shareholder incentive results are shown in Table 3-15.

Table 3-15. Union DSMSI results

Scorecard	Draft Utility-Reported DSMSI*	DSMSI
Resource Acquisition	$4,776,312	$4,010,638
Low Income	$2,192,257	$2,462,534
Large Volume	$0	$0
Market Transformation	$566,721	$566,721
Total	**$7,535,290**	**$7,039,894**

* Union-reported DSMSI values reflect those presented in Union's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.

3.3.2 LRAM

The EC summed the verified net annual savings by rate class and month. The summed savings were entered into the Union tracking workbook LRAM calculator, which was verified by the EC. Table 3-16 shows the results.

Table 3-16. Union LRAM results

Rate Class	Utility-Reported Draft LRAM	Verified LRAM
M4 Industrial	$77,105	$73,713
M5 Industrial	$38,366	$36,565
M7 Industrial	$33,512	$31,937
T1 Industrial	$2,789	$777
T2 Industrial	$1,050	$389
20 Industrial	$7,002	$6,845
100 Industrial	$5,578	$1,565
Total	**$165,411**	**$151,791**

4 Enbridge Gas Distribution, Inc.

This section reports on the results of the annual verification and scorecard achievements of Enbridge's 2015 DSM programs.

4.1 Scorecard achievements

Enbridge has five scorecards: Resource Acquisition, Low Income, Residential Savings by Design (RSBD), Commercial Savings by Design (CSBD), and Home Labelling. Table 4-1 shows an overview of the programs included in each scorecard. For a discussion of the calculations behind the DSMSI and LRAM, see APPENDIX J.

Table 4-1. Overview of Enbridge 2015 programs by scorecard

Scorecard	Programs
Resource Acquisition	Home Energy Conservation Commercial and Industrial Prescriptive Commercial and Industrial Custom RunitRight
Low Income	Low Income Multi-family Low Income Single Family
RSBD	RSBD
CSBD	CSBD
Home Labelling	Home Labelling

Table 4-2 shows the Enbridge scorecard for 2015, including the target metrics, reported achievement, weight, and maximum shareholder incentive. These were the metrics reviewed as part of the annual verification. The recommendations related to these activities are listed in section 5.

Table 4-2. Enbridge's unverified, reported 2015 achievement, target, weight, and maximum shareholder incentive by scorecard

Scorecard	2015 Target	2015 Reported Achievement	Weight	Maximum Shareholder Incentive (if 150% of target achieved)
Enbridge				
Resource Acquisition	1,011,900,000 CCM	767,627,826 CCM	92%	$6,482,744
	762 deep savings participants	5,646 participants	8%	
Low Income	24,100,000 single family CCM	28,343,978 CCM	50%	$2,495,721
	68,700,000 multi-family CCM	69,226,782 CCM	45%	
	40% of Part 3 participants enrolled	65% enrolled	5%	
Residential Savings by Design (Market Transformation)	18 Builders enrolled	19 Builders enrolled	20%	$1,076,493
	1,111 homes built 20% more efficient than OBC	1,987 of homes	13%	
Commercial Savings by Design (Market Transformation)	18 New developments enrolled	24 developments enrolled	33%	$418,269
Home Labelling (Market Transformation)	5,000 Realtor commitments	41,650 Realtor commitments	17%	$616,397
	4,500 Ratings performed	336 Ratings performed	17%	
TOTAL				**$11,089,624**

4.1.1 Resource Acquisition

This section summarizes the results of the EC's review of the Enbridge Resource Acquisition scorecard. The metrics for the Resource Acquisition scorecard include:

- Total cumulative natural gas savings
- Number of residential deep savings participants

To verify natural gas savings, the EC team reviewed each program independently. The programs that contribute energy savings to the Resource Acquisition scorecard are shown in Table 4-3. The table also shows the appendix that has the detailed explanation of the verification activities.

Table 4-3. Enbridge Resource Acquisition report location of detailed verification

Program	Location of Detailed Explanation	Description of Detailed Explanation
Residential Program		
Home Energy Conservation	APPENDIX D	How home retrofit program savings were verified
Commercial / Industrial Program		
Commercial & Industrial Prescriptive	APPENDIX C	How prescriptive savings were certified
Commercial & Industrial Custom	APPENDIX H APPENDIX N	How CPSV / NTG results and spillover are applied for annual verification
RunitRight	APPENDIX F	How RunitRight gross savings were verified

At a high level, the EC completed the following verification activities for each Resource Acquisition program:

- **Home Energy Conservation:** The EC sampled 25 participants and reviewed the program documentation to confirm that the model savings matched the tracking data. We calculated an adjustment factor and applied it to the tracking savings to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.
- **Commercial and Industrial Prescriptive:** The EC confirmed energy savings for the population of measures by recreating the program tracking data using program-assumed quantities and approved energy savings per unit to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.
- **Commercial and Industrial Custom:** The EC conducted site verifications as part of the CPSV / NTG study. We also did secondary source research to estimate spillover. We applied the results to produce verified gross and net savings for the following sectors:
  - Commercial Custom
  - Industrial Custom
  - Multi-family
  - New Construction
  - Industrial Agriculture
  - RunitRight (net savings only)

- **RunitRight:** The EC sampled 10 participants to confirm that the calculated energy savings were reasonable. We calculated an adjustment factor and applied it to the tracking savings to produce verified gross savings. The EC applied the results of the NTG study and the secondary source spillover research to produce net savings.

Table 4-4 shows the gross and net cumulative natural gas savings (CCM), as reported by the utility and verified by the EC. The tables also show the realization rates (RR) of the savings, both in terms of gross savings (those savings which were found to be in place upon the EC's review) and net savings (those savings which have been adjusted to exclude free riders and include spillover).[9] The commercial and industrial custom and prescriptive programs have been expanded to more refined sector subsets to match those in the utility-reported tracking data.

Table 4-4. Enbridge's verified 2015 Resource Acquisition savings

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate**†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition						
Home Energy Conservation	120,488,487	102,415,214	100%	85%	120,488,487	102,415,214
Prescriptive Commercial	117,938,979	98,693,722	97%	86%	114,897,650	98,862,563
Custom Commercial	210,800,594	185,504,523	91%	21%	192,840,383	40,105,236
RunitRight	2,684,105	2,684,105	100%	53%	2,684,105	1,434,923
Custom Multi-family	152,593,766	122,075,013	91%	38%	139,592,777	53,699,388
C&I Custom New Construction	102,294,475	75,697,912	91%	22%	93,578,986	20,231,777
Custom Industrial	336,500,502	168,250,251	100%	36%	337,417,582	122,387,967
Prescriptive Industrial	10,826,785	7,593,008	100%	70%	10,826,785	7,593,008
Custom Industrial Ag	7,856,800	4,714,080	99%	32%	7,815,133	2,467,184
Total	**1,061,984,493**	**767,627,826**	**96%**	**44%**	**1,020,141,888**	**449,197,259†**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
** The gross realization rate for C&I prescriptive includes the removal rate for the multifamily showerhead measure, which was previously included in the net-to-gross adjustment. See APPENDIX C for more detail.
†These values are rounded.

To verify the number of residential deep savings participants, the EC followed the process outlined in Table 4-5 and described in APPENDIX D. The EC found 5,646 qualifying deep savings participants, which is the same number reported by the utility.

[9] The current spillover estimate is a provisional value based on secondary source research. There is a spillover study in progress. but the results are not ready.

Table 4-5. Enbridge deep savings participant verification activities and outcomes

Verification Activity	Outcome
Confirm that two major measures were installed for each sampled site.	Confirmed for 6 of 24 sites using the supplied photos. For the remaining sites, photos only verified one major measure.*
Calculate the average percent reduction across the sample and confirm greater than 25%.	By assuming that the total natural gas consumption was equal to the space and water heat consumption, we were able to calculate an average savings reduction of 31%.
Calculate the percent reduction for each sample site and compare it to the tracking values.	There were 2 sites with differences; overall, however, the adjusted result was still greater than 25%.
Apply the gross realization rate to the population and determine the number of qualifying deep savings participants.	The EC found 5,646 qualifying deep savings participants, which is the same number reported by the utility.

*Despite the low confirmation rate, the EC did not adjust the outcome based on the initial review. Though the activity did not confirm that there were two major measures, it also did not confirm that there were not. It's likely that the second major measure was more difficult to visually confirm, such as air sealing.

4.1.2 Low Income

This section summarizes the results of the EC's review of the Enbridge Low Income scorecard. The metrics for the Low Income scorecard include:

- Total cumulative natural gas savings for multi-family
- Total cumulative natural gas savings for single family
- The percentage of Part 3 participants who are also participating in the Low Income Building Performance Management (LIBPM) program

To verify natural gas savings, the EC team reviewed the prescriptive and custom savings for Low Income independently. Table 4-6 shows the appendix that has the detailed explanation of the verification activities for each type of project.

Table 4-6. Enbridge Low Income location of detailed verification

Program	Location of Detailed Explanation	Description of Detailed Explanation
Single Family Program		
Low Income Single Family: Winterproofing	APPENDIX D	How home retrofit program savings were verified
Low Income Single Family non-Winterproofing	APPENDIX C	How prescriptive savings were certified
Multi-family Program		
Low Income Multi-family (prescriptive projects)	APPENDIX C	How prescriptive savings were certified
Low Income Multi-family (custom projects)	APPENDIX H	How CPSV / NTG results are applied for annual verification

At a high level, the EC completed the following verification activities for each Low Income program:

- **Multi-family Custom Projects:** The EC conducted site verifications as part of the CPSV / NTG study. We applied the results to produce verified gross and net savings.
- **Winterproofing:** The EC sampled 25 participants and reviewed the program documentation to confirm that the model savings matched the tracking data. We calculated an adjustment factor and applied it to the tracking savings to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.
- **Single Family and Multi-family Prescriptive Projects:** The EC confirmed energy savings for the population of measures by recreating the program tracking data using program-assumed quantities and approved energy savings per unit to produce verified gross savings. Program-assumed free-ridership values were used to produce net savings.

Table 4-7 shows the gross and net cumulative natural gas savings (CCM), as reported by the utility and verified by the EC. The tables also show the realization rates (RR) of the savings, both in terms of gross savings (those savings which were found to be in place upon the EC's review) and net savings (those savings which have been adjusted to exclude free riders and include spillover).

Table 4-7. Enbridge's verified 2015 Low Income savings

Program	Draft Utility-Reported Savings		Verification Results		Verified Savings	
	Gross Cumulative (m^3)	Net Cumulative (m^3)	Gross Realization Rate**†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Low Income						
LI Multi-Family	69,505,240	69,226,782	101%	100%	70,147,603	70,426,062
Single Family	28,410,725	28,343,978	99%	100%	28,067,264	28,132,657
Total	**97,915,965**	**97,570,759**	**100%**	**100%**	**98,214,867**	**98,558,719**

** The gross realization rate for single family low income and multi-family low income includes the removal rate for some measures, which was previously included in the net-to-gross adjustment. See APPENDIX C for more detail.
†These values are rounded.

To verify the percentage of Part 3 buildings participating in the LIBPM program, the EC:

- Confirmed the calculation method
- Verified the calculation inputs
- Confirmed the overall utility-reported result of 65%.

4.1.3 Residential Savings by Design

This section summarizes the results of the EC's review of the Enbridge RSBD scorecard. The metrics for the RSBD scorecard are the number of builders participating in the RSBD program and the number of houses built to RSBD standard, which is greater than 25% above the Ontario Building Code (OBC) 2012. Enbridge reported achievements of 19 builders enrolled and 1,987 homes built, which was confirmed by the EC. By definition, an enrolled builder must have built a minimum of 50 homes in the previous year to qualify. The detailed verification efforts are described in APPENDIX I.

4.1.4 Commercial Savings by Design

This section summarizes the results of the EC's review of the Enbridge CSBD scorecard. The metric for the CSBD scorecard is the number of developments enrolled in the program. Enbridge reported an achievement of 24 developments enrolled, which was confirmed by the EC. The detailed verification efforts are described in APPENDIX I.

4.1.5 Home Labelling

This section summarizes the results of the EC's review of the Home Labelling scorecard. The scorecard metrics for the Home Labelling scorecard are the number of annual listings by realtors committed to the program and the number of ratings performed. Enbridge reported achievements of 41,650 listings and 336 ratings performed, which were confirmed by the EC.

4.2 Program spending and cost-effectiveness

This section reports on Enbridge's program spending and cost-effectiveness.

4.2.1 Program spending

The Enbridge tracking database included reported program spending information. Table 4-8 summarizes the costs across the portfolio. Additional spending detail is in APPENDIX L.

Table 4-8. Enbridge program cost summary

Scorecard / Program	OEB-Approved Budget	Actual Spending			Difference	
		Indirect	Direct	Total	$	%
Program Costs						
Resource Acquisition Total	**$14,443,790**	**$13,838,372**	**$3,912,353**	**$17,750,725**	**$3,306,935**	**23%**
Residential	$1,872,720	$8,340,428	$1,021,867	$9,362,295	$7,489,575	400%
Commercial	$8,252,370	$3,923,856	$2,297,867	$6,221,724	($2,030,646)	-25%
Industrial	$4,318,700	$1,574,088	$592,619	$2,166,706	($2,151,994)	-50%
Low Income Total	**$6,864,090**	**$5,523,356**	**$1,033,006**	**$6,556,362**	**($307,728)**	**-4%**
Market Transformation Total	**$4,890,900**	**$1,899,739**	**$1,143,988**	**$3,043,727**	**($1,847,173)**	**-38%**
Overhead Total	**$6,603,160**	**$0**	**$7,869,780**	**$7,869,780**	**$1,266,620**	**19%**
Resource Acquisition	$4,731,485	$0	$5,639,080	$5,639,080	$907,595	19%
Low Income	$517,988	$0	$617,349	$617,349	$99,361	19%
Market Transformation	$1,353,687	$0	$1,613,352	$1,613,352	$259,665	19%
Incremental Costs	**$4,920,291**	**$179**	**$559,200**	**$559,378**	**($4,360,913)**	**-89%**
Total	**$37,722,231**	**$21,261,646**	**$14,518,327**	**$35,779,973**	**($1,942,258)**	**-5%**

4.2.2 Cost-effectiveness

Table 4-9 and Table 4-10 show summary results for the TRC, TRC-Plus, and PAC tests, including the cost-benefit ratio and the net present value. Additional detail is provided in APPENDIX M. While there is a general drop in cost-effectiveness results following the verification of savings, almost all OEB-defined programs still pass the cost-effectiveness threshold for both the TRC-Plus and the PAC tests. The only exception is the RunitRight program (see APPENDIX M), which was not cost-effective when using utility draft reported savings, before any verification-related adjustment.[10] When the utility definition of program is used (see APPENDIX M), the threshold is always exceeded.

Table 4-9. Enbridge summary of cost-effectiveness ratio results

Scorecard	Draft using Utility-Reported Savings*			Final Verified Ratio		
	TRC**	TRC-Plus	PAC	TRC	TRC-Plus	PAC
Resource Acquisition	3.3	3.8	6.0	2.3	2.7	2.7
Low Income	2.1	2.5	2.5	1.7	2.0	1.9
Total Portfolio	**3.1**	**3.6**	**5.2**	**2.2**	**2.6**	**2.5**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Enbridge only reported TRC-Plus and PAC in its filings for 2015.

Table 4-10. Enbridge summary of cost-effectiveness net present value results

Scorecard	Draft Net Present Value (M$) using Utility-Reported Savings*			Final Verified Net Present Value (M$)		
	TRC**	TRC-Plus	PAC	TRC	TRC-Plus	PAC
Resource Acquisition	123.2	149.7	120.4	50.1	61.8	40.9
Low Income	9.2	11.8	10.7	6.0	8.1	6.2
Total Portfolio	**132.4**	**161.6**	**131.1**	**56.1**	**69.9**	**47.1**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Enbridge only reported TRC-Plus and PAC in its filings for 2015.

As very low net-to-gross factors were applied to the C&I custom sector, the TRC, TRC-Plus, and PAC net values dropped significantly. It is interesting to note that because both savings and costs are affected by the net-to-gross factor, the impact on the TRC ratio is far less significant.

4.3 DSMSI and LRAM

This section reports on the results of the DSMSI and LRAM calculations. The recommendations related to these activities are listed in section 5. Table 4-11 shows the verified savings results for the Enbridge portfolio.

[10] The RunitRight program is not required to be cost effective; only the utility-defined Resource Acquisition program must be cost effective.

Table 4-11. Enbridge verified savings results

Program	Draft Utility-Reported Savings*		Verification Results		Verified Savings	
	Gross Cumulative (m³)	Net Cumulative (m³)	Gross Realization Rate**†	Net-to-Gross†	Gross Cumulative (m³)	Net Cumulative (m³)
Resource Acquisition						
Home Energy Conservation	120,488,487	102,415,214	100%	85%	120,488,487	102,415,214
Total Residential	120,488,487	102,415,214	100%	85%	120,488,487	102,415,214
C&I Custom	812,730,242	558,925,884	95%	31%	773,928,967	240,326,475
C&I Prescriptive	128,765,764	106,286,730	98%	85%	125,724,435	106,455,571
Total C&I	941,496,006	665,212,614	96%	39%	899,653,401†	346,782,045†
Total Resource Acquisition	**1,061,984,493**	**767,627,828**	**96%**	**44%**	**1,020,141,888**	**449,197,259**
Low Income						
Single Family (Part 9)	28,410,725	28,343,978	99%	100%	28,067,264	28,132,657
Multi-family (Part 3)	69,505,240	69,226,782	101%	100%	70,147,603	70,426,062
Total Low Income	**97,915,965**	**97,570,760**	**100%**	**100%**	**98,214,867**	**98,558,719**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
** The gross realization rate for C&I prescriptive, single family low income, and multi-family low income includes the removal rate for some measures, which was previously included in the net-to-gross adjustment. See APPENDIX C for more detail.
†These values are rounded.

4.3.1 DSMSI

The EC gathered the verified scorecard achievements from section 4.1 and compared them to the defined upper and lower bands in the Enbridge DSMSI calculation (see APPENDIX J for a description of the DSMSI calculation), shown in Table 4-12. The verified program achievements were entered into the Enbridge tracking workbook DSMSI calculator, which was verified by the EC.

Table 4-12. Enbridge's 2015 scorecard targets, lower band, upper band, and weight

Scorecard	Lower Band	2015 Target	Upper Band	Verified Achievement	Weight
Enbridge					
Resource Acquisition	758,900,000 CCM 571 participants	1,011,900,000 CCM 762 deep savings participants	1,264,900,000 CCM 952 participants	449,197,259 CCM 5,646 participants	92% 8%
Low Income	18,100,000 CCM 51,600,000 CCM 30%	24,100,000 single family CCM 68,700,000 multi-family CCM 40% of Part 3 in LIBPM	30,200,000 CCM 86,000,000 CCM 50%	28,132,657 CCM 70,426,062 CCM 65%	50% 45% 5%
Savings by Design Residential	13 builders 833 homes	18 builders enrolled 1,111 homes built by participating builders were 20% more efficient than OBC	22 builders 1,389 homes	19 builders 1,987 homes	60% 40%
Savings by Design Commercial	11 developments	18 developments enrolled	24 developments	24 developments	100%
Home Labelling	No listings 2,250 ratings	5,001 total listings from committed realtors 4,500 ratings performed	10,001 listings 6,750 ratings	41,650 listings 333 ratings	50% 50%

The resulting shareholder incentive results are shown in Table 4-13.

Table 4-13. Enbridge DSMSI results

Scorecard	Utility-Reported Draft DSMSI*	Verified DSMSI
Resource Acquisition	$6,482,744	$2,632,886
Low Income	$1,724,691	$1,745,422
Residential Savings by Design	$1,076,493	$1,076,493
Commercial Savings by Design	$418,269	$418,269
Home Labelling	$616,397	$616,397
Total	**$10,318,594**	**$6,489,467**

* Enbridge-reported DSMSI values reflect those presented in Enbridge's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.

4.3.2 LRAM

The EC summed the verified net annual savings by rate class and month. The summed savings were entered into the Union[11] tracking workbook LRAM calculator, which was verified by the EC. Table 4-14 shows the results.

Table 4-14. Enbridge LRAM results

Rate Class	Utility-Reported Draft LRAM*	Verified LRAM
110	$18,795	$11,662
115	$6,478	$2,836
135	$330	$239
145	$2,267	$834
170	$953	$584
Total	**$28,822**	**$16,155**

* Enbridge-reported LRAM values reflect those presented in Enbridge's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.

[11] The Enbridge tracking workbook calculation did not lend itself to easy update.

5 Findings and recommendations

This section contains the recommendations from the 2015 annual verification efforts and all other evaluations conducted on the 2015 programs. The annual verification recommendations are in the first section. CPSV / NTG recommendations are in the second section. Some recommendations overlap the various studies and are provided in all sections.

5.1 2015 annual verification recommendations

As part of the 2015 annual verification, a number of recommendations were identified. In the tables below, the primary outcomes of the recommendation are classified into three categories: reduce costs (evaluation or program or both), improve savings accuracy, and decrease risk (multiple types of risk are in this category including risk of adjusted savings, risk to budgets or project schedules, and others). Details of the findings, recommendations and outcomes follow the tables.

Table 5-1. Summary of recommendations that apply to the overall annual verification

#	Overall Annual Verification Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
O1A	Consider investing in a relational program tracking database.	✓	✓		✓	✓	✓
O1B	Enbridge should include site-level information for all measures installed through the program.		✓			✓	✓
O2A	Deliver tracking data in a single flat file.	✓	✓		✓	✓	✓
O2B	Consider investing in a relational program tracking database.	✓	✓		✓	✓	✓
O3A	Develop and maintain an electronic summary of the TRM.	✓	✓	✓	✓	✓	✓
O3B	Track prescriptive savings using unique measure descriptions that map to electronic TRM.	✓	✓	✓	✓	✓	✓

Table 5-2. Summary of recommendations that apply to RunitRight

#	RunitRight Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
RR1	Consider adding independent variables to the regression to account for school breaks.		✓			✓	
RR2A	Consider including the date when each activity was implemented.		✓			✓	
RR2B	Provide information on both the baseline and installed case.		✓			✓	
RR2C	Increase the level of documentation when a single change results in a significant portion of savings.		✓			✓	
RR3A	Consider including a basic description of all end-use equipment served by the gas meter.		✓			✓	
RR3B	Consider using engineering calculations to estimate electricity savings.		✓			✓	
RR3C	Consider reviewing the process for selecting the HDD reference temperature.		✓			✓	

Table 5-3. Summary of recommendations that apply to simulation modeling

#	Simulation Modeling Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation	Primary Outcome: Reduce Costs	Primary Outcome: Improve Savings Accuracy	Primary Outcome: Decrease Risk
SM1	Provide simulation file and output to the evaluation team.	✓	✓		✓		✓
SM2	Provide more explicit support for major measure installations.	✓	✓				✓
SM3	Consider reviewing and modifying program processes to avoid data entry or outdated simulation result errors.	✓	✓		✓	✓	✓
SM4	Consider funding a study to verify the models produced by the utility agents.			✓		✓	

Table 5-4. Summary of recommendations that apply to cost-effectiveness

#	Cost-effectiveness Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation	Primary Outcome: Reduce Costs	Primary Outcome: Improve Savings Accuracy	Primary Outcome: Decrease Risk
CE1	Allocate “sector”-level administrative costs and overhead to each individual program and report program-level cost-effectiveness results.	✓	✓		✓		✓
CE2	Use a consistent real discount rate of 4% when using real streams of benefits and costs.	✓	✓		✓		✓
CE3	Explore the possibility of better defining water avoided costs.	✓	✓	✓	✓		✓
CE4	Work towards better uniformity in methods and assumptions.	✓	✓	✓	✓		✓

Table 5-5. Summary of recommendations that apply to other areas

#	Other Recommendation	Applies to			Primary Outcome		
		Union	Enbridge	Evaluation	Reduce Costs	Improve Savings Accuracy	Decrease Risk
OR1	When the C&I deep savings metric is used, deliver monthly billing data for each C&I participant.	✓					✓
OR2	Provide a detailed explanation for the DSMSI calculation.	✓	✓		✓		✓

5.1.1 Overall annual verification recommendations

O1. Finding: The Enbridge tracking database does not currently include information that allows the evaluator to identify all the projects installed by a single customer. Without this information, the EC could not identify projects installed across customers to determine whether interactive effects may have reduced energy savings. Some prescriptive measures in the Enbridge data did not have site-level information at all, only a summary of the energy savings for that technology across all sites.

Recommendation A: Both utilities should strongly consider investing in relational program tracking databases. Relational program tracking databases and customer relationship management (CRM) systems allow for multiple measures and projects to be associated with a single customer and/or customer site. The incremental cost of implementation is low if it is part of the initial database design, populated as projects are started, and updated once they are complete.

Outcome: Reduced burden on utility staff and reduced evaluation costs. A relational database would streamline aggregation of program data for scorecards and make providing data simpler for annual savings evaluation and verification.

Recommendation B: Enbridge should include site-level information for every measure installed in the program.

Outcome: Confirmation that each installation is unique.

O2. Finding: Both utilities invested significant effort in developing Excel-based tracking workbooks that summarized data and calculated DSMSI based on utility-reported results. Union's workbook included a feature that was designed to allow evaluators to enter adjustment factors in a single location and automatically update DSMSI and LRAM calculations. Neither workbook was well suited for evaluation efforts.

Recommendation A: Deliver to evaluators a single, flat file of tracking data.[12] Each record should have measure-level information which includes the information listed below.

- Program identification information, such as scorecard, and program name
- Customer identification information, such as a unique customer ID, rate class, and location
- Measure identification information, such as measure description, unique measure identification, measure group, measure life, free rider rate, and savings per unit for prescriptive measures
- Savings information, such as annual gross and net savings, cumulative gross and net savings, and non-gas savings
- Additional information as needed to allow the evaluator to verify LRAM and cost-effectiveness

The Union tracking data most closely followed this recommendation, but both utilities invested in workbook features that did not enhance evaluation efficiency.

Outcome: Reduced burden on program staff, more flexibility for evaluators.

Recommendation B: See recommendation O1A. The utilities should consider investing in a new database.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

O3. Finding: Neither Union nor Enbridge tracking databases currently use prescriptive measure descriptions that map directly to the approved energy savings spreadsheet (TRM). The EC often struggled to align tracking measures to the correct TRM measure, which resulted in repeated back-and-forth between evaluation and the utilities for clarification. During this process, the EC found that some Enbridge measures were assigned to the wrong sub-category by capacity or other size measure. The EC also found that some Enbridge measures were assigned outdated savings values from previously-approved TRMs.

Recommendation A: Develop and maintain an electronic summary of the TRM, such as an Excel file. Each measure (identified as a unique savings value) should have an assigned measure ID number, and new ID numbers should be assigned when a measure is updated with a new savings value. This allows for a historical record of the changes in the TRM and allows the evaluation to identify outdated values.

Recommendation B: Track prescriptive savings using unique measure descriptions that clearly map to the electronic TRM.

Outcome: Reduced burden on utility staff and reduced evaluation costs. Fewer errors in the tracking data.

5.1.2 RunitRight savings recommendations

RR1. Finding: Not all the RunitRight regression models provided a strong fit for the consumption data. In particular, school buildings, which have widely inconsistent occupancy throughout the year, show low R-squared values.

12 In this context, a flat file is a table with one record per line and no summary information.

Recommendation: Consider including additional independent variables for schools to account for break periods, which may improve the regression fit.

Outcome: More confidence in the reported savings estimates.

RR2. **Finding:** The RunitRight documentation includes a description of the activities at each site, which are documented in the calculation workbook and annual site report. The same level of documentation is included for all activities, regardless of the percentage of savings contributed by that activity.

Recommendation A: Consider including the date when each activity was implemented.

Recommendation B: Provide information on both the baseline and installed case. For example, when a schedule is reset, provide the pre- and post-installation schedule.

Recommendation C: Increase the level of documentation on end use equipment when a change to that equipment results in a significant reduction in consumption.

Outcome: More confidence in the reported savings estimates.

RR3. **Finding:** The evaluator observed a number of opportunities to improve the savings estimates associated with the RunitRight program, including savings at the electric meter. Some sites had base loads that were unexpectedly sensitive to the reference temperature.

Recommendation A: Consider including a basic description of the end-use equipment served by the gas meter, such as DHW, heating, or cooking. This will help the reviewer better assess the consumption patterns occurring over time and the magnitude of base load and weather-sensitive savings estimated.

Recommendation B: Consider using engineering calculations to estimate electric energy savings to capture the full value of the program.

Recommendation C: Consider reviewing the process for selecting the HDD reference temperature to reduce baseload sensitivity.

Outcome: More accurate savings estimates.

5.1.3 Simulation modeling recommendations

SM1. **Finding:** Both utilities use building simulation modeling to estimate energy savings for their home retrofit programs, including Home Energy Conservation, Home Reno Rebate, Winterproofing, and the Home Weatherization Program. HOT2000 is the most common program used for those simulations, which is a program developed and released by NRCan for certified energy advisors. Because of the restrictions on the program, the evaluator could not consistently run the simulation files and produce the same result reported by the program.

Recommendation: Provide both the building simulation file and the program output to the evaluation team. By delivering both, the evaluation team would not have to follow up with the utility to obtain output for models that could not be run, but could still verify the output for models that can be run.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

SM2. **Finding:** Both utilities have market-rate scorecard metrics that rely on a definition of deep savings that is related to the number of “major” measures installed at a site. Both utilities also collect and deliver photographs to support many of the changes made at a home retrofit site. However, the evaluator could not consistently confirm the number or type of major measures installed based on the photographs or other documentation provided.

Recommendation: Consider providing more explicit support for each major measure to eliminate uncertainty around the number of deep savings program participants.

Outcome: Greater certainty around scorecard achievements.

SM3. **Finding:** The evaluator identified a number of inaccurate savings entries due to data entry errors or outdated Union home retrofit simulation results. Many of these errors could be avoided through changes in program processes.

Recommendation: Consider reviewing and modifying program processes to avoid similar errors in the future.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

SM4. **Finding:** The energy savings from the home retrofit programs rely exclusively on the simulations provided by the delivery agents. Those simulations likely rely on a number of assumptions or standard modeling practices which may or may not follow industry standards. A detailed review of the models was outside the scope of the annual audit.

Recommendation: Consider funding a study to verify the models produced by the utility agents to ensure they conform to standard industry practice.

Outcome: Greater certainty around savings estimates.

5.1.4 Cost-effectiveness recommendations

CE1. **Finding:** In some cases, the Union program costs were grouped together for several programs. To get program- or sector-level cost-effectiveness results, the EC prorated costs to programs based on natural gas savings.

Recommendation: Allocate “sector”-level administrative costs and overhead to each individual program and report program-level cost-effectiveness results.

Outcome: Greater certainty around program-level achievements.

CE2. **Finding:** Enbridge uses a real discount rate of 4% and applies it to streams of current (nominal) values. However, the real discount rate should only be applied to real (inflation-adjusted) streams of benefits and costs. Nominal discount rates should be applied to streams of current (nominal) values.

Recommendation: Use a consistent real discount rate of 4% for both Enbridge and Union when using “real” (inflation-adjusted) streams of benefits and costs.

Outcome: More accurate cost-effectiveness results.

CE3. **Finding:** Water rates are currently used as a proxy for the water avoided costs. Water avoided costs should only include the marginal impact from reduced consumption. Using the full rate as the avoided cost may be appropriate in some jurisdictions with a completely variable rate structure. However, those with high fixed costs (which, in our experience, can represent 75% to 80% of water costs) should use a true avoided cost.

Recommendation: Explore the possibility of better defining water avoided costs.

Outcome: More accurate cost-effectiveness results.

CE4. **Finding:** The EC found major discrepancies in the way the utilities calculate cost-effectiveness. Some areas of discrepancies included the discount rate, the use of a non-energy benefit adder, the format of reporting results, and the allocation of administration and overhead costs by program. While there is always a balance to be found between uniform methods and the need to account for each specific utility's needs, greater uniformity could be achieved.

Recommendation: Work towards a better uniformity of cost-effectiveness methods and assumptions between the two gas utilities.

Outcome: More accurate and consistent cost-effectiveness results.

5.1.5 Other recommendations

OR1. **Finding:** The Union scorecard includes a metric that relies on an understanding of the whole-building energy use for each C&I program participant. The program data included the total annual consumption at each site, normalized by a regional (north or south) estimate of heating degree days. The calculation appeared to assume that industrial sites were not weather-sensitive but commercial sites were.

Recommendation: When the C&I deep savings metric is used, deliver monthly billing data for each C&I participant to allow the EC to verify the annual consumption values and the weather sensitivity assumptions. Provide the supporting information (and calculation, if possible) for the normalized regional heating degree days.

Outcome: Greater certainty around scorecard achievements.

OR2. **Finding:** The evaluator was unable to locate a source document that supports the utilities' calculation of DSMSI. Given the importance of the shareholder incentive, it is appropriate to have a clearly defined and detailed explanation of how it is calculated.

Recommendation: Provide a detailed explanation for the DSMSI calculation for review by the EC and OEB.

Outcome: Greater certainty around shareholder incentives.

5.2 CPSV / NTG findings and recommendations

As part of the CPSV / NTG evaluations, a number of recommendations were identified. In the tables below, the primary outcomes of the recommendation are classified into four categories: reduce costs, increase savings, increase (or maintain) customer satisfaction and decrease risk (multiple types of risk are in this category including risk of adjusted savings, risk to budgets or project schedules, and others). Details of the findings, recommendations and outcomes follow the tables.

Table 5-6: Energy savings and program performance recommendations

#	Energy Savings and Program Performance Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
ES1	The utilities should continue in their commitment to accuracy.	✓	✓				✓	✓
ES2	Evaluate free-ridership for the programs annually and couple the free-ridership evaluation with process evaluation			✓		✓		
ES3	Error ratios from this report inform sample design for future evaluation.			✓	✓			✓
ES4	Align the program design with cumulative net goals	✓	✓			✓		
ES5	Do not pay incentives until after installation is complete.	✓	✓					✓
ES6	Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.	✓	✓					✓
ES7	Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.	✓	✓	✓				✓
ES8	Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.	✓	✓			✓		✓
ES9	Consider establishing an official definition for EUL and implementing a study to define EULs for program measures	✓	✓	✓				✓
ES10	Track metrics for how long it takes from the final installation verification to the posting of incentive payments.	✓	✓				✓	
ES11	Increase transparency of "influence adjustments" and do not include in gross	✓				✓	✓	✓

#	Energy Savings and Program Performance Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
	savings							
ES12	Conduct a process evaluation to improve Large Volume influence on customer projects	✓				✓	✓	
ES13	Consider approaches to market that leverage third-party vendors.	✓	✓		✓	✓		

Table 5-7: Verification process recommendations

#	Verification Process Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
VP1	Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.	✓	✓		✓			✓
VP2	The verification and utility staff should agree to a code of conduct for each role during onsite visits.	✓	✓	✓			✓	

Table 5-8: Documentation and Support recommendations

#	Documentation and Support Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DS1	Take steps to improve documentation: • Include explicit sources for all inputs and assumptions in the project documentation. • Store background studies and information sources with the project files and make them available to evaluators. • Provide evaluators full access to customer data. • Provide pre- and post-installation photos, where available. • Document and provide internal M&V documents where available. • Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification	✓	✓			✓		✓
DS2	Ensure that incremental costs are supported by invoices or other documentation	✓	✓					✓
DS3	Increase the amount of documentation and source material for projects that have greater energy savings.	✓	✓					✓
DS4 A	Digitize and file project documentation for all projects as they are completed and paid during project closeout.	✓	✓		✓			✓
DS4 B	Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.			✓	✓			✓

#	Documentation and Support Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DS5	Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner.	✓			✓			✓
DS6	Use a consistent summary workbook.		✓		✓			✓

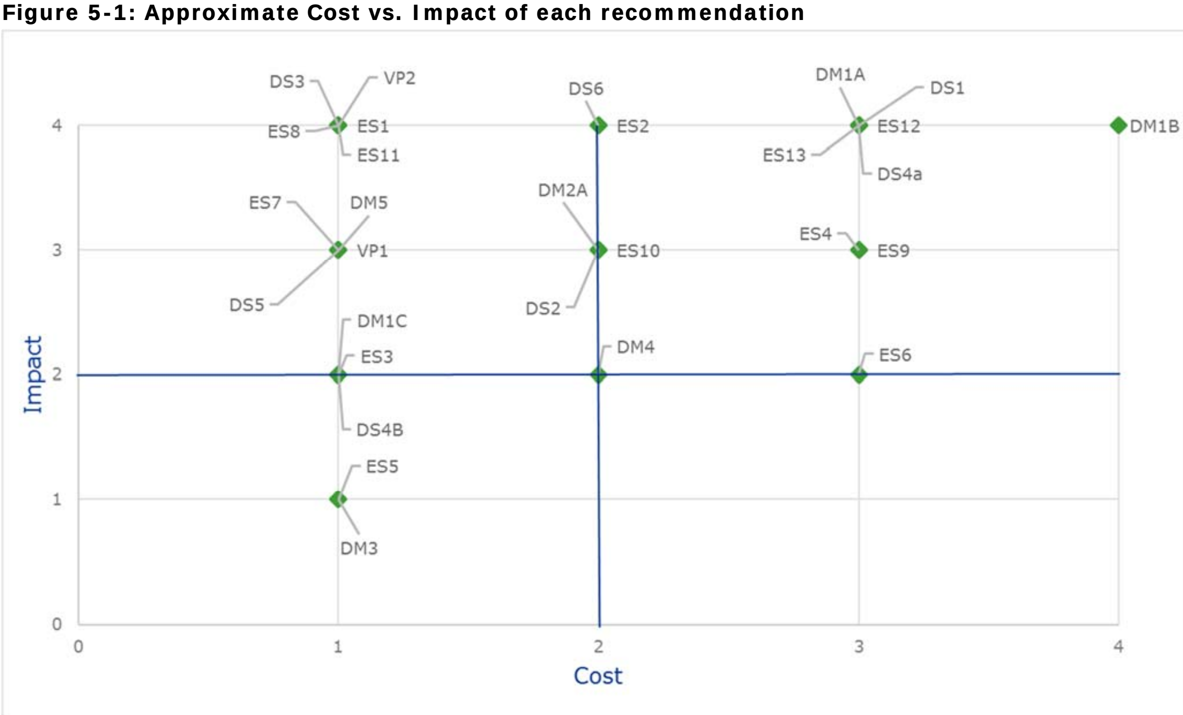
Table 5-9: Data management recommendations

#	Data Management Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DM1 A	Track contacts associated with projects in the program tracking database.	✓	✓		✓			✓
DM1 B	Strongly consider investing in relational program tracking databases.	✓	✓		✓			✓
DM1 C	Include structure for improved data integrity in the evaluator request for contact information for the 2016 and 2017 savings verification and evaluation.			✓	✓		✓	
DM2 A	Consider offering bonus incentives early in the year to combat the “hockey stick” phenomenon where a large percent of projects get closed in the fourth quarter of the year (which results in rushed QC for data).	✓	✓		✓			✓
DM3	Track and provide to evaluators dates for key milestones in the project.	✓	✓		✓			✓
DM4	Maintain a customer identifier in the database to clearly identify related sites.	✓	✓		✓		✓	

#	Data Management Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DM5	Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking extracts provided to evaluators.	✓	✓			✓		✓

Figure 5-1 shows an approximate cost vs. impact relation ship for each of the recommendations on a 4-point scale. The upper left quadrant of the figure shows the recommendations that are relatively low cost that would have a high impact. Those in the upper right are recommendations where both cost and impact are high.

Figure 5-1: Approximate Cost vs. Impact of each recommendation



5.2.1 Energy savings and program performance

ES1. Finding: Both utilities exhibit a strong commitment to accurate energy savings estimates. Both utilities have made significant investments in developing calculation tools which model savings accurately. For example, Union's dock door seal calculator is well considered and designed, and Enbridge's Etools calculator is very thorough in attempting to model savings for key measures.

Both utilities chose to retain engineers with strong understandings of their customers' building and process systems. We had numerous opportunities to interact with these engineers on phone calls and site visits, and have grown to respect their knowledge and engagement with the types of systems that matter to their customers.

Both utilities showed a commitment to finding accurate savings. On several occasions, both on the phone and in writing, the evaluation team suggested a value that would have increased savings in a way that the program engineer did not think was valid. When this happened, neither utility was shy in suggesting that we may want to make a more conservative choice.

Recommendation: The utilities should continue in their commitment to accuracy.

Outcome: Accurate energy savings.

ES2. Finding: Free-ridership in the utilities' programs is high

Recommendation: With high free-ridership and rapidly changing programs, consistent evaluation of free-ridership annually and free-ridership evaluation coupled with process evaluation will help identify specific ways for each program to manage and reduce free-ridership.

Outcome: Effective free-ridership management will allow the programs to increase their net savings significantly in future years.

ES3. Finding: Relative precision targets were exceeded for some programs and not met for others.

Recommendation: Error ratios from the results provided in this report should be used to inform sample design for future evaluation years.

Outcome: Better defined error ratios for the measures in the programs will allow more efficient sample design for future evaluations, improving precisions and reducing costs.

ES4. Finding: Attribution for the programs came primarily through acceleration rather than changes in efficiency or quantity/size. This is partly due to the measures that dominate the programs: controls, maintenance, and optimisation. These measures do not have varying efficiencies, so the programs are either affecting the number of units implemented or accelerating the measure. Acceleration is less valuable to programs that are seeking to meet cumulative net goals. Acceleration periods tend to be considerably shorter than the estimated useful life (EUL) of a measure and thus the partial attribution that results is low relative to cumulative gross savings.

Recommendation: To align the programs with cumulative net goals, the utilities should seek to:

- continue promoting long life measures and consider discontinuing promotion of short lived measures
- proactively upsell equipment purchases from standard to efficient products
- target hard to reach customers who have not participated in the past
- promote EE measures with low market penetration (such as heat reflector panels)

- motivate customers to increase the scope of their projects, some options include multi-measure bonuses or escalating incentive structures that pay more for doing more

Outcome 1: Focusing on proactive sales rather than reactive will help the net-to-gross (NTG) ratio.

Outcome 2: Effective free-ridership management will allow the program to increase net savings significantly in future years.

ES5. **Finding:** A handful (<5) of respondents indicated that all or part of their incentivized project had not yet been installed over a year after the incentive was paid.

Recommendation: Do not pay incentives until after installation is complete.

Outcome: Cost-effectiveness of the program will increase as it avoids paying for savings that do not materialize.

ES6. **Finding:** Some customers receive incentives from their electric provider and natural gas utility to complete the same EE measure. Both providers may claim the same changes in energy use, resulting in overlap when aggregated across fuels at the provincial level.

Recommendation: Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.

Outcome: More accurate energy and carbon savings estimates across the province.

ES7. **Finding:** Some measures (e.g., geothermal heat pumps, combined heat and power, and those that save district heating energy) have difficult-to-define baseline technologies.

Recommendation: Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.

Outcome: Less evaluation risk and a better alignment between province energy efficiency goals and program implementation.

ES8. **Finding:** Projects with very long and very short simple payback periods often have low NTG ratios. However, from a customer service standpoint, it may be difficult for utilities to deny incentives to customers unless they have pre-established rules to point to.

Recommendation: Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.

Outcome: The rule will give utilities a guideline to restrict the program to projects that are more likely to result in net savings. It will also allow the utilities to reject potentially poor projects without a large effect on customer satisfaction.

ES9. **Finding:** Members of the EAC and evaluation team have different understandings of the definition of some evaluation inputs.

Recommendation: Consider establishing an official definition for EUL and implementing a study to define EUL for all measures, especially steam traps, pipe leaks, steam leaks, condensate leaks, and pipe insulation.

Outcome: The study will improve the accuracy of lifetime savings estimates.

ES10. Finding: A handful (<5) of sites reported unhappiness with delays in receiving their incentive payment (5 months).

Recommendation: Track metrics for how long it takes from the final installation verification to the posting of incentive payments. Consider holding program managers accountable to these metrics by considering them during performance reviews, building in performance bonuses if all payments are posted within one month, and/or implementing a penalty if it takes greater than three months to post any payments.

Outcome: Improved customer satisfaction.

ES11. Finding: Influence adjustments were made to projects that adjusted the gross savings for "net" or program influence reasons. Accounting of which projects had these adjustments was not maintained by the program and the adjustments were included in different places in project calculation workbooks, making their identification challenging. In addition, the program NTG was also applied to these projects, effectively double discounting savings in scorecards.

Recommendation: If the utility chooses to continue making influence adjustments to the savings upon which it calculates savings, these adjustments should be made more transparent and not included in the reported gross savings for the program in scorecards. Instead the specific project influence adjustment should be included in the scorecard in place of the general program or domain level NTG factor.

Outcome: Reduced risk of double adjustments.

ES12. Finding: Union's Large Volume program has a very high amount of free-ridership.

Recommendation: This evaluation did not include a process evaluation. Union should consider conducting a process evaluation focused on how to reduce the rate of free-ridership. Three options that the Union might consider are:

- Eliminate measure types with high free-ridership (Union indicated that most maintenance type measures were eliminated in 2016).
- Use an application process that includes a committee review that can reject free riders. This option is hard for utilities to manage as it can affect customer satisfaction negatively
- Clear payback criteria such as initial payback must be longer that X years and the incentive paid must reduce payback below Y years. This has the advantage of being a rule that account representatives can explain when talking to customers.
- Non-energy benefits of projects that large industrial customers gravitate to are often large compared to energy saving benefits, so simple payback criteria will not eliminate all free rider projects. Awareness of this issue should be promoted among the implementation team.

Outcome: Effective free-ridership management may allow the program to increase its net savings significantly in future years.

ES13. Finding: Vendor attribution did not increase overall program attribution significantly. Of the vendors that customers cited as influences, few indicated that either program had much effect on the projects.

Recommendation: The utilities should consider approaches to market that leverage third-party vendors. A process evaluation that includes vendor interviews might uncover opportunities.

Outcome: Effective leveraging of vendors could both increase NTG ratios and increase program uptake.

5.2.2 Verification processes

VP1. Finding: DNV GL was unable to obtain access to all the equipment at all the sites selected for verification. Both Enbridge and Union have several large projects with industrial companies, including food processing, refineries, and other industries. In many cases, the customer refused to provide SCADA data or similar trend data to allow a reasonable verification of the project. This means we were unable to do more than a reasonableness check on the savings.

A review of the Enbridge contract shows that the customer is not required to provide the information that is necessary for EM&V. The most relevant sections are:

- Item 6 states: Payment of the Incentive Payment is subject to the completion of a satisfactory site inspection of the improvements, including the installed equipment by an authorized representative of Enbridge.
- Item 9 states: Upon request within eighteen months of the commissioning date of the Project, and with reasonable notice, the Customer agrees to provide authorized representatives of Enbridge with access to the Project, and with required information or data relating to the project for the purposes of the Application and these General Terms and Conditions.

Neither of these are sufficient for EM&V.

Recommendation: Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.

Outcome: Reduced evaluation costs and risks. Participant non-compliance requires evaluators to request documentation for a large backup sample, and to survey and/or visit additional sites to obtain sufficient data for the evaluation. The process of contacting a site and getting a refusal costs time and money, as does the substitution of an additional site to make up for the unobtained data. In some cases, there might not be additional sites to sample, in which case the evaluation estimates will have lower precision than they would with full compliance.

VP2. Finding: Verification engineers and verification forms caused confusion with site contacts and the length of visits also led to a handful of customer complaints. Utility staff at a handful of sites responded to questions in place of participating customers and in one case interfered with data collection.

Recommendation: The verification and utility staff should agree to a code of conduct for each role. The teams should receive clear direction as to the dos and don'ts of all parties involved in site visits, including both verification engineers and utility staff should they attend the visit. Open lines of communication between the site team and utility staff should be maintained to reduce misunderstandings and ensure that the teams are on the same page as to each other's role.

In general, the following should be part of standard verification practices:

- Ensure site engineer reviews final site report for accuracy post-audit.
- Align data collection forms with site report structure to reduce communication and transcription errors.
- Ensure data appropriate to determining EUL is collected while on-site (i.e., make EUL determination a primary, rather than secondary focus).
- Request specific documentation or data from systems prior to site visit (allowing for adequate time for site contact to obtain).

Outcome: Improved data collection and customer satisfaction.

5.2.3 Documentation and support

DS1. Finding: Project documentation for some projects lacked sufficient details to allow evaluators to reproduce the calculations made by program staff or third-party vendors. Specific issues included:

- Project data or details missing
- Insufficient measure-level details to fully describe what was installed
- Descriptions that were difficult to understand
- Use of black box tools
- Hardcoded information in calculation spreadsheets
- Energy intensity changes presented without providing the data to justify it
- Undocumented assumptions
- Sources referenced but not included or available, such as feasibility studies and historical analysis of energy use that was left out of the project documentation
- Scanned documents that were unreadable
- Input adjustments that approximate other effects, but are not explained
- Insufficient access to customer data (by customers) for confidentiality reasons.
- Modelling files that could not be opened
- Adjustments to savings estimates for safety or influence that were not clearly marked, sourced, or carried out in a consistent fashion
- Etools files not provided for many industrial boiler & boiler add-on projects

Recommendation: Several steps could be taken to improve data quality:

- Include explicit sources for all inputs and assumptions in the project documentation.
- Store background studies and information sources with the project files and make them available to evaluators.
- Provide evaluators full access to customer data.
- Provide pre- and post-installation photos, where available.
- Document and provide internal M&V documents where available.
- Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification

Outcome: Properly explaining and sourcing the savings calculation method and assumptions allows the evaluating engineer to more easily identify what needs to be verified. It also makes it easier to determine whether the methods and assumptions are reasonable and use ex ante assumptions rather than seek documented values elsewhere.

DS2. Finding: Invoices were not always included with documentation, and we saw a handful (<5) of cases where utility program staff were overclaiming incremental costs. This did not appear to be systemic, but higher incremental costs enable payment of a larger incentive.

Recommendation: Ensure that incremental costs are supported by invoices or other documentation, especially for add-on and optimization measures where the total cost and incremental cost are likely to be the same. Equipment replacement measures may require an additional standard efficiency quote to produce incremental cost.

Outcome: Incremental cost is an important component of simple payback, which is often used to judge the economic benefit of energy efficiency projects. It is also an input to some benefit-cost tests.

DS3. **Finding:** Larger projects appeared to fall under the same documentation standards as smaller projects.

Recommendation: Increase the amount of documentation and source material for projects that have greater energy savings.

Outcome: Projects that are better documented tend to have more accurate savings estimates and receive fewer evaluation adjustments than those that are less documented. Large projects have a greater effect on overall savings adjustment factors. Therefore, large projects with better documentation are more likely to result in adjustment factors closer to 100%.

DS4. **Finding:** Enbridge did not maintain complete digital project files prior to the evaluation request. Union appeared to have digital documentation that was not completely assembled prior to evaluation.

Recommendation A: Digitize and file project documentation for all projects as they are completed and paid during project closeout. PDF and Excel files associated with a project should be stored in a way that allows them to be easily found and associated with a specific project and/or customer. The best practice is to include a document repository as part of the program tracking system with a separate folder for each project.

Recommendation B: Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.

Outcome: In our experience, DSM programs that store complete and well-organized digital records experience less evaluation risk. In other words, their gross savings adjustments are closer to 100%. This happens for three reasons:

- Digitization facilitates internal review of project documentation, providing additional opportunities to identify missing information and errors
- Assembly during project closeout improves the comprehensiveness of the documentation because less time has elapsed than if it was assembled for evaluation, so less information is lost or forgotten

Easy retrieval makes it more likely that the complete file is sent to the evaluation team, reducing the information gap between implementation and evaluation.

DS5. **Finding:** Union custom projects utilized a project application summary workbook that summarizes the key project inputs, calculations, and most details. In general, this is a good approach that facilitates internal review and evaluation. One challenge was that different projects used the workbook in different ways:

- The notes section was sometimes used to identify and highlight specific unique approaches and features in projects, but not always.
- Calculations internal to the summary page were consistent for most projects, but not all (additional factors were sometimes added).
- Sub-methods critical to the calculation were contained in hidden sheets.
- Safety and influence adjustments were inserted in different locations and not always explained.

Recommendation: Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner. Identify a common approach for common measures and, if necessary, document deviations and the reasons for the deviations in a clearly labelled field on the summary sheet.

Outcome: A consistent summary workbook aids both internal and external quality assurance, quality control, and measurement and verification.

DS6. Finding: The Enbridge Etools is used as both a calculation tool and as a communication tool with customers. While it appears to serve the needs of the program, this form of communication is difficult for the evaluation efforts.

- Etools does not easily allow for assumptions to be sourced within the record.
- Some Etools selections may be site-specific and some may be defaults; the calculator does not distinguish.
- Energy savings that are calculated outside of Etools are hard-entered in Etools but not always sourced.

Recommendation: Use a consistent summary workbook.

Outcome: A consistent summary workbook aids both internal and external quality assurance, quality control, and measurement and verification.

5.2.4 Data management

DM1. Finding: Neither Union nor Enbridge currently track participating customer or participating vendor contact information in their program tracking database. Providing the information to the evaluation put significant burden on utility staff. When contact information was provided, there were significant data integrity issues including contacts listed in the wrong places, partial addresses, and incorrect or missing phone numbers and email addresses.

Recommendation A: Track contacts associated with projects in the program tracking database. At a minimum, the program tracking database should include:

- Project site address
- Customer mailing address
- Primary customer contact name
- Primary customer contact phone
- Primary customer contact email
- Primary customer contact mailing address
- Addresses are best tracked as multiple fields including:
  - Street address line 1
  - Street address line 2
  - City
  - Province
  - Postal code

Phone number fields should include data validation to enforce a consistent format and avoid missing or extra digit errors. Phone extensions should be tracked in a field separate from the ten-digit phone number and be restricted to numeric data only.

The best practice is to maintain contacts in a table separate from specific project or customer data. This allows for a single contact to be connected to multiple accounts and/or projects as necessary without creating duplication. This structure also makes it easier to associate multiple contacts with a single project.

Vendor contact information should also be tracked in the database, in the same table as the participating customer contact information. With a relational database, the contact ID from the table can be added to a project record in the role consistent with the contact's participation (such as vendor, decision maker, or technical expert) with a separate table that allows a single vendor contact to be associated with multiple projects.

Outcome A: Reduced burden on utility staff to seek contact information for projects, whether for internal or evaluation use. Reduced evaluation costs and improved sample design expectations.

Recommendation B: The utilities should strongly consider investing in relational program tracking databases. Relational program tracking databases and customer relationship management (CRM) systems allow for multiple contacts to be associated with a single account and/or project. This allows programs to easily clarify aspects of projects during implementation and to provide accurate, timely, and usable contact information to evaluators and verifiers. The incremental cost of implementation is low if it is part of the initial database design, populated as projects are started, and updated once they are complete.

Outcome B: Reduced burden on utility staff and reduced evaluation costs. A relational database would streamline aggregation of program data for scorecards and make providing data simpler for annual savings evaluation and verification.

Recommendation C: For 2016 (and perhaps 2017), we do not anticipate that contact information will have been entered into the program tracking databases. When the evaluation requests contact information for the 2016 and 2017 savings verification and evaluation, the contact request spreadsheet will be updated to provide additional fields to enforce data integrity (e.g., specific fields for a parsed address and company name for the technical and decision-making contacts).

Outcome C: Reduced evaluation costs due to less data cleaning and research to fill missing information. Improved data collection with less returned advance letters and more accurate connection between projects and contacts.

DM2. Finding: Both utilities have indicated that inputting and/or extracting data necessary for annual reporting and evaluation requires significant effort.

Recommendation A: Consider offering bonus incentives early in the year to combat the "hockey stick" phenomenon where a large percent of projects get closed in the fourth quarter of the year.

Outcome: Reduced burden on program staff, more consistency in meeting annual filing deadlines.

Recommendation B: See recommendation DM1B. The utilities should consider investing in a new database.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

DM3. Finding: The extracts from the utility program tracking database do not include dates for key project milestones. Enbridge's data did not include any dates and Union's included only the "installation date."

Recommendation: Track and provide to evaluators dates for key milestones in the project. Dates for project start, installation, and those that define the program year provide useful context for interviewers that is not always easy to find in project documentation

Outcome: Improved data collection through more informed interviewers and reduced evaluation costs through less need to search for dates in documentation.

DM4. Finding: Customers with multiple sites are not tracked in the program tracking database. A few property management groups had many sites selected in the sample, but it was not clear from project tracking or the provided contact information that the sites were related. Property management firms were the most significant but not the only customer type where this was true.

Recommendation: Maintain a customer identifier in the database to clearly identify related sites. This is easiest to deploy in a relational database see recommendation DM1B.

Outcome: Reduced evaluation costs and reduced customer burden. In some cases, a failure to identify related sites can result in multiple calls to the same customer, which a customer identifier would avoid. In addition, tracking related sites could improve program implementation by increasing awareness of connected opportunities.

DM5. Finding: EUL and cumulative gross savings were not provided in the standard program tracking database extracts. The evaluation team backed out the missing information from the fields provided.

Recommendation: Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking database.

Outcome: Improved data integrity results in less evaluation risk and more accurate savings totals. Providing each of the key savings types and their components allows evaluation to confirm that the savings provided are internally consistent.

APPENDIX A. DATA AND DOCUMENTATION REQUESTS

There were officially two data and documentation requests during the 2015 Annual Verification. In practice, there was repeated back-and-forth between the EC and the utility teams with questions and follow-up information. The back-and-forth is described in the individual program verification sections later in these appendices. This appendix shows the two formal documentation requests. The first is a copy of the memo sent on January 6, 2017, and the second is a copy of the email sent January 31, 2017.

First documentation request

Memo to: Tina Nicholson, Union Gas Deborah Bullock, Enbridge Gas	**Date:**	January 6, 2017
Copied to: Valerie Bennett, OEB Josh Wasylyk, OEB	**Prep. By:**	Tammy Kuiken, DNV GL

Ontario Gas Portfolio Data Request

This memo formally requests anonymized program tracking data for all Enbridge[13] and Union[14] projects submitted as part of the non-custom program filings for the 2015 program year. It also requests additional reports, data, and other documentation to support the Evaluation Contractor's (EC's) verification of the 2015 program year impacts and scorecard achievements. The deadline for this request is January 20, 2017.

Data already received

Through the CPSV and NTG efforts, we have received and confirmed the completeness of data for the 2015 programs listed in Table A-1.

[13] Reporting of Enbridge Gas Distribution Inc.'s 2015 DSM Program Results (EB-2015-0245): 2015 Demand Side Management Draft Annual Report. April 22, 2016.

[14] Union Gas Limited ("Union") – Demand Side Management ("DSM") Program Evaluations – Draft 2015 Annual Report: 2015 Demand Side Management Draft Annual Report. April 22, 2016.

Table A-1: 2015 Programs/projects already confirmed

Union Programs	Enbridge Programs
Completeness confirmed	
C&I Custom	Commercial Custom
Large Volume (Custom projects only)	Industrial Custom
Low Income Multi-family (Custom projects only) [15]	Run-it-Right
Market Rate Multi-family (Custom projects only) [16]	

Non-tracking data requested

The EC team is requesting additional data to support our verification of the 2015 program year impacts and scorecard achievements. In addition to the tracking data requested in the rest of this memo, we ask that Union and Enbridge send:

- A copy of Year 2015 verification and evaluation studies
- A copy of any previous verification and evaluation studies that apply to Year 2015 savings calculations
- A copy of operational and quality assurance documentation associated with the tracking database
- A copy of the spreadsheets or other documentation that confirms the reported market transformation achievements for Year 2015, if they are not already included in the tracking data
- FOR UNION ONLY: Year 2015 whole-building billing data for all commercial program participants, which will be used to confirm the percent-savings scorecard metric for C&I programs
- FOR ENBRIDGE ONLY: Documentation that confirms the enrollment percentage for the Part 3 scorecard metric

Tracking data requested

The additional programs/projects for which we are requesting 2015 tracking data are shown in Table A-2. Please provide all **anonymized** records associated with the measures installed through these programs as part of the 2015 program year.

[15] Provided August 15th, 2016.
[16] Relevant projects included as part of the C&I Custom program

Table A-2: Additional 2015 programs/projects requested now

Union Programs	Enbridge Programs
Resource Acquisition Requested	
Home Reno Rebate	Residential Home Energy Conservation
Energy Savings Kit	Commercial Prescriptive
Market Rate Multi-family (Prescriptive projects only)	Industrial Prescriptive
Commercial Prescriptive	
Large Volume Requested	
Large Volume (Prescriptive projects only)	
Low Income Requested	
Low Income Weatherization	Low Income Home Winterproofing
Low Income Multi-family Housing (Prescriptive projects only)	Low Income Multi-family Housing (Prescriptive projects only)
Market Transformation Requested	
Optimum Home	Residential Savings by Design
	Commercial Savings by Design
	Home Labelling

The first step in the verification is to confirm that the provided tracking data matches the participant/measure counts and savings reported in the 2015 filings. To perform step one, the evaluation requires the database fields shown in Table A-3. The names of the fields are indicative of the content and do not reflect the names that the utilities use in their tracking systems.

Table A-3: Minimum database fields required for matching database to utility filings

Required Database Field	Field Description
Measure ID	Unique Identifier – smallest grain of analysis, a measure is a unique calculation within a project. For example, 2 identical boilers would be one measure, while 2 different boilers would be two separate measures
Project ID	Unique Identifier - project can include multiple measures at one site and at one time; typically projects affect a single account
Account ID	Unique Identifier - billing account
Site ID	Unique Identifier - unique to a facility or group of facilities at a location
Customer ID	Unique Identifier - customer may have multiple sites, multiple accounts
Annual gross gas savings	Gross per year
Annual net gas savings	Net per year
Cumulative gross gas savings	Gross over lifetime of measure
Cumulative net gas savings	Net over lifetime of measure
Estimated useful life	Lifetime of the measure
Incentive amount	Amount of financial incentive paid (may be multiple fields if more than one party received a financial incentive)
Incentive type	Participant Rebate, Grant, Vendor Rebate/Spiff, participant loan
Program Year	The program year in which the measure impacts are claimed
Program	The program under which the measure impacts are claimed
Offering	The offering under which the measure impacts are claimed
Market segment	Business type or rate class for C&I (both in separate fields are best) 4-way single/multi-family by Low Income/market rate for residential
Net-to-gross factor	The net-to-gross (NTG) rate used for the program/offering/measure in calculating net savings for the filing

For prescriptive measures, the next step is to confirm the inputs and assumptions used in the savings estimates versus those required by the technical resource manual (TRM) or agreed-on prescriptive savings documentation applicable to the 2015 program year. This step is best completed on a measure level dataset, where each row in the tracking data conforms to a single measure defined in the TRM. The information required for this task depends on the measures covered by the TRM and implemented by the programs. For the verification, the EC needs a tracking database which includes all the site-specific inputs required to estimate savings using the TRM. An example of the type of information required in the database for this process is shown in Table A-4. This list is not comprehensive; please provide all necessary fields for calculating the prescriptive measure savings.

Table A-4: Example of the type of information required to verify prescriptive savings

Example Database Field	Verification Purpose
Measure description	Connects the tracking measure to the TRM measure to determine the per-unit savings.
Quantity	Identifies the number of units installed to produce the total measure savings.
New / existing installation	Connects the tracking measure to the appropriate savings value in the TRM.
Details of efficient equipment	Connects the tracking measure to the appropriate savings value in the TRM.
Base equipment	Connects the tracking measure to the appropriate savings value in the TRM.

Please provide tracking data for the programs identified in Table A-5 which includes the fields listed in Table A-3 and Table A-4, in addition to any similar or relevant fields that will aid in the verification. The deadline for this request is January 20, 2017.

Please contact Shane Sankey with any questions or concerns related to this contact information request at (608) 259-9152 ext 70216 or shane.sankey@dnvgl.com.

Thank you in advance for your assistance.

Advance notice for future requests

After receiving and reviewing the data and documentation requested in this memo, the EC will follow up with a second round of documentation request for a sample of program participants in some programs. Table A-5 shows the programs that will be included in the documentation request and a brief description of the quantity and type of documentation that will be requested. The final details will be established after the EC reviews the tracking data requested in this memo.

The EC will send the second documentation request on Jan 31, 2017 with a due date of Feb 14, 2017.

Table A-5: Documentation requested in the second round of data requests

Program	Description of Documentation
Union	
Home Reno Rebate	Full documentation for a number (estimate 25 or less) of participants, including HOT2000 model outputs.
Low Income Weatherization	Full documentation for a number (estimate 25 or less) of participants, including HOT2000 model outputs.
Optimal Home	Full documentation for at least one completed house to confirm it meets program requirements. Full documentation for at least one participating builder.
Enbridge	
Home Energy Conservation	Full documentation for a number (estimate 25 or less) of participants, including HOT2000 model outputs.
Low Income Weatherization	Full documentation for a number (estimate 25 or less) of participants, including HOT2000 model outputs.
Residential Savings by Design	Full documentation for at least one completed house to confirm it meets program requirements. Full documentation for at least one participating builder.
Commercial Savings by Design	Full documentation for at least one completed development to confirm it meets program requirements. Full documentation for at least one participating builder.
Home Labelling	Full documentation of at least one realtor commitment and subsequent ratings performed.

Second documentation request

(email sent January 31, 2017)

Enbridge & Union teams,

We have prepared our second data request pertaining to the 2015 Annual Verification. In this request, we are asking for complete documentation for a sample of participants for some of the programs you deliver. For any data pertaining to residential customers or accounts, please anonymize the information prior to sending it to us. The deadline for this request is February 14, 2017.

Here (Table A-6) is a breakdown of the documentation requested in the second round of these data requests. Tomorrow, we will send a secure file listing the specific participants that have been sampled. Here is an overview of what we will request.

Table A-6: Documentation requested in the second round of data requests

Program	Description of Documentation
Union	
Home Reno Rebate	Full documentation for 25 participants, including HOT2000 model outputs.
Low Income Weatherization	Full documentation for 25 participants, including HOT2000 model outputs.
Optimal Home	Full documentation for one completed house to confirm it meets program requirements. Full documentation for one participating builder.
Enbridge	
Home Energy Conservation	Full documentation for 25 participants, including HOT2000 model outputs.
Low Income Weatherization	Full documentation for 25 participants, including HOT2000 model outputs.
Residential Savings by Design	Full documentation for one completed house to confirm it meets program requirements. Full documentation for one participating builder.
Commercial Savings by Design	Full documentation for one completed development to confirm it meets program requirements. Full documentation for one participating builder.
Home Labelling	Full documentation of one realtor commitment and subsequent ratings performed.

APPENDIX B. DESCRIPTION OF DATA RECEIVED

This appendix describes the initial data received from the utilities in response to the data requests shown in APPENDIX A. The appendix also describes the EC process for verifying that the correct data was received. As discussed in APPENDIX A, there was repeated back-and-forth between the EC and the utilities after the initial data submissions. Those will be discussed in the individual program verification sections.

Union: first submission

Union's first data submission included the following:

- An Excel file with:
  - The tracking data for 2015, including custom and prescriptive programs
  - A breakout of the Energy Savings Kit measures by rate class
  - A summary spreadsheet with savings by scorecard, program, and rate class
  - The utility-calculated scorecard results and shareholder incentive based on the utility-reported results
  - The utility-reported budget spending by program and activity (incentives/promotion, administration, evaluation, and promotion costs)
  - A number of tables that format the previous information and add cost-effectiveness results based on utility-reported results
  - A calculation of the C&I deep savings metric
  - A summary of the Optimum Homes built and verified in 2015, by vendor, and the total new gas attachments in 2015
  - 2015 avoided costs
- An Excel file with:
  - The tracking data for 2015, including custom and prescriptive programs
  - A calculation of the Lost Revenue Adjustment Mechanism based on utility-reported results
  - 2015 avoided costs
- An Excel file with the detailed (non-summarized) data for Optimum Home
- Reports from previously-conducted Energy Savings Kit verification studies
- Prescriptive savings tables applicable to 2015
- A document summarizing the Union tracking database procedures
- A report from a previously-conducted custom projects attribution study

Despite some difficulties, the Union data satisfied the initial data request. Some notes on the tracking data:

- The Union tracking data (the first Excel file listed above) is contained in a single table within the Excel workbook. There was one row per record with no interim rows containing summary information. It was very easy for the EC team to import the data into our own analysis tool for manipulation and verification.
- The Union workbook relies heavily on Excel data management formulas to summarize information by program and measure. The formulas are often directed to named data ranges that are difficult to identify and track. This made it harder for the EC team to confirm that the calculation was operating correctly.

- It is unclear whether each record (row) in the data represents the same level of participation. For example, prescriptive projects are listed at the measure level, with one row for air curtain, one row for faucet aerator, etc. However, the custom projects are delineated by equipment vs. infrared poly vs. O&M and whether the measure affects baseload or is weather sensitive. It's unclear whether the custom measures are also tracked at the measure level.
- The data also does not contain a unique identifier, which made it difficult to communicate follow-up data requests with Union.

To verify that we received the correct data, the EC compared the summarized energy savings values with those reported by Union in their annual report. We initially struggled to map the program names to the program offerings and the resulting scorecard; Union provided this mapping in a follow-up email. Ultimately, there were discrepancies in four projects, which had already been identified by Union when they submitted their data. With those adjustments, the EC verified that we had received a complete submission.

Enbridge: first submission

Enbridge's first data submission included the following:

- An Excel file with:
  - The tracking data for 2015, including custom and prescriptive programs, contained in multiple sheets within the workbook
  - A sheet with the prescriptive and quasi-prescriptive measures, with each measure listed individually and summed to the overall measure category.
  - A sheet with the RunitRight savings estimates
  - A sheet summarizing showerhead installations in multi-family residences
  - A sheet summarizing the Home Energy Conservation measures by residence and energy savings
  - A sheet summarizing the Winterproofing energy savings by residence
  - A sheet summarizing the TAPS installations by residence
  - A sheet that incorporates all the previous summaries with the custom project savings for overall savings for the portfolio.
  - 2015 avoided costs and multiple sheets supporting the avoided costs
  - A master reporting sheet that shows, by program and scorecard, the utility-calculated energy savings, number of participants, program-level costs, and cost-effectiveness results based on utility-reported results.
  - The utility-calculated scorecard results and shareholder incentive based on the utility-reported results
- An Excel file with the custom C&I projects from 2013, 2014, and 2015 with two highlighted projects that were removed from the program between delivery of the annual report and the evaluation documentation request.

Despite some difficulties, the Enbridge data largely satisfied the initial data request. Some notes on the tracking data:

- The Enbridge tracking data (the first Excel file listed above) is contained in multiple sheets within the workbook. Most sheets have multiple levels of data in them, including those listed in the bullets below. The interim summary rows made it impossible to import the data directly into our own analysis tool for manipulation and verification, which made the verification process much more difficult to complete.

  - Site-level savings for custom projects, summarized to the building type (such as accommodation or retail), the segment (such as large commercial or multi-family) and program (such as commercial or industrial within the same sheet.
  - Measure-level savings for prescriptive and quasi-prescriptive projects, summarized to the measure type.
- The Enbridge tracking data was very "manual" in its summary approach. Formulas are clearly directed to individual cells, making it very easy to follow the calculation throughout the workbook.
- The data was not always presented at the site level. For example, the air curtain measures were simply presented in terms of the number of addresses that received the measure, not the site-level information (such as company name and address) of the facility that received the measures.

To verify that we received the correct data, the EC compared the summarized energy savings values with those reported by Enbridge in their annual report. With the two removals reported by Enbridge, the EC verified that we had received a complete submission.

Union: second submission

Union's second data submission included the following:

- Forty-nine HOT2000 files with personally-identifiable information redacted
- Pre-post installation photos and invoices for the Home Reno Rebate program
- Documentation for Optimum Home Builder T
- Documentation for Optimum Home customer H310

The data satisfied the documentation request.

Enbridge: second submission

Enbridge's second data submission included the following:

- Forty-eight folders with HOT2000 files, pre-post installation photos, and invoices for Home Energy Conservation
- Twenty-five folders with HOT2000 files, pre-post installation photos, and invoices for Winterproofing
- A spreadsheet listing the participating Home Labelling realtors
- A spreadsheet describing the Part 3 buildings metric calculation for the scorecard
- A workbook listing the participating Commercial Savings by Design builders
- A workbook listing the participating Residential Savings by Design builders
- A workbook listing the SBD-compliant homes built by the participating Residential Savings by Design builders

The data satisfied the documentation request.

Recommendations

The EC has the following recommendations resulting from these verification activities:

- **Consider investing in relational program tracking databases.** Relational program tracking databases and customer relationship management (CRM) systems allow for multiple measures to be associated with a single customer. Within this kind of format, each participant should receive a unique customer ID that allows multiple projects or measures to be connected to the single customer or account, with unique IDs attached to each measure.
- **Deliver the tracking data in a single flat worksheet.** While the utility workbooks were helpful to show the EC how the utilities calculate shareholder incentives, lost revenue, and cost-effectiveness, we would prefer to receive the data in a single flat worksheet with no additional summary information. If possible, the data should be delivered using the guidelines in the following bullets. In the event that relational databases are adopted, the entire database can be delivered to the EC and we will assemble it into a single flat file. Guidelines for data delivery:
  - One row per installed measure
  - All measures connected to a unique customer or account identification number
  - No intermediary summary information, such as the sum of savings by measure or building type
  - Related information, such as program name and measures description, that allows the EC to apply the verification results appropriately to calculate shareholder incentive, lost revenue, and cost-effectiveness
- **Enbridge: Ensure that all site-level information is included in the tracking data.**

APPENDIX C. PRESCRIPTIVE SAVINGS VERIFICATION

This appendix describes the detailed process used to certify the reported (tracked) prescriptive and quasi-prescriptive savings for Union and Enbridge. It also describes the process used to verify the Union scorecard metric related to deep savings through the C&I prescriptive and custom programs.

Union: certify prescriptive and quasi-prescriptive savings

The EC reviewed tracked natural gas savings for prescriptive and quasi-prescriptive measures for several Union energy efficiency programs. Tracked gas savings were compared to the OEB's Approved Savings Values Tables ("Savings Tables").[17] Review of the prescriptive and quasi-prescriptive measures resulted in no changes between the original tracked and certified savings, for a savings ratio of 100% of tracked savings, as shown in Table C-1.

Table C-1: Union total claimed and certified gas savings with savings ratio

Measure Group	Original Claimed Savings (m^3)	Certified Savings (m^3)	Savings Ratio
Prescriptive	2,751,561	2,751,561	100%
Quasi-prescriptive	8,935,625	8,935,625	100%
Total	**11,687,186**	**11,687,186**	**100%**

The tracked savings for most measures were easily identified and matched to the correct measure description and prescriptive savings in the Savings Tables. For those that weren't, Table C-2 shows certified annual savings, issues, and their resolutions. There were two primary issues:

- Measure names in the tracking data were not easily matched with those in the Savings Tables.
- The appropriate savings values for measures such as pipe insulation, showerheads, and make-up air units were included in sub-documents to clarify and provide specific values in the Savings Tables. The EC referenced sub-documents 'Basic-Showerhead-1.25 gpm average existing stock (contractor installed)', 'Residential and Low-income pipe wrap subdoc - 2015 SHI', and 'MUA Substantiation Document - 2015 SHI CORRECT'.

Ultimately, all questions were adequately addressed, with Union's claimed gas savings matching verified calculations.

Table C-3 and Table C-4 show the Union tracking and certified annual and lifetime net savings, by measure, for pure prescriptive and quasi-prescriptive measures.

[17] OEB Approved Savings Values Tables represent the input assumptions (natural gas savings values and measure life information for individual technologies and pieces of equipment) that have been approved by the OEB in the past and are applicable to the calculation of overall performance for the 2015 program year.

Table C-2: Union savings certification issues and resolutions, by measure and type

Measure	Measure Type	Issue	Resolution	Tracked Annual Savings (m^3)	Certified Annual Savings (m^3)
Basic-Pipe Insulation - 2m (Low Income, SF)	Prescriptive	Savings values claimed did not match available savings for identifiable like measures in Savings Table.	Union provided approved sub-documents. Upon review, claimed savings values were verified.	1,073	1,073
Basic-Showerhead-1.25 gpm existing 2.0-2.5 (Low Income, SF)	Prescriptive			137	137
Basic-Showerhead-1.25 gpm existing 2.6+ (Low Income, SF)	Prescriptive			1,045	1,045
ERV 6- => 2000 cfm Off, Whse, Ed & All Other Comm	Quasi-Prescriptive	Union data marked single record as having zero savings.	Union verified that zero savings in records was intentional, not a data error.	295,774	295,774
HRV 4- =>2,000cfm-Off,Whse,Man,Ed,Other Comm	Quasi-Prescriptive	Union data marked single record as having zero savings.	Union verified that zero savings in records was intentional, not a data error.	126,512	126,512
Condensing Boiler WH - => 1,000 MBtu/hr	Quasi-Prescriptive	Original Union descriptions not sufficient to properly identify specific boiler type and assign savings. Re-assigned to Savings Tables Categories below.		36,108	
Condensing Boiler WH - => 1,000 MBtu/hr LIMF	Quasi-Prescriptive			11,540	
Condensing Boiler WH - 300 to 999 MBtu/hr	Quasi-Prescriptive			163,685	
Condensing Boiler WH - 300 to 999 MBtu/hr LIMF	Quasi-Prescriptive			34,791	
Condensing Boiler WH - up to 299 MBtu/hr	Quasi-Prescriptive			62,560	
Condensing Boiler WH - up to 299 MBtu/hr LIMF	Quasi-Prescriptive			1,961	
Condensing Boiler - DHW (100 to 199 Mbtu/h)	Quasi-Prescriptive		Union response and explanation allowed proper identification of all boiler types, and thus assign savings values.		19,955
Condensing Boiler - DHW (1000+ Mbtu/h)	Quasi-Prescriptive				36,108
Condensing Boiler - DHW (200 to 299 Mbtu/h)	Quasi-Prescriptive				44,565
Condensing Boiler - DHW (300+ Mbtu/h)	Quasi-Prescriptive				134,490
Condensing Boiler - DHW (600+ Mbtu/h)	Quasi-Prescriptive				75,527

Measure	Measure Type	Issue	Resolution	Tracked Annual Savings (m^3)	Certified Annual Savings (m^3)
MUA 01- MURB&LTC Imp Effic 1000-4999cfm	Quasi-Prescriptive	Savings values claimed did not match available savings for identifiable like measures in Savings Table.	Union provided sub-document with clarifying and detailed savings values for MUA units.	6,384	6,384
MUA 01- MURB&LTC Imp Effic 1000-4999cfm LIMF	Quasi-Prescriptive			1,596	1,596
MUA 02- MURB&LTC Imp Effic =>5000 cfm	Quasi-Prescriptive			9,768	9,768
MUA 02- MURB&LTC Imp Effic =>5000 cfm LIMF	Quasi-Prescriptive			9,576	9,576
MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm	Quasi-Prescriptive			16,783	16,783
MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm LIMF	Quasi-Prescriptive			52,448	52,448
MUA 06- MURB&LTC Effic + VFD => 5000 cfm LIMF	Quasi-Prescriptive			157,871	157,871
MUA 07- Other Comm Imp Effic 1000-4999 cfm	Quasi-Prescriptive			6,485	6,485
MUA 08- Other Comm Imp Effic => 5000 cfm	Quasi-Prescriptive			35,473	35,473
MUA 09- Other Comm Effic + 2 speed 1000-4999cfm	Quasi-Prescriptive			3,200	3,200
MUA 11- Other Comm Effic + VFD 1000-4999 cfm	Quasi-Prescriptive			8,849	8,849
MUA 12- Other Comm Effic + VFD =>5000 cfm	Quasi-Prescriptive			21,632	21,632

Table C-3: Union tracking and certified savings, annual and lifetime, pure-prescriptive measures

Measure	Draft Utility-Reported Net Savings*		Realization Rate	Certified Net Savings	
	Annual (m^3)	Cumulative (m^3)		Annual (m^3)	Cumulative (m^3)
Air Curtains-Pedestrian >=48 sq ft & < 96 sq ft	28,514	427,714	100%	28,514	427,714
Air Curtains-Pedestrian >=96 sq ft	18,883	283,247	100%	18,883	283,247
Air Curtains-Shipping >=100 sq ft	352,346	5,285,183	100%	352,346	5,285,183
Air Curtains-Shipping >=64 sq ft & < 80 sq ft	7,187	107,801	100%	7,187	107,801
Condensing Gas Water Heater 1- 100gal/day	6,939	90,204	100%	6,939	90,204
Condensing Gas Water Heater 2- 500gal/day	37,321	485,170	100%	37,321	485,170
Condensing Gas Water Heater 3- 1000gal/day	184,181	2,394,356	100%	184,181	2,394,356
DCKV < 5000 cfm - NC	4,561	68,414	100%	4,561	68,414
DCKV < 5000 cfm - RF	45,610	684,143	100%	45,610	684,143
DCKV 10000-15000 cfm - NC	17,978	269,667	100%	17,978	269,667
DCKV 5000 - 9999 cfm - NC	21,823	327,351	100%	21,823	327,351
DCKV 5000 - 9999 cfm - RF	130,940	1,964,106	100%	130,940	1,964,106
Dishwasher - Rack Conveyor Multi HT	3,101	62,021	100%	3,101	62,021
Dishwasher - Rack Conveyor Single HT	1,226	24,528	100%	1,226	24,528
Dishwasher - Stationary Rack Door Type HT	24,341	365,112	100%	24,341	365,112
Dishwasher - Stationary Rack Door Type LT	125,504	1,882,560	100%	125,504	1,882,560
Dishwasher - Stationary Rack Single Rack HT	738	11,064	100%	738	11,064
Dishwasher - Undercounter HT	852	8,520	100%	852	8,520
Energy Star Fryer	79,974	959,693	100%	79,974	959,693
Condensing Gas Water Heater 3- 1000gal/day LIMF	11,788	153,239	100%	11,788	153,239
Basic-Faucet Aerator-Bath	279	2,788	100%	279	2,788
Basic-Faucet Aerator-Kitchen	549	5,493	100%	549	5,493
Basic-Pipe Insulation - 2m	1,073	16,091	100%	1,073	16,091
Basic-Showerhead-1.25 gpm existing 2.0-2.5	137	1,366	100%	137	1,366
Basic-Showerhead-1.25 gpm existing 2.6+	1,045	10,454	100%	1,045	10,454
Basic-Thermostat-Programmable	210	3,148	100%	210	3,148
Astat - WIFI $25	3,927	58,910	100%	3,927	58,910
ESK Pull- Customer Initiated Others (Coupon/Req)	13,017	153,945	100%	13,017	153,945
ESK Pull- Customer Initiated Web Request	539,382	6,379,094	100%	539,382	6,379,094
ESK Push- Door to Door	1,054,602	12,472,428	100%	1,054,602	12,472,428
Pstat- D2C $25	26,464	396,959	100%	26,464	396,959
Smart thermostats $25	7,069	106,037	100%	7,069	106,037

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation.

Table C-4: Union tracking and certified savings, annual and lifetime, quasi-prescriptive measures

Measure	Draft Utility-Reported Net Savings*		Realization Rate	Certified Net Savings	
	Annual (m^3)	Cumulative (m^3)		Annual (m^3)	Cumulative (m^3)
Condensing Boiler - DHW (100 to 199 Mbtu/h)	19,955	498,884	100%	19,955	498,884
Condensing Boiler - DHW (1000+ Mbtu/h)	36,108	902,711	100%	36,108	902,711
Condensing Boiler - DHW (200 to 299 Mbtu/h)	44,566	1,114,151	100%	44,566	1,114,151
Condensing Boiler - DHW (300+ Mbtu/h)	134,490	3,362,248	100%	134,490	3,362,248
Condensing Boiler - DHW (600+ Mbtu/h)	75,527	1,888,174	100%	75,527	1,888,174
Condensing Boiler SH - => 1,000 MBtu/hr	2,027,129	50,678,225	100%	2,027,129	50,678,225
Condensing Boiler SH - => 1,000 MBtu/hr LIMF	61,256	1,531,400	100%	61,256	1,531,400
Condensing Boiler SH - 300 to 999 MBtu/hr	1,252,507	31,312,684	100%	1,252,507	31,312,684
Condensing Boiler SH - 300 to 999 MBtu/hr LIMF	135,425	3,385,629	100%	135,425	3,385,629
Condensing Boiler SH - up to 299 MBtu/hr	270,050	6,751,244	100%	270,050	6,751,244
Condensing Boiler SH - up to 299 MBtu/hr LIMF	15,073	376,813	100%	15,073	376,813
DCV-Office-RTU/MUA => 2500 sq ft-w/o plan	2,721	27,214	100%	2,721	27,214
DCV-Office-RTU/MUA up to 2499 sq ft-w/o plan	2,302	23,024	100%	2,302	23,024
DCV-Retail-RTU/MUA => 5000 sq ft-w/o plan	289,033	2,890,334	100%	289,033	2,890,334
DCV-Retail-RTU/MUA up to 4999 sq ft-w/o plan	15,151	151,510	100%	15,151	151,510
Destratification Fan	856,732	12,850,974	100%	856,732	12,850,974
ERV 1- up to 1999 cfm MURB, Healthcare, Nursing	154,143	2,157,995	100%	154,143	2,157,995
ERV 2- => 2000 cfm MURB, Healthcare, Nursing	442,355	6,192,964	100%	442,355	6,192,964
ERV 3- up to 1999 cfm Hotel, Restaurant, Retail	64,909	908,732	100%	64,909	908,732
ERV 4- => 2000 cfm Hotel, Restaurant, Retail	57,110	799,543	100%	57,110	799,543
ERV 5- up to 1999 cfm Off,Whse,Ed & All Other Comm	167,053	2,338,746	100%	167,053	2,338,746
ERV 6- => 2000 cfm Off,Whse,Ed & All Other Comm	295,774	4,140,840	100%	295,774	4,140,840
HRV 1- 500 to 1999cfm-Hotel,Restaurant,Retail,Rec	14,823	207,523	100%	14,823	207,523
HRV 2- =>2,000cfm-Hotel,Restaurant,Retail,Rec	22,474	314,630	100%	22,474	314,630
HRV 3- 500 to 1999cfm-Off,Whse,Man,Ed,Other Comm	20,781	290,931	100%	20,781	290,931
HRV 4- =>2,000cfm-Off,Whse,Man,Ed,Other Comm	126,512	1,771,173	100%	126,512	1,771,173
HRV 5- MURB, Healthcare, Nursing	101,891	1,426,467	100%	101,891	1,426,467
Infrared Heating 1-Stage - NC <50k	33,807	676,132	100%	33,807	676,132
Infrared Heating 1-Stage - NC 165k+	216,115	4,322,304	100%	216,115	4,322,304
Infrared Heating 1-Stage - NC 50k-165k	296,266	5,925,319	100%	296,266	5,925,319
Infrared Heating 1-Stage - RF <50k	9,937	198,749	100%	9,937	198,749

Measure	Draft Utility-Reported Net Savings*		Realization Rate	Certified Net Savings	
	Annual (m^3)	Cumulative (m^3)		Annual (m^3)	Cumulative (m^3)
Infrared Heating 1-Stage - RF 165k+	246,555	4,931,093	100%	246,555	4,931,093
Infrared Heating 1-Stage - RF 50k-165k	393,291	7,865,821	100%	393,291	7,865,821
Infrared Heating 2-Stage - NC <50k	1,297	25,942	100%	1,297	25,942
Infrared Heating 2-Stage - NC 165k+	71,342	1,426,832	100%	71,342	1,426,832
Infrared Heating 2-Stage - NC 50k-165k	196,433	3,928,652	100%	196,433	3,928,652
Infrared Heating 2-Stage - RF <50k	2,594	51,885	100%	2,594	51,885
Infrared Heating 2-Stage - RF 165k+	77,827	1,556,544	100%	77,827	1,556,544
Infrared Heating 2-Stage - RF 50k-165k	206,339	4,126,787	100%	206,339	4,126,787
MUA 01- MURB&LTC Imp Effic 1000-4999cfm	6,384	95,760	100%	6,384	95,760
MUA 01- MURB&LTC Imp Effic 1000-4999cfm LIMF	1,596	23,940	100%	1,596	23,940
MUA 02- MURB&LTC Imp Effic =>5000 cfm	9,768	146,513	100%	9,768	146,513
MUA 02- MURB&LTC Imp Effic =>5000 cfm LIMF	9,576	143,640	100%	9,576	143,640
MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm	16,783	251,741	100%	16,783	251,741
MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm LIMF	52,448	786,720	100%	52,448	786,720
MUA 06- MURB&LTC Effic + VFD => 5000 cfm LIMF	157,871	2,368,067	100%	157,871	2,368,067
MUA 07- Other Comm Imp Effic 1000-4999 cfm	6,485	97,278	100%	6,485	97,278
MUA 08- Other Comm Imp Effic => 5000 cfm	35,473	532,088	100%	35,473	532,088
MUA 09- Other Comm Effic + 2 speed 1000-4999cfm	3,200	48,005	100%	3,200	48,005
MUA 11- Other Comm Effic + VFD 1000-4999 cfm	8,849	132,739	100%	8,849	132,739
MUA 12- Other Comm Effic + VFD =>5000 cfm	21,632	324,473	100%	21,632	324,473
Ozone WE =< 60 lbs cap & => 200,000 lbs/yr	88,691	1,330,369	100%	88,691	1,330,369
Ozone WE >60 lbs & =< 120lbs & => 200,000 lbs/yr	59,216	888,242	100%	59,216	888,242

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation.

Union: verify percent of deep savings for C&I

To verify the Union scorecard metric related to the percent of whole-building C&I savings, the EC:

- **Identified the deep savings metric explanation in the Union 2015 plan.** The metric is defined as the ratio between the weather-normalized 2015 program savings to the weather-normalized 2014 consumption for all C&I participants.
- **Confirmed the calculation in the Union tracking workbook.** The workbook has a sheet specific to the deep savings metric which has hard-coded energy savings values by "Contract or Banner Customer Number". The sheet also has hard-coded 2014 annual consumption for each customer. The 2014 annual consumption for industrial customers is not normalized; presumably under the assumption that the

industrial load is process-driven, not weather-driven. For commercial customers, the 2014 consumption is multiplied by the equation below, where HDD is heating degree days. There are two separate adjustments; one for facilities in the South and one for the North, each with its own value of HDD.

$$normalized\ consumption = \frac{(normal\ HDD - 2014\ HDD)}{normal\ HDD} * C\&I\ baseload\ elasticity\ factor$$

- **Verified the site-level pre-adjusted savings values.** The EC confirmed the site-level savings estimates for each C&I site by summing the savings from the tracking data by Contrax or Banner number and comparing to the deep savings spreadsheet.
- **Adjusted the savings based on the custom project savings verification (CPSV) and prescriptive certification results.** The EC applied the appropriate realization rates from the CPSV and prescriptive certification efforts. For the prescriptive certification, shown in Table C-1, the savings ratio was 100%. For the CPSV study, the overall gross savings realization rate was 98%, shown in Table C-5.

Table C-5: Union custom C&I realization rate

Domain	n	Ratio	90% Confidence Interval				Error Ratio	% Program Savings
			+/-	Lower Bound	Upper Bound	Relative Precision		
Agriculture & Greenhouse-Banner	4	100%	14%	87%	114%	14%	0.12	3%
Agriculture & Greenhouse-Contrax	27	97%	3%	94%	100%	3%	0.06	38%
Commercial & Institutional Buildings-Banner	12	87%	15%	72%	102%	17%	0.29	3%
Commercial & Institutional Buildings-Contrax	17	87%	27%	60%	114%	31%	0.54	15%
Industrial-Banner	12	98%	15%	83%	113%	16%	0.23	3%
Industrial-Contrax	37	102%	7%	95%	110%	7%	0.21	37%
Low Income Multi-Family Custom	5	100%	0%	100%	100%	0%	0.00	0%
Overall	**114**	**98%**	**4%**	**94%**	**101%**	**4%**	**0.20**	**100%**

Monthly billing data was not provided, so the EC could not confirm the annual 2014 consumption. With the adjustment factors applied, the resulting verified scorecard metric is 8.08% of whole building energy use saved.

Enbridge: certify prescriptive and quasi-prescriptive savings

The EC reviewed tracked natural gas savings for prescriptive and quasi-prescriptive measures for several Enbridge energy efficiency programs. Tracked gas savings were compared to the OEB's Savings Tables. Review of the prescriptive and quasi-prescriptive measures resulted in a savings ratio of 98.9% of tracked savings, as shown in Table C-6.

Table C-6: Enbridge total claimed and certified gas savings with savings ratio

Measure Group	Original Claimed Net Annual Savings (m^3)	Certified Net Annual Savings (m^3)	Savings Ratio
Prescriptive	2,672,814	2,615,853	97.9%
Quasi-prescriptive	3,824,270	3,812,871	99.7%
Total	**6,497,084**	**6,428,724**	**98.9%**

The EC found few issues with the savings for prescriptive measures. The savings for bathroom aerators for the Low Income program were significantly underreported because they were initially calculated using the suites or households in which they were installed instead of the quantity of aerators installed. The verified savings include the appropriate correction.

Some of the quasi-prescriptive savings were over-reported. Table C-7 shows certified annual savings, issues, and their resolutions. There were two primary issues:

- Multiple measures (based on equipment capacity or building type) were included in a single reporting category.
- Individual reports had calculation issues.

Table C-8 and Table C-9 show the Enbridge tracking and certified annual and lifetime net savings, by measure, for pure prescriptive and quasi-prescriptive measures.

Some Enbridge measures include “removal rates” that account for direct-install equipment that is later removed by the user. These measures include market-rate and low income multifamily showerheads and single family low income bathroom aerators, kitchen aerators, and showerheads. Enbridge included the effect of the removal rates in their net savings, not gross, which results in a net savings number that does not exclusively account for free ridership and spillover. To avoid confusion, the EC team moved the adjustment from the net savings to gross savings when reporting verified results.[18]

[18] The transfer was made by dividing the net savings by (1-removal rate) and multiplying the gross savings by (1-removal rate).

Table C-7: Enbridge savings certification issues and resolutions, by measure and type

Measure	Measure Type	Issue	Resolution	Tracked Annual Net Savings (m^3)	Certified Annual Net Savings (m^3)
LI Prescriptive - Bathroom Aerators	Prescriptive	Specific aerator type, identifying gpm, not identifiable.	Specific aerator type provided in March telephone conference call.	638	773
		Total savings calculated off households, not measures.	April response document confirmed that savings to be calculated from number of measures.		
		Unidentified Reduction Factor included in data.	Enbridge claimed reduction factor is accepted.		
LI Prescriptive - Kitchen Aerators	Prescriptive	Specific aerator type, identifying gpm, not identifiable.	Specific aerator type provided in March telephone conference call.	1,500	1,500
		Unidentified Reduction Factor included in data.	Enbridge claimed reduction factor is accepted.		
LI Prescriptive - Showerheads 2.6+	Prescriptive	Specific type, identifying gpm, not identifiable.	Specific aerator type provided in March telephone conference call.	6,020	6,020
		Total savings calculated off households, not measures.	Enbridge confirmed intentional that savings based on suite, not measures.		
		Unidentified Reduction Factor included in data.	Enbridge claimed reduction factor is accepted.		
LI Prescriptive – Novitherm Reflective Panels	Prescriptive	Enbridge data calculated lifetime savings using 18 year measure life	TRM value for measure life of 25 years used, an increase from 18 year citation.	**CCM:** 10,296	**CCM:** 14,320
RA.DCKV.1	Prescriptive	Some calculations used outdated TRC/CCM calculator.	Corrected savings calculated for units using outdated calculator.	54,731	43,963
RA.DCKV.2	Prescriptive			283,704	259,770
RA.DCKV.3	Prescriptive			107,867	99,915
RA.DISH.ST.RACK.HT	Prescriptive	In the course of supplying site-specific information, Enbridge discovered that the original count of units was incorrect.	Corrected savings calculated using the correct number of units.	24,341	25,078
RA.DISH.ST.RACK.LT	Prescriptive			376,512	361,148
RA.DISH.HT	Prescriptive			1,278	1,363
LW.MR.HEBO (Space Htg)	Quasi-Prescriptive	Enbridge identified calculation and data entry error.	Enbridge provided corrected values for inclusion in certified values.	130,116	137,254

Measure	Measure Type	Issue	Resolution	Tracked Annual Net Savings (m^3)	Certified Annual Net Savings (m^3)
RA.CB 2 (Space Htg)	Quasi-Prescriptive	Savings for 1 of 5 measures not matching.	Equipment capacity reported incorrectly for calculations. Enbridge provided corrected values.	13,485	13,485
RA.CB 3 (Space Htg)	Quasi-Prescriptive	One unit incorrectly reported as condensing boiler for space heat was for DHW.	Unit redefined as Condensing Boiler for DHW. Total savings unchanged.	40,746	38,664
RA.CB 3 (Water Htg)	Quasi-Prescriptive			-	2,082
RA.COND.MUA	Quasi-Prescriptive	In the course of evaluating savings, EC requested additional equipment information to calculate and confirm savings. In resulting additional data submission, Enbridge included revised savings value for RA.COND.MUA savings.	The revised submission agreed with EC calculations, but was different from original value.	11,875	11,590
RA.DCV - 15 Year ML	Quasi-Prescriptive	Mixed category with both Commercial and Retail measures, which have different savings calculations	Redefined into separate categories. One measure was utilizing wrong savings calculation, claiming Retail savings but classified as Commercial, resulting in savings reductions.	964,074	953,587
RA.HEBO (Space Htg)	Quasi-Prescriptive	Multiple Savings types/classes included in single category.	Reclassified into correct sub-categories by capacity.	486,228	479,409
		Savings calculation issues with misc. reports	Corrected savings calculated		
RA.HEBO.MR (Space Htg)	Quasi-Prescriptive	Multiple Savings types/classes included in single category.	Reclassified into correct sub-categories by capacity.	288,426	296,885
		Savings calculation issues with misc. reports	Corrected savings calculated		
RA.HEBO.MR (Water Htg)	Quasi-Prescriptive	Multiple Savings types/classes included in single category.	Reclassified into correct sub-categories by capacity.	45,462	29,580
		Savings calculation issues with misc. reports	Corrected savings calculated		

Measure	Measure Type	Issue	Resolution	Tracked Annual Net Savings (m^3)	Certified Annual Net Savings (m^3)
RA.OZ, RA.OZ.2, RA.OZ.3, RA.OZ.5	Quasi-Prescriptive	Multiple Savings types/classes included in single category, ultimately causing underreporting	Reclassified into correct sub-categories by capacity.	607,874	614,455

Table C-8: Enbridge tracking and certified savings, annual and lifetime, pure-prescriptive measures

Measure	Draft Utility-Reported Net Savings*		Annual Realization Rate†	Certified Net Savings	
	Annual (m^3)	Cumulative (m^3)		Annual (m^3)	Cumulative (m^3)
LI Prescriptive - Bathroom Aerators	638	6,379	121%	773	7,733
LI Prescriptive - Kitchen Aerators	1,500	14,999	100%	1,500	14,999
LI Prescriptive - Novitherm Reflective Panels	572	10,296	100%	573	14,320
LI Prescriptive - Programmable Thermostats	2,862	42,930	100%	2,862	42,930
LI Prescriptive - Showerheads 2.6+	6,020	60,197	100%	6,020	60,197
Multi Family Low Income Showerheads	198,543	1,985,432	100%	198,543	1,985,432
RA.AIR	5,703	85,543	100%	5,703	85,543
RA.AIR.2	15,978	239,671	100%	15,978	239,671
RA.AIR.4	17,968	269,525	100%	17,968	269,525
RA.AIR.4.IND	17,968	269,525	100%	17,968	269,525
RA.AIR.5	78,299	1,174,485	100%	78,299	1,174,485
RA.AIR.5.IND	58,724	880,864	100%	58,724	880,864
RA.DCKV.1	54,731	820,971	80%	43,963	659,447
RA.DCKV.2	283,704	4,255,563	92%	259,770	3,896,549
RA.DCKV.3	107,867	1,618,002	93%	99,915	1,498,730
RA.DISH.HT	1,278	12,780	107%	1,363	13,632
RA.DISH.LT	3,397	33,966	100%	3,397	33,966
RA.DISH.RACKCON.MULTI.LT	1,802	36,047	100%	1,802	36,047
RA.DISH.RACKCON.SINGL	818	16,352	100%	818	16,352
RA.DISH.RACKCON.SINGL LT	51,240	1,024,803	100%	51,240	1,024,803
RA.DISH.ST.RACK.HT	24,341	365,112	103%	25,078	376,176
RA.DISH.ST.RACK.LT	376,512	5,647,680	96%	361,248	5,418,720
RA.FS.FRYER	105,882	1,270,579	100%	105,882	1,270,579
RA.FS.OVEN	6,228	74,736	100%	6,228	74,736
RA.FS.STCOOK	7,111	85,334	100%	7,111	85,334
RA.SCH.P (Elementary School)	193,517	4,837,932	100%	193,517	4,837,932
RA.SCH.P (Secondary School)	261,233	6,530,832	100%	261,233	6,530,832
RA.SHA	788,377	7,883,769	100%	788,377	7,883,769

†These values are rounded.

Table C-9: Enbridge tracking and certified savings, annual and lifetime, quasi-prescriptive measures

Measure	Draft Utility-Reported Net Savings*		Annual Realization Rate†	Certified Net Savings	
	Annual (m^3)	Cumulative (m^3)		Annual (m^3)	Cumulative (m^3)
LW.MR.HEBO (Space Htg)	130,116	3,252,900	105%	137,254	3,431,359
LW.MR.HEBO (Water Htg)	7,475	186,875	100%	7,475	186,882
RA.CB 1 (Space Htg)	1,046	26,149	100%	1,045	26,137
RA.CB 2 (Space Htg)	13,485	337,131	100%	13,485	337,123
RA.CB 3 (Space Htg)	40,746	1,018,661	95%	38,664	966,598
RA.CB 3 (Water Htg)	-	-	N/A	2,082	52,041
RA.COND.MUA	11,845	178,125	98%	11,590	173,850
RA.DCV - 10 Year ML - Retail	44,099	440,990	100%	44,099	440,989
RA.DCV - 15 Year ML - Commercial	21,260	318,901	51%	10,767	161,498
RA.DCV - 15 Year ML - Retail	942,814	14,142,213	100%	942,820	14,142,305
RA.ERV 1	51,041	714,569	100%	51,041	714,569
RA.ERV.3	5,772	80,811	100%	5,772	80,811
RA.HEB.199	1,248	31,208	100%	1,248	31,192
RA.HEB.99	272	6,793	100%	272	6,797
RA.HEBO (Space Htg)	486,228	12,155,704	99%	479,409	11,985,219
RA.HEBO (Water Htg)	1,638	40,942	100%	1,637	40,933
RA.HEBO.MR (Space Htg)	288,426	7,210,640	103%	296,885	7,422,115
RA.HEBO.MR (Water Htg)	45,462	1,136,540	65%	29,580	739,511
RA.HRV	19,465	272,504	100%	19,464	272,497
RA.HRV.2	1,736	24,299	94%	1,632	22,841
RA.HRV.3	74,246	1,039,448	100%	74,247	1,039,453
RA.INFRD	5,345	106,900	100%	5,345	106,900
RA.INFRD.2	266,827	5,336,535	100%	266,827	5,336,535
RA.INFRD.3	133,193	2,663,855	100%	133,193	2,663,855
RA.INFRD.4	3,243	64,856	100%	3,243	64,856
RA.INFRD.5	83,262	1,665,240	100%	83,262	1,665,240
RA.INFRD.6	213,946	4,278,912	100%	213,946	4,278,912
RA.INFRD.IND.2	154,664	3,093,283	100%	154,664	3,093,283
RA.INFRD.IND.3	129,525	2,590,496	100%	129,525	2,590,496
RA.INFRD.IND.5	17,999	359,976	100%	17,999	359,976
RA.INFRD.IND.6	19,943	398,864	100%	19,943	398,864
RA.OZ	157,130	2,356,943	107%	168,221	2,523,310
RA.OZ.2	44,366	665,491	100%	44,366	665,488

Measure	Draft Utility-Reported Net Savings*		Annual Realization Rate†	Certified Net Savings	
	Annual (m^3)	Cumulative (m^3)		Annual (m^3)	Cumulative (m^3)
RA.OZ.3	223,036	3,345,534	102%	227,129	3,406,931
RA.OZ.5	183,343	2,750,147	95%	174,740	2,621,094

†These values are rounded.

Recommendations

The EC has the following recommendations resulting from these verification activities:

- **Consider investing in relational program tracking databases.** Relational program tracking databases and customer relationship management (CRM) systems allow for multiple measures to be associated with a single customer. Within this kind of format, each participant should receive a unique customer ID that allows multiple projects or measures to be connected to the single customer or account, with unique IDs attached to each measure.
- **Deliver the tracking data in a single flat worksheet.** While the utility workbooks were helpful to show the EC how the utilities calculate shareholder incentives, lost revenue, and cost-effectiveness, the EC would prefer to receive the data in a single flat worksheet with no additional summary information. If possible, the data should be delivered using the guidelines in the following bullets. In the event that relational databases are adopted, the entire database can be delivered to the EC and we will assemble it into a single flat file. Guidelines for data delivery:
  - One row per installed measure
  - All measures connected to a unique customer or account identification number
  - No intermediary summary information, such as the sum of savings by measure or building type
  - Related information, such as program name and measures description, that allows the EC to apply the verification results appropriately to calculate shareholder incentive, lost revenue, and cost-effectiveness
- **Develop and maintain an electronic summary of the TRM.** To facilitate savings certification, the TRM should be summarized in an electronic spreadsheet, such as an Excel file. Each measure (identified as a unique savings value) should have an assigned measure ID number, and new ID numbers should be assigned when a measure is updated with a new savings value. This allows for a historical record of the changes in the TRM and helps the savings certification identify when, for example, a previous measure was not updated correctly.
- **Track prescriptive savings using unique measure descriptions that clearly map to the electronic TRM.** To facilitate savings certification, each record in the tracking data should easily and immediately map to the electronic TRM. This allows the EC to confirm which measure is installed and identify the appropriate savings estimate for that measure.
- **Deliver additional data for the C&I deep savings verification.** Union should deliver billing data for each C&I participant to allow the EC to verify the annual consumption values. In addition, Union should provide supporting information (and a calculation, if possible) for the normalized heating degree days to allow the EC to verify that the correct values are used.

APPENDIX D. RESIDENTIAL RETROFIT PROGRAM VERIFICATION

This appendix describes the detailed process used to verify the reported residential retrofit program savings and number of deep savings participants for Union and Enbridge. The programs addressed are the Home Reno Rebate and Low Income Weatherization programs for Union and the Home Energy Conservation and Winterproofing programs for Enbridge.

Union Home Reno Rebate program

The EC requested the full documentation from a sample of 25 participants of the Home Reno Rebate program. The sample was selected at random from the population of participants in the tracking data. The EC received 25 file folders, one for each participant. The typical file folder had the following information:

- Photographs of pre- and post-installation conditions
- A redacted data collection form with personally identifiable information removed
- HOT2000 simulation output in the form of a TSV file, which contained some inputs and some simulation-produced results, including the simulated estimate of annual gas and electric usage.

The folders did not contain the actual building simulation files, only the simulation output. The folders also contained different identification numbers than those in the tracking data. The EC requested and received a mapping file to connect the tracking records to the correct simulation results. One file did not appear to have both the pre-installation and post-installation simulation results; after a follow-up request, the file was declared the correct output with an incorrect file name.

The EC created an analysis sheet that calculated the simulation-based energy savings[19] and compared it to the tracking data. All 25 sites had differences between the tracking results and the simulation results; however, a certain level of discrepancy had been expected.[20] The EC defined a tolerance band of ±2% of natural gas or electricity savings. Nine projects fell within the tolerance band, leaving 16 projects that showed discrepancies between the simulation results and tracking savings.

The EC requested an explanation for the discrepancies. Union provided the following comment:

> Union relies upon its service providers to run HOT2000 in accordance with the requirements of Union's program. This sometimes involves running models that are different than what is required by NRCan for use of the HOT2000 software. Service providers do their best to retain all appropriate model scenarios/corrections/amendments but sometimes not all get saved. Service providers are also the parties responsible for data entering the HOT2000 output used by Union for program results. Service providers do their best to ensure data entered captures all modeling amendments but some changes may not ultimately get captured as well as they should be.

[19] The calculation subtracted the energy use of the post-installation simulation results from the energy use of the pre-installation simulation results.

[20] The program delivery agents use HOT2000 in the EnerGuide Rating mode, which is only available for Service Organizations and Energy Advisors licensed to deliver the EnerGuide Rating Service for Natural Resources Canada. All other entities must use the General mode, which does not have the same capabilities. HOT2000 simulations created in EnerGuide mode might not run in the General mode. If they do run, the General mode may produce different savings results.

Union reviewed the 16 projects and provided the explanations for the discrepancies shown in Table D-1. The table also shows how each discrepancy was addressed by the EC to produce verified savings. Four of the projects could not be explained; Union suggested they might be models that include upgrades that did not receive an incentive, but Union did not have confirmation of that assumption. They may also have been data entry errors. The EC chose to treat them as if they were data entry errors because it is the option that assigns responsibility to the utilities.

Table D-1: Union: description of Home Reno Rebate discrepancies and how they were addressed

Discrepancy	#	How Addressed for Verified Savings
Data entry error	5	The verified savings were set equal to those calculated from the simulation output.
HOT2000 model includes upgrades that did not receive an incentive	3	The verified savings were set equal to the tracking savings.
Unknown; might be either of the first two discrepancies	4	The EC assumed a data entry error and the verified savings were set equal to those calculated from the simulation output.
Something was initially modeled incorrectly; new model uploaded but tracking not changed	3	The verified savings were set equal to those calculated from the simulation output.

The EC used the results of the review to produce a realization rate for electric and gas, shown in Table D-2. The gross savings realization rate for natural gas is 98%.

Table D-2: Union Home Reno Rebate gross savings realization rate

Fuel	n Houses	Ratio	90% Confidence Interval			
			+ / -	Lower Bound	Upper Bound	Relative Precision
Natural Gas	25	98%	6%	92%	104%	7%
Electricity	25	88%	18%	70%	106%	21%

The EC also reviewed the number of deep savings participants, which is one of the Resource Acquisition scorecard metrics. The deep savings metric measures participants that "achieve a minimum gas savings of 11,000 cumulative m^3 (based on HOT2000 software used in EnerGuide mode), and implement a minimum of two major measures in their home as outlined in Exhibit A, Tab 3, Appendix A, Section 1.0."[21] The aggregate of all of the deep savings homes must also achieve at least a 25% reduction in their annual gas usage for space and water heating. The major measures include basement insulation, exterior wall insulation, attic insulation, air sealing, furnace/boiler installation, water heater installation, or a window/door/skylight.

Table D-3 shows the EC activities used to verify the number of deep savings participants and the outcome of each activity.

[21] EB-2015-0029 – Union Gas Limited – 2015-2020 DSM Plan, Exhibit A, Tab 2, Page 13 of 38.

Table D-3: Union deep savings participant verification activities and outcomes

Verification Activity	Outcome
Confirm that two major measures were installed for each sampled site.	Confirmed for 6 of 25 sites using the supplied photos. For the remaining sites, photos only verified one major measure.*
Calculate verified cumulative savings for each sampled site and confirm over 11,000 cumulative m^3.	Three of 25 sites did not have cumulative savings over 11,000 cumulative m^3 but were identified as deep savings participants.
Calculate the average percent reduction across the sample and confirm greater than 25%.	By assuming that the total natural gas consumption was equal to the space and water heat consumption, we were able to calculate an average savings reduction of 29%.
Apply the gross realization rate to the population and determine the number of qualifying deep savings participants.	The EC found 2,529 qualifying deep savings participants compared to 2,537 reported by the program.

*Despite the low confirmation rate, the EC did not adjust the outcome based on the initial review. Though the activity did not confirm that there were two major measures, it also did not confirm that there were not. It's likely that the second major measure was more difficult to visually confirm, such as air sealing.

Union Low Income Weatherization program

The EC requested the full documentation from a sample of 25 participants of the Low Income Weatherization program replacement measures. The replacement measures are the whole-house improvements, as opposed to the retrofit measures, which are select direct-install equipment such as faucet aerators and showerheads. The sample was selected at random from the population of participants in the tracking data. The EC received 25 file folders, one for each participant. The typical file folder contained the following documentation:

- Photographs of pre- and post-installation conditions
- A redacted declaration and consent form with personally identifiable information removed
- Two HOT2000 simulation files

One of the simulation files was not immediately transferred; the EC submitted an additional request and it was provided.

The EC created an analysis sheet that calculated the simulation-based energy savings and compared it to the tracking data. Each pre- and post-installation simulation file was opened, run, and the energy usage was entered in the analysis sheet. The savings were determined by subtracting the post-installation results from the pre-installation results.

The EC was unable to run both pre- and post-installation simulations for seven of the 25 sites. Of those that were run, the energy savings from the simulation matched the tracking savings for eight customers. The EC requested additional information for the seven un-run sites and explanations for the 10 sites that were run but had discrepancies. Union responded with the output from the TSV files for 15 of the 17 sites; two could not be re-run.

With the additional files, the EC could finalize the verified savings for the Union Low Income Weatherization program. The simulation savings matched the tracking savings for 19 of the 25 sites. For four records, the savings differed, possibly because of data entry errors; the EC set the verified savings equal to those calculated from the simulation output for those sites. The final two sites were removed from the sample because their savings could not be verified.

The EC used the results of the review to produce a realization rate for electric and gas, shown in Table D-4. The gross savings realization rate for natural gas is 107%.

Table D-4: Union Low Income Weatherization gross savings realization rate

Fuel	n Houses	Ratio	90% Confidence Interval			
			+/-	Lower Bound	Upper Bound	Relative Precision
Natural Gas	23	107%	10%	93%	117%	9%
Electricity	23	99%	15%	84%	114%	16%

Enbridge Home Energy Conservation program

The EC requested the full documentation from a sample of 25 participants of the Home Energy Conservation program. The sample was selected at random from the population of participants in the tracking data. The EC received many file folders; in many but not all cases, there were two folders per site. The typical file folder had the following information:

- Photographs of pre- and post-installation conditions
- A redacted participation form with personally identifiable information removed
- Invoice information
- HOT2000 simulation files

One site's simulations were modeled in REM/Rate and could not be verified; this site was removed from the sample.

The EC created an analysis sheet that calculated the simulation-based energy savings[22] and compared it to the tracking data. Fourteen of the 24 sites were verified to have savings within ±2% of natural gas and electricity savings, leaving 10 projects that showed discrepancies between the simulation results and tracking savings.

The EC requested an explanation for the discrepancies. Enbridge provided the TSV files for each of the 10 simulations. Two sites were found to have a difference greater than 2% between tracking and verified savings, which resulted from data entry errors. The EC set verified savings for those sites equal to the simulation results.

The EC used the results of the review to produce a realization rate for gas savings, shown in Table D-5. The EC did not calculate an electricity realization rate because the program did not summarize the electricity savings in the documentation they provided. The gross savings realization rate for natural gas is 100%.

[22] The calculation subtracted the energy use of the post-installation simulation results from the energy use of the pre-installation simulation results.

Table D-5: Enbridge Home Energy Conservation gross savings realization rate

Fuel	n Houses	Ratio	90% Confidence Interval			
			+/-	Lower Bound	Upper Bound	Relative Precision
Natural Gas	24	100%	2%	98%	102%	2%

The EC also reviewed the number of deep savings participants, which is one of the Resource Acquisition scorecard metrics. The deep savings metric measures participants with “at least two major measures.”[23] The aggregate of all of the deep savings homes must also achieve at least a 25% reduction in their annual gas usage for space and water heating.

Table D-6 shows the EC activities used to verify the number of deep savings participants and the outcome of each activity.

Table D-6: Enbridge deep savings participant verification activities and outcomes

Verification Activity	Outcome
Confirm that two major measures were installed for each sampled site.	Confirmed for 6 of 24 sites using the supplied photos. For the remaining sites, photos only verified one major measure.*
Calculate the average percent reduction across the sample and confirm greater than 25%.	By assuming that the total natural gas consumption was equal to the space and water heat consumption, we were able to calculate an average savings reduction of 31%.
Calculate the percent reduction for each sample site and compare it to the tracking values.	There were 2 sites with differences; overall, however, the adjusted result was still greater than 25%.
Apply the gross realization rate to the population and determine the number of qualifying deep savings participants.	The EC found 5,646 qualifying deep savings participants, which is the same number reported by the utility.

*Despite the low confirmation rate, the EC did not adjust the outcome based on the initial review. Though the activity did not confirm that there were two major measures, it also did not confirm that there were not. It's likely that the second major measure was more difficult to visually confirm, such as air sealing.

Enbridge Winterproofing program

The EC requested the full documentation from a sample of 25 participants of the Winterproofing program. The sample was selected at random from the population of participants in the tracking data. The EC received 25 file folders, one for each participant. The typical file folder contained the following documentation:

- Photographs of pre- and post-installation conditions
- Redacted data collection forms with personally identifiable information removed
- Simulation files or output reports: these included HOT2000 or REM/Rate

The EC created an analysis sheet that calculated the simulation-based energy savings and compared it to the tracking data. Each pre- and post-installation simulation file was opened, run, and the energy savings were entered in the analysis sheet. The savings were determined by subtracting the post-installation results from the pre-installation results.

[23] EB-2015-0049 – Enbridge Gas Distribution Inc. – Multi-Year Demand Side Management Plan (2015 to 2020), Exhibit B, Tab 1, Page 6 of 19.

The EC requested additional information on many of the files. The request and resolution are shown in Table D-7. One site was found to have a difference greater than 2% between tracking and verified savings, which resulted from a data entry error. The EC set verified savings for that site equal to the simulation results.

Table D-7: Enbridge Winterproofing follow-up questions and resolution

Follow-up Question	Resolution
Seven sites had only one simulation file.	The software allows for a comparison of both the base and upgrade case in one file.
Four sites had post-installation files with different file numbers, which was inconsistent with the naming convention.	The delivery agent does not follow the same naming convention; the provided files were correct.
Two sites had pre- and post-installation simulations that showed the same consumption.	The pre-installation file had a base and upgrade case; the second file was sent in error.
Seven sites had energy savings that were greater than 2% different from the tracking savings.	Enbridge provided screen shots for each site supporting the tracking data.

The EC used the results of the review to produce a realization rate for gas savings, shown in Table D-8. The EC did not calculate an electricity realization rate because the information to do so was not consistently available. The gross savings realization rate for natural gas is 99%.

Table D-8: Enbridge Winterproofing gross savings realization rate

Fuel	n Houses	Ratio	90% Confidence Interval			
			+/-	Lower Bound	Upper Bound	Relative Precision
Natural Gas	25	99%	< 1%	98%	100%	< 1%

Overall savings

The overall tracking and verified savings for the home retrofit programs are shown in Table D-9.

Table D-9. Overall tracking and verified savings for home retrofit programs

Program	Utility-Reported Draft Gross Cumulative Savings (m^3)	Gross Realization Rate†	Verified Gross Cumulative Savings (m^3)
Union			
Home Reno Rebate	69,321,370	98%	67,934,943
Home Weatherization	33,505,239	107%	35,847,824
Enbridge			
Home Energy Conservation	120,488,487	100%	120,488,487
Winterproofing	28,410,725	99%	28,067,264

†These values are rounded.

Recommendations

The EC has the following recommendations resulting from these verification activities:

- **Provide both the building simulation file and program output to the evaluation team.** The EC was unable to verify all of the tracking savings directly from the simulation files because some simulations could not be run. Providing both the output files and the simulation models would allow the EC to verify savings without additional follow-up.
- **Review program processes to improve the quality of the tracking data.** The EC identified a number of inaccurate savings entries due to data entry mistakes or outdated results. Many of these errors could be avoided through changes in program processes. Consider reviewing and modifying program processes to avoid similar errors in the future.
- **Provide more explicit support for the major measures installed at each site.** For the market-rate programs, the EC could not verify that the deep savings participants had installed two major measures using the photographs provided with the documentation. Consider providing more explicit support for each major measure to eliminate uncertainty.
- **Consider funding a study to verify the models produced by the delivery agents.** An in-depth review of the simulation models is outside the scope of this verification. Consider funding a study to conduct an in-depth review of the models to ensure they conform to standard industry practice.

APPENDIX E. ENERGY SAVINGS KIT VERIFICATION

This appendix describes the detailed process used to certify the reported Energy Savings Kit savings for Union. The EC applied the adjustment factors that were identified in previous evaluations, including:

- Final Report Following an Impact Evaluation of the Union Gas ESK-Residential Program: Pull Initiative 2014
- Final Report Following an Impact Evaluation of the Union Gas ESK Residential Program: Door-to-Door Drop-off Initiative 2014
- Final Report Following an Audit of the Union Gas ESK-Helping Homes Conserve-HHC-Program Low-income Initiative 2012

The adjustment factors from these reports are shown in Table E-1. Table E-2 shows the tracking and verified savings for market-rate residential by rate class. Table E-3 shows the tracking and verified savings for Low Income residential by rate class.

Table E-1: Union: adjustment factors for Energy Savings Kits

Kit Measure	Adjustment Factor
Pull – Energy-efficient showerhead	55%
Pull – Kitchen faucet aerator	71%
Pull – Bathroom faucet aerator	81%
Pull – Pipe wrap	98%
Door-to-Door – Energy-efficient showerhead	50%
Door-to-Door – Kitchen faucet aerator	68%
Door-to-Door – Bathroom faucet aerator	80%
Door-to-Door – Pipe wrap	95%
Helping Homes Conserve – Showerhead	80%
Helping Homes Conserve – Kitchen faucet aerator	81%
Helping Homes Conserve – Bathroom faucet aerator	86%
Helping Homes Conserve – Pipe insulation	94%

Table E-2: Union: tracking and verified gross energy savings for residential Energy Savings Kits by rate class

Rate class	Measure	Draft Utility-Reported Savings		Adjustment Factor	Verified Savings	
		Annual Gross Savings (m^3)	Cumulative Gross Savings (m^3)		Annual Gross Savings (m^3)	Cumulative Gross Savings (m^3)
M1 South Residential	Pstat	5,300	79,500	100%	5,300	79,500
M1 South Residential	Pstat	36,146	542,190	100%	36,146	542,190
M1 South Residential	Pstat	-	-	100%	-	-
M1 South Residential	Pstat	11,183	167,745	100%	11,183	167,745
M1 South Residential	ESK Pull - Energy-efficient Showerhead	217,580	2,175,800	55%	119,669	1,196,690
M1 South Residential	ESK Pull - Kitchen Faucet Aerator	57,164	571,642	71%	40,587	405,866
M1 South Residential	ESK Pull - Bathroom Faucet Aerator	31,648	316,480	81%	25,635	256,349
M1 South Residential	ESK Pull - Pipe Wrap	153,097	2,296,458	98%	150,035	2,250,529
M1 South Residential	ESK D2D - Energy-efficient Showerhead	570,372	5,703,720	50%	285,186	2,851,860
M1 South Residential	ESK D2D - Kitchen Faucet Aerator	149,852	1,498,523	68%	101,900	1,018,996
M1 South Residential	ESK D2D - Bathroom Faucet Aerator	82,963	829,632	80%	66,371	663,706
M1 South Residential	ESK D2D - Pipe Wrap	401,334	6,020,017	95%	381,268	5,719,016
01 North Residential	Pstat	1,590	23,850	100%	1,590	23,850
01 North Residential	Pstat	10,282	154,230	100%	10,282	154,230
01 North Residential	Pstat	-	-	100%	-	-
01 North Residential	Pstat	1,219	18,285	100%	1,219	18,285
01 North Residential	ESK Pull - Energy-efficient Showerhead	81,180	811,800	55%	44,649	446,490
01 North Residential	ESK Pull - Kitchen Faucet Aerator	21,328	213,282	71%	15,143	151,430
01 North Residential	ESK Pull - Bathroom Faucet Aerator	11,808	118,080	81%	9,564	95,645
01 North Residential	ESK Pull - Pipe Wrap	57,121	856,818	98%	55,979	839,682
01 North Residential	ESK D2D - Energy-efficient Showerhead	-	-	50%	-	-
01 North Residential	ESK D2D - Kitchen Faucet Aerator	-	-	68%	-	-
01 North Residential	ESK D2D - Bathroom Faucet Aerator	-	-	80%	-	-
01 North Residential	ESK D2D - Pipe Wrap	-	-	95%	-	-
	Total	**1,901,169**	**22,398,052**	**N/A**	**1,361,705**	**16,882,059**

Table E-3: Union: tracking and verified gross energy savings for Home Weatherization Program basic measures by rate class

Rate class	Measure	Draft Utility-Reported Savings*		Adjustment Factor	Verified Savings	
		Annual Gross Savings (m^3)	Cumulative Gross Savings (m^3)		Annual Gross Savings (m^3)	Cumulative Gross Savings (m^3)
M1 South Residential	HHC - Energy-efficient Showerhead 2-2.5	138	1,380	80%	110	1,104
M1 South Residential	HHC - Energy-efficient Showerhead 2.6+	1,056	10,560	80%	844.80	8,448
M1 South Residential	HHC - Kitchen Faucet Aerator	555	5,549	81%	449	4,495
M1 South Residential	HHC - Bathroom Faucet Aerator	282	2,816	86%	242	2,422
M1 South Residential	HHC - Pipe Wrap	1,084	16,254	94%	1,019	15,279
	Total	**3,114**	**36,559**	**N/A**	**2,665**	**31,747**

APPENDIX F. RUNITRIGHT VERIFICATION

This appendix describes the detailed process used to certify the reported RunitRight (RiR) savings for Enbridge. The EC reviewed the RunitRight models, energy savings calculations, and related files to identify any concerns regarding the methodology used by the program, and significant risks for savings accuracy. We also identified opportunities for improvement and suggested future evaluation activities.

The EC randomly selected 10 of 28 participating sites for review. The tasks in the file review included:

- **Data review:** Compare savings claimed for the program to the savings stated in the individual spreadsheets.
  - **Conclusion:** the savings were confirmed to match.
- **Methodology review:** A senior engineer reviewed the calculation methods and independently calculated savings for one site using the raw consumption data and defined program periods.
  - **Conclusion:** the methodology used by the RiR program to estimate savings is appropriate for the application. No significant concerns were identified by the team; however, the RiR tool does not allow observation of all of the calculations performed. Independently-calculated savings were statistically equivalent to those calculated by the program for the one site reviewed.
- **Savings review:** Evaluation engineers reviewed the spreadsheets, regression models, and supporting documentation for the sample of sites to identify the answers to the following questions:
  - Is the building type correctly identified?
  - How many months were used in the baseline, improvement, and reference periods?
  - What type of model was used?
  - What independent variables were used?
  - What R-squared values were used for the baseline and reference models?
  - What is the p-value?
  - What balance points were used in the baseline and reference models?
  - What are the estimated savings during the reference period?
  - What are the normalized annual savings?
  - Were capital project savings deducted?
  - What percentage of consumption do the savings represent?
  - Were the measures completed as invoiced?
  - Could the measures have resulted in these savings?
- **Savings risk assessment:** The EC assessed the risk of savings accuracy as Low, Normal, or High based on the calculation review completed, a review of the consumption pattern at the facility, and a review of the baseline model used. Three key questions were answered:
  - Based on experience, is the baseline model specification reasonable?
  - Based on experience, is the baseline time period definition reasonable?
  - What is the assessed level of risk for achieving savings?

  - **Conclusion:** The baseline model specifications and time period definitions were reasonable. One site was assigned Low risk, five were assigned Normal risk and four were assigned High risk.
  - Three of the four high risk facilities were schools. The regression models were a poor fit for the consumption data, resulting in substantial uncertainty in any savings estimate. The EC

recommends an assessment of other independent variables for schools, such as an in-session/out-of-session variable to capture break periods.

All savings claims were supported by actions at the facility and clear changes in the consumption patterns occurred. The EC's review supports a savings claim for all sites.

Recommendations

The EC has the following recommendations resulting from these verification activities:

- **Consider additional independent variables when modeling school consumption.** The regressions did not fit school consumption effectively. Additional independent variables accounting for break periods may improve the fit.
- **Provide more information about each site.** Include a basic description of the end-use equipment served by the gas meter, such as DHW, heating, or cooking.
- **Improve the activity documentation.** Include the date of each implemented activity in the calculation workbook and site report. Provide both the baseline and installed values; for example, the pre- and post-installation schedule for a schedule reset. Increase the detail of the end use equipment when a single change results in a significant reduction in consumption.
- **Consider quantifying electric savings through engineering calculations.** While billing data may not be available, engineering calculations would help the program demonstrate the full value it is providing.
- **Consider reviewing the process for selecting the HDD reference temperature.** The EC observed multiple sites where the base load consumption was unexpectedly sensitive to the reference temperature. If in error, the result may be negative baseline savings estimates and poor summer regression results.

APPENDIX G. LOW INCOME MULTI-FAMILY VERIFICATION

This appendix describes the detailed process used to verify the percentage of Part 3 participants enrolled in the Enbridge Low Income Building Performance Management (LIBPM) program, which is one of the scorecard metrics. The equation for calculating the metric is:

$$\% \, LIBPM = \frac{(x+y)}{(x+y+z)}$$

Where:

- X is the number of new LIBPM buildings in the current year which have participated in another aspect of the Low Income program in a previous year of the 2012-2014 plan
- Y is the number of new LIBPM buildings participating in the current year which have not previously participated in the Low Income program
- Z is the number of buildings in the current year which have implemented custom projects other than LIBPM.[24]

In response to an EC request, Enbridge provide an Excel workbook with the following information:

- A sheet describing the calculation and showing the values for x, y, and z as well as the calculation result based on utility-reported data.
- A sheet listing the 121 participants in the 2015 LIBPM program, with flags for previous participation
- A sheet listing the number of participants installing custom projects in 2015 who did not participate in the LIBPM program.

To verify this information, the EC:

- Confirmed that all reported 2015 Low Income Part 9 buildings were included in the LIBPM workbook. We found that 12 buildings were not, but the projects were prescriptive, not custom, so there was no result in the calculation input. The correct z value is 66, as reported by the program
- Confirmed the x and y counts of buildings. We confirmed the program (x + y) total of 121 buildings.

Given the information, the EC calculated the following:

$$\% \, LIBPM = \frac{(121)}{(121+66)} = 65\%$$

The EC result is the same as the reported utility result.

[24] EB-2015-0049 – Enbridge Gas Distribution Inc. – Multi-Year Demand Side Management Plan (2015 to 2020), Exhibit B, Tab 1, Schedule 3, Page 8 of 19.

APPENDIX H. CUSTOM PROJECT VERIFICATION

This appendix describes the detailed process used to determine the CPSV results and how they are applied to the utility-reported gross savings to get verified gross savings. It also describes the process used to determine the free ridership-based study results which are combined with spillover as discussed in APPENDIX N.[25]

The primary reporting domains in the CPSV / NTG study report do not align to the programs for LRAM and DSMSI. To get the appropriate effective adjustment factors, the EC:

- Applied the measure-level CPSV and free ridership ratios to the population of tracking data
- Summed the verified cumulative savings across the desired group (program for Resource Acquisition and Low Income; rate class for Large Volume)
- Summed the tracking cumulative savings across the same group
- Divided the sum of verified gross by the sum of tracking gross and the sum of verified net by the sum of verified gross to get CPSV and free ridership[26] adjustments that most closely follow our sample design.

Table H-1 shows the CPSV and free ridership adjustment factors.

Table H-1. Union CPSV and NTG adjustment factors by subset

Program	CPSV Adjustment†	Free Ridership Adjustment*†
C&I Custom Comm & Inst Buildings	89%	44%
C&I Custom Ag and Greenhouse	97%	41%
C&I Custom Industrial	103%	39%
Low Income Multi-Family Custom	89%	95%
Large Industrial R100	147%	8%
Large Industrial T1	154%	9%
Large Industrial T2	131%	8%

†These values are rounded.
* This is presented in the form of a NTG ratio based solely on free ridership. Technically, this value is 1 minus free ridership.

To get the appropriate adjustment factors for the Enbridge custom projects, the EC followed the same process. Table H-2 shows the adjustment factors.

[25] "2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation". Prepared for the Ontario Energy Board. August 15, 2017.

[26] In this analysis, the "free ridership adjustment" is in the form of a NTG ratio based on free ridership alone. It is more accurate to say that the value calculated by dividing the sum of verified net by the sum of verified gross is 1 minus the free ridership value.

Table H-2. Enbridge CPSV and NTG adjustment factors

Program	CPSV Adjustment†	Free Ridership Adjustment*†
Custom Commercial	91%	17%
C&I Custom New Construction	91%	18%
Custom Multi-family	91%	35%
Custom Industrial Ag	99%	28%
Custom Industrial	100%	33%
RunitRight	100%	50%

†These values are rounded.
* This is presented in the form of a NTG ratio based solely on free ridership. Technically, this value is 1 minus free ridership.

APPENDIX I. MARKET TRANSFORMATION VERIFICATION

This appendix describes the detailed process used to verify the scorecard metrics for the market transformation programs for both utilities. The programs addressed in this appendix are Union's Optimum Home program and Enbridge's Residential Savings by Design, Commercial Savings by Design, and Home Labelling programs.

Union Optimum Home

The scorecard metric for the Union Optimum Home program is the percentage of homes built to Optimum Home standard by participating builders. The Optimum Home standard is greater than 20% above the Ontario Building Code 2012 (OBC). The target is 30% of homes built. Union reported an achievement of 50.3% of homes built.

To support the metric achievement, Union provided a spreadsheet showing the participating builders (anonymized), the number of Optimum Homes built and verified in 2015 by those builders, and the total number of new gas attachments in 2015 for those builders. The reported number of Optimum Homes was 1,246 and the total new attachments was 2,477 for the 50.3% achievement.

To verify the metric, the EC:

- Confirmed program participation for one randomly selected builder
- Confirmed Optimum Home status for one randomly selected home

The EC selected Builder T and requested all documentation related to that builder. We received:

- Signed participation paperwork for Builder T
- Documentation confirming the number of new attachments requested by Builder T in 2015
- Documentation confirming the number of Optimum Home qualifying homes

The EC confirmed:

- Builder T is a participant in the Optimum Homes program
- Builder T requested 30 new attachments in 2015
- Builder T built 21 Optimum Home-qualifying homes in 2015, defined as homes that have an Energy Star for New Homes Compliance Report from NRCan with an Evaluation Date in 2015

Per the NRCan website[27] for Energy Star New Homes, an Energy Star certified new home is, on average, 20% more efficient than a home built to code; therefore, homes with an Energy Star certification will, on average, exceed the metric.

The EC also selected home H310 built by Builder H and requested all documentation related to that home. We received:

- Documentation of the air test and results by a third-party consulting firm
- An Energy Star for New Homes compliance report

[27] http://www.nrcan.gc.ca/energy/efficiency/housing/new-homes/5057

- A workbook showing the Energy Star for New Homes Energy Advisor Verification Checklist

The EC confirmed:

- Home H310 built by Builder T conforms to Optimum Home requirements.
- The home has gas water and space heat.

As a result of this review, the EC confirms the reported Optimum Home scorecard metric of 50.3%.

Enbridge Residential Savings by Design

The scorecard metrics for the Enbridge Residential Savings by Design (RSBD) program are the number of builders enrolled in the program and the number of homes built to RSBD standard. The RSBD standard is greater than 25% above the Ontario Building Code 2012 (OBC). The targets are 18 builders enrolled and 1,111 homes built. Enbridge reported achievements of 19 builders enrolled and 1,987 homes built. By definition, an enrolled builder must have built a minimum of 50 homes in the previous year to qualify.

To support the metric achievement, Enbridge provided a spreadsheet showing the participating builders, confirmation that they built more than 50 homes in the prior year, and the integrated design process (IDP) date for each builder. Enbridge also provided a workbook listing the houses built to RSBD standard, by builder, that received an incentive, and the number of reported houses, by builder, self-reported through letters.

To verify the metrics, the EC:

- Confirmed program participation for one randomly selected builder
- Confirmed RSBD status for one randomly selected home

The EC selected Builder #65 and requested all documentation related to that builder. We received:

- A copy of the builder commitment form, which confirms that the builder completed more than 50 homes in the previous year
- Notes from the visioning session
- The agenda from the Integrated Design Charrette
- The findings from the integrated design process (IDP)

The EC confirmed:

- Builder #65 is a participant in the RSBD program and joined in 2015
- Builder #65 self-reported a minimum of 50 homes build in 2014
- Builder #65 participated in the visioning workshop and IDP session and designed a townhome that is 27.6% better than OBC

The EC also selected home HL88 and requested all documentation related to that home. We received:

- Documentation of the air test and results by a third-party consulting firm
- An SBD modelling summary sheet
- A HOT2000 model file

The EC confirmed:

- Home RSBD conforms to RSBD requirements.

As a result of this review, the EC confirms the reported RSBD scorecard metrics of 19 builders and 1,987 homes built.

Enbridge Commercial Savings by Design

The scorecard metric for the Enbridge Commercial Savings by Design (CSBD) program is the number of developments enrolled in the program. The target is 18 new developments enrolled. Enbridge reported an achievement of 24 developments enrolled. To qualify, the development must exceed 50,000 square feet in size.

To support the metric achievement, Enbridge provided a spreadsheet showing the participating builders and the developments that were enrolled in 2015.

To verify the metrics, the EC confirmed program participation for one randomly selected developer. The EC selected the development by Builder #54 and requested all documentation related to that builder and development. We received:

- A copy of the application form for the builder
- Pre-meeting notes from the ½-day visioning session with the builder
- A report on the findings from the integrated design workshop.
- An email confirming that the size of the development is greater than 50,000 square feet.

The EC confirmed:

- Builder #54 is a participant in the CSBD program
- Builder #54 participated in the visioning workshop and IDP session and designed a development that is 34.2% better than OBC

As a result of this review, the EC confirms the reported CSBD scorecard metric of 24 developments enrolled.

Enbridge Home Labelling

The scorecard metrics for the Enbridge Home Labelling program are the number of annual listings by realtors committed to the program and the number of ratings performed. The targets are 5,000 listings and 4,500 ratings performed. Enbridge reported achievements of 41,650 listings and 336 ratings performed.

To support the metric achievement, Enbridge provided a spreadsheet that listed all of the addresses that received a Home Labelling rating and another spreadsheet showing the number of listings represented by each committed realtor. To verify the number of addresses, the EC:

- Confirmed program participation for one randomly selected realtor
- Confirmed the number of listings represented by that realtor
- Confirmed the ratings completed by that realtor

The EC selected a realtor and requested all documentation related to that office. We received:

- The brokerage commitment form
- Proof of labelling at three addresses related to that realtor
- An updated labelling tracking spreadsheet

In assembling the documentation for the requested realtor, Enbridge discovered a duplicate entry. They reviewed all of the documentation in the program and found three duplicates in total, reducing the number of completed ratings to 333.

The EC confirmed:

- The realtor is a participant in the Home Labelling program
- The realtor represents 2000 listings per year.
- The builder completed three ratings in 2015

As a result of this review, the EC confirms the reported Home Labelling scorecard metric of 333 ratings and 41,650 listings.

APPENDIX J. REVIEW OF LRAM AND DSMSI CALCULATIONS

This appendix describes the EC team's review of the lost revenue adjustment mechanism (LRAM) and demand side management shareholder incentive (DSMSI) calculations.

The LRAM calculation is based on:

- The verified net natural gas savings (in annual cubic meters) by rate class
- The delivery cost of the natural gas by rate class
- The month in which the measure was installed

The DSMSI calculation is based on:

- The actual program achievements compared to the target metrics for that scorecard
- The weight placed on each metric within each scorecard
- The maximum incentive achievable for that scorecard

The detailed DSMSI calculations for each utility are outlined in the following sections. The EC was unable to identify or locate the source of approval for the calculations. The two utility calculations are very similar and follow the same principles and do not violate the general direction approved by the OEB; therefore, the EC will use the methodology provided by the utilities.

The EC confirmed the lower band, upper band, target metric, and weights for both utilities.

LRAM: Union

Union delivered a calculation workbook for LRAM which includes the tracking savings, an input sheet for adjustment factors, and a sheet with avoided costs. The LRAM calculation for a given rate class and month is as follows:

- The verified net energy savings for the given rate class and month are summed.
- The savings are multiplied by the following calculation, which pro-rates the savings for the remainder of the year and divides by 1000 to produce the savings volume in thousands of cubic meters.

$$\frac{(12 - Month\,\# + 1)}{(12)(1000)}$$

For example, the savings for a particular rate class for measures installed in July would be multiplied by:

$$\frac{(12 - 7 + 1)}{(12)(1000)} = \left(\frac{6}{12}\right)\left(\frac{1}{1000}\right)$$

The equation allots energy savings from that project to half of the year and converts it to thousands of cubic meters.

The savings from each month are summed across rate classes and multiplied by an annual delivery rate for that class to get the revenue impact for each class.

The revenue impact from each rate class is summed across classes to get the total LRAM for Union. Only the contract rate cases are included in the LRAM calculations.

LRAM: Enbridge

Enbridge delivered a calculation workbook for LRAM which includes the tracking savings, a sheet to calculate the budgeted LRAM values, a sheet to calculate the actual LRAM values, and a sheet showing the distribution margin rates. The actual LRAM calculation for a given rate class and month is as follows:

- The annual net savings are summed by rate class and sector and the month in which the measure was installed.
- The savings by rate class and sector and month are divided by 12 to produce monthly savings and applied to each month from the installation month through the rest of the year.
- The savings are summed across months for each sector.
- The savings are summed across sectors for each rate class.

The Enbridge calculation workbook does not calculate the actual LRAM, it calculates the LRAM variance, which shows the difference between the actual LRAM and the budgeted LRAM for the year.[28] To calculate the actual LRAM (consistent with the Union calculation above), the EC multiplied the actual net savings summed across sectors for each rate by the distribution margin to get LRAM.

The revenue impact from each rate class is summed across classes to get the total LRAM for Enbridge. Only the contract rate cases are included in the LRAM calculations.

[28] After the draft report was produced, Enbridge provided a calculation workbook that included the actual LRAM in addition to the LRAM variance.

DSMSI: Union

The Union tracking workbook includes a sheet for calculating the DSMSI based on utility-reported results. The DSMSI is calculated based on the metric achievement relative to the target level within an acceptable ± band. The Union targets, upper and lower bands, and weights are shown in Table J-1. The EC verified the metrics, upper and lower bands, and weights shown in the table.

Table J-1. Union's 2015 scorecard targets, lower band, upper band, and weight

Scorecard	Lower Band	2015 Target	Upper Band	Weight
Union				
Resource Acquisition	612,421,364 CCM	816,561,818 CCM	1,020,702,273 CCM	90%
	934 participants	1,245 deep savings participants	1,556 participants	5%
	7.88%	8.88% of commercial whole building natural gas use saved	9.88%	5%
Large Volume	154,692,013 CCM	206,256,017 Rate 1 CCM	257,820,021 CCM	60%
	772,381,040 CCM	1,029,841,387 Rate T2/100 CCM	1,287,301,734 CCM	40%
Low Income	19,500,000 CCM	26,000,000 single family CCM	32,500,000 CCM	60%
	13,200,000 CCM	17,600,000 multi-family CCM	22,000,000 CCM	40%
Market Transformation	25%	30% of homes built by participating builders were 20% more efficient than OBC	35%	100%

The shareholder incentive calculation in the Union tracking workbook first defines a % Achievement.

- If the achieved metric is less than the target, % achievement is calculated:

$$\%\,Achievement = \frac{(1-0.5)*achieved\ metric}{(target\ metric - lower\ band)} + 1 - \frac{(1-0.5)*target\ metric}{target\ metric - lower\ band}$$

- If the achieved metric is greater than the target, % achievement is calculated:

$$\%\,Achievement = \frac{(1.5-1)*achieved\ metric}{(upper\ band - target\ metric)} + 1.5 - \frac{(1.5-1)*upper\ band}{upper\ band - target\ metric}$$

The % Achievement is multiplied by the weight to produce % Contribution, which is summed. The summed value is used to calculated the achieved shareholder incentive using:

- If the sum of % Contribution is greater than 0.5 and less than 1, then:

$$achieved\ incentive = \left[0.8*\left(\sum \%\,Contribution\right) - 0.4\right] * maximum\ shareholder\ incentive$$

- If the sum of % Contribution is greater than or equal to 1 and less than or equal to 1.5, then:

$$achieved\ incentive = \left[1.2*\left(\sum \%\,Contribution\right) - 0.8\right] * maximum\ shareholder\ incentive$$

- If the sum of % Contribution is greater than 1.5, then:

$$achieved\ incentive = [1.2*1.5-0.8] * maximum\ shareholder\ incentive$$

- Otherwise the maximum shareholder incentive is zero.

DSMSI: Enbridge

The Enbridge tracking workbook includes a sheet for calculating the DSMSI based on utility-reported results. The DSMSI is calculated based on the metric achievement relative to the target level within an acceptable ± band. The Enbridge targets, upper and lower bands, and weights are shown in Table J-2. The EC verified the metrics, upper and lower bands, and weights shown in the table.

Table J-2. Enbridge's 2015 scorecard targets, lower band, upper band, and weight

Scorecard	Lower Band	2015 Target	Upper Band	Weight
Enbridge				
Resource Acquisition	758,900,000 CCM	1,011,900,000 CCM	1,264,900,000 CCM	92%
	571 participants	762 deep savings participants	952 participants	8%
Low Income	18,100,000 CCM	24,100,000 single family CCM	30,200,000 CCM	50%
	51,600,000 CCM	68,700,000 multi-family CCM	86,000,000 CCM	45%
	30%	40% of Part 3 in LIBPM	50%	5%
Savings by Design Residential	13 builders	18 builders enrolled	22 builders	60%
	833 homes	1,111 homes built by participating builders were 20% more efficient than OBC	1,389 homes	40%
Savings by Design Commercial	11 developments	18 developments enrolled	24 developments	100%
Home Labelling	No listings	5,001 total listings from committed realtors	10,001 listings	50%
	2,250 ratings	4,500 ratings performed	6,750 ratings	50%

The shareholder incentive calculation in the Enbridge tracking workbook first defines a Score.

- If the achieved metric is less than or equal to the target, Score is calculated:

$$Score = 1 - \frac{0.5 * (target\ metric - achieved\ metric)}{(target\ metric - lower\ band)}$$

- If the achieved metric is greater than the target, Score is calculated:

$$Score = 1 + \frac{0.5 * (achieved\ metric - target\ metric)}{(upper\ band - target\ metric)}$$

The Score is multiplied by the weight and summed to produce the Weighted Score. The Weighted Score is used to calculated the achieved shareholder incentive using:

- If the Weighted Score is less than 0.5 then the shareholder incentive is zero.
- If the Weighted Score is greater than or equal to 0.5 and less than 1, then:

$$MIB = middle\ incentive\ band = 0.4 * maximum\ shareholder\ incentive$$

$$achieved\ incentive = MIB * \frac{(Weighted\ Score - 0.5)}{0.5}$$

- If the Weighted Score is greater than or equal to 1 and less than or equal to 1.5, then:

$$achieved\ incentive = MIB + (maximum\ shareholder\ incentive - MIB) * \frac{(Weighted\ Score - 1)}{0.5}$$

- If the Weighted Score is greater than 1.5 then the shareholder incentive is equal to the maximum shareholder incentive.

Recommendations

The EC has the following recommendation resulting from these verification activities:

- **Provide a detailed explanation for the DSMSI calculation for review by the EC and OEB.** The EC was unable to locate a source document that supports the utility calculation of DSMSI. Given the importance of the shareholder incentive, it is appropriate to have a clearly defined and detailed explanation of how it is calculated.

APPENDIX K. LRAM AND DSMSI: DETAILED CALCULATIONS

This appendix describes the detailed process used to calculate the DSMSI and LRAM for both utilities.

Union DSMSI

The metrics that affect the Union DSMSI include:

- Resource Acquisition cumulative net savings
- Low Income cumulative net savings
- Large Volume cumulative net savings
- Non-savings metrics:
  - The number of deep savings participants in the Home Reno Rebate program
  - The average percent of whole-building energy use saved by C&I customers
  - The number of homes built greater than 20% above Ontario Building Code by participating Optimum Home builders

To verify the savings metrics, the EC applied the program-level results from the previous appendices. Table K-1 shows the location of the detailed explanation for each program.

Table K-1. Union source of detailed explanation of adjustment factors

Portfolio Component	Location of Detailed Explanation
Ag and Greenhouse	APPENDIX H APPENDIX N
Commercial and Institutional Buildings	APPENDIX H APPENDIX N
Industrial	APPENDIX H APPENDIX N
Energy Savings Kit	APPENDIX E
Home Reno Rebate	APPENDIX D
Commercial and Industrial Prescriptive	APPENDIX C
Low Income Multi-family (custom projects)	APPENDIX H
Low Income Multi-family (prescriptive projects)	APPENDIX C
Home Weatherization Program	APPENDIX D
Large Volume (custom projects)	APPENDIX H APPENDIX N
Large Volume (prescriptive projects)	APPENDIX C

The analysis to produce the verified savings from the tracking savings differed by the type of project.

- For custom projects (those discussed in APPENDIX H), the appropriate CPSV adjustment factor was applied to the annual and cumulative gross tracking savings to produce annual and cumulative gross verified savings. The appropriate NTG adjustment factor, including the provisional spillover value discussed in APPENDIX N, was applied to the annual and cumulative gross verified savings to produce annual and cumulative net verified savings.

- For the home renovation projects (those discussed in APPENDIX D), the appropriate natural gas adjustment factor was applied to the annual gross tracking savings to produce annual gross verified savings. The annual gross verified savings were multiplied by the program-assumed measure life to produce cumulative gross verified savings. Both the annual gross and cumulative gross verified savings were multiplied by the complement of the program-assumed free-ridership percentage to produce annual and cumulative verified net savings.
- For the Energy Savings Kit projects (those discussed in APPENDIX E), the EC calculated the measure-level annual and cumulative gross verified savings, summed them to the technology level (such as showerheads or pipe wrap), and divided the cumulative gross verified savings by the cumulative gross tracking savings to produce a technology-level gross adjustment factor. The annual and cumulative gross verified savings were multiplied by the complement of the program-assumed free-ridership percentage to produce annual and cumulative net verified savings.
- For the remaining prescriptive projects (those discussed in APPENDIX C), the EC multiplied the annual and cumulative gross tracking savings by the appropriate adjustment factor to produce annual and cumulative gross verified savings. The annual and cumulative gross verified savings were multiplied by the complement of the program-assumed free-ridership percentage to produce annual and cumulative net verified savings.

Program-level adjustment factors were determined by first summing the gross cumulative verified and tracking savings and net cumulative verified and tracking savings across the program, then dividing the verified by the tracking result to get the adjustment factor.

Table K-3 shows the Union verified 2015 savings by scorecard and program.

For the non-savings metrics, the EC determined the verified metric as described in the previous appendices. Table K-2 shows the location of the detailed explanation for each metric and the verified value.

Table K-2. Union source of detailed explanation of final non-savings metrics and verified value

Metric	Location of Detailed Explanation	Verified Value
Number of residential deep savings participants	APPENDIX D	2,529
Percent of whole-building energy use saved	APPENDIX C	8.08%
Percent of qualifying homes by Optimum Home builders	APPENDIX I	50.3%

Table K-3. Union's verified 2015 savings by scorecard and program

Program	Draft Utility-Reported Savings*				Verification Results		Verified Savings	
	Gross Annual (m^3)	Gross Cumulative (m^3)	Net Annual (m^3)	Net Cumulative (m^3)	Gross Realization Rate†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition								
C&I Prescriptive	10,659,544	208,919,006	9,283,248	182,411,887	100%	87%	208,919,006	182,411,887
C&I Custom Ag and Greenhouse	41,708,475	611,477,005	19,185,899	281,279,422	97%	44%	592,368,700	262,534,051
C&I Custom Comm & Inst Buildings	16,527,002	268,582,354	7,602,421	123,547,883	89%	47%	239,199,444	112,642,330
C&I Custom Industrial	36,329,242	593,859,359	16,711,451	273,175,305	103%	43%	612,343,937	260,640,852
Energy Savings Kit	1,901,169	22,398,052	1,644,462	19,567,373	75%	88%	16,882,059	14,800,935
Home Reno Rebate	3,828,386	69,321,370	3,254,128	58,923,165	98%	85%	67,934,943	57,744,701
Total RA	**110,953,818**	**1,774,557,146**	**57,681,609**	**938,905,035**	**98%**	**51%**	**1,737,648,089**	**890,774,755†**
Large Volume								
Large Industrial-T1	12,469,705	171,240,007	5,743,536	78,919,835	154%	13%	263,624,641	33,725,518
Large Industrial-T2	83,288,363	1,002,106,837	38,382,453	462,016,235	131%	11%	1,309,850,111	147,448,803
Large Industrial-R100	11,155,712	80,624,184	5,131,627	37,087,125	147%	12%	118,331,969	13,695,699
Total LV	**106,913,780**	**1,253,971,028**	**49,257,616**	**578,023,195**	**135%**	**12%**	**1,691,806,721**	**194,870,020**
Low Income								
Low Income Multi-family	957,046	17,840,732	909,194	16,948,695	96%	95%	17,193,011	16,333,361
Home Weatherization	1,341,946	33,505,239	1,341,913	33,504,841	107%	100%	35,847,824	35,847,426
Total LI	**2,298,992**	**51,345,970**	**2,251,107**	**50,453,536**	**103%**	**98%**	**53,040,835**	**52,180,787**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
†These values are rounded.

The EC entered the appropriate metrics into the Union scorecard calculator. The resulting shareholder incentive results can be found in Table K-4. The total shareholder incentive is $7,039,894.

Table K-4. Union DSMSI results

Scorecard	DSMSI
Resource Acquisition	$4,010,638
Low Income	$2,462,534
Large Volume	$0
Market Transformation	$566,721
Total	**$7,039,894**

Enbridge DSMSI

The metrics that affect the Enbridge DSMSI include:

- Resource Acquisition cumulative net savings
- Low Income cumulative net savings
- Non-savings metrics:
  - The number of deep savings participants in the Home Energy Conservation program
  - The percentage of Part 3 participants that are also in the LIBPM program
  - The number of builders participating in the RSBD program
  - The number of homes built greater than 25% above Ontario Building Code by participating RSBD builders
  - The number of builders participating in the CSBD program
  - The number of listings represented by realtors in the Home Labelling program
  - The number of ratings in the Home Labelling program

To verify the savings metrics, the EC applied the program-level results from the previous appendices. Table K-5 shows the location of the detailed explanation for each program.

Table K-5. Enbridge source of detailed explanation of adjustment factors

Portfolio Component	Location of Detailed Explanation
Home Energy Conservation	APPENDIX D
Commercial Prescriptive	APPENDIX C
Commercial Custom	APPENDIX H APPENDIX N
RunitRight	APPENDIX F APPENDIX H APPENDIX N
Multi-family	APPENDIX H APPENDIX N
New Construction	APPENDIX H APPENDIX N
Industrial Custom	APPENDIX H APPENDIX N
Industrial Prescriptive	APPENDIX C
Industrial Agriculture	APPENDIX H APPENDIX N
Low Income Multi-family (prescriptive projects)	APPENDIX C
Low Income Multi-family (custom projects)	APPENDIX H
Low Income Single Family: Winterproofing	APPENDIX D
Low Income Single Family non-Winterproofing	APPENDIX C

The analysis to produce the verified savings from the tracking savings differed by the type of project.

- For custom projects (those discussed in APPENDIX H), the appropriate CPSV adjustment factor was applied to the annual and cumulative gross tracking savings to produce annual and cumulative gross verified savings. The appropriate NTG adjustment factor, including the provisional spillover value discussed in APPENDIX N, was applied to the annual and cumulative gross verified savings to produce annual and cumulative net verified savings.
- For the home renovation projects (those discussed in APPENDIX D), the appropriate natural gas adjustment factor was applied to the annual gross tracking savings to produce annual gross verified savings. The annual gross verified savings were multiplied by the program-assumed measure life to produce cumulative gross verified savings. Both the annual gross and cumulative gross verified savings were multiplied by the complement of the program-reported free-ridership percentage to produce annual and cumulative net verified savings.
- For the RunitRight projects (those discussed in APPENDIX F), the EC applied the gross savings verification adjustment from APPENDIX F to the annual and cumulative gross tracking savings to produce annual and cumulative gross verified savings. The appropriate NTG adjustment factor (from APPENDIX H and APPENDIX N) was applied to the annual and cumulative gross verified savings to produce annual and cumulative net verified savings.

- For the remaining prescriptive projects (those discussed in APPENDIX C), the EC calculated the verified gross annual and cumulative savings for the population of measures. The verified savings were summed into groupings corresponding to the program-reported free-ridership rate. The annual and cumulative verified net savings were produced by multiplying the verified gross savings by the complement of the program-reported free-ridership rate. The final gross savings adjustment factor was calculated by dividing the cumulative gross verified savings by the cumulative gross tracking savings.

Program-level adjustment factors were determined by first summing the gross cumulative verified and tracking savings and net cumulative verified and tracking savings across the program, then dividing the verified by the tracking result to get the adjustment factor.

Table K-7 shows the Enbridge verified 2015 savings by scorecard and program.

For the non-savings metrics, the EC determined the final metric as described in the previous appendices. Table K-6 shows the location of the detailed explanation for each metric and the verified value.

Table K-6. Enbridge source of detailed explanation of final non-savings metrics and verified value

Metric	Location of Detailed Explanation	Verified Value
Number of residential deep savings participants	APPENDIX D	5,646
Percent of Part 3 in LIBPM	APPENDIX G	65%
Number of builders in RSBD	APPENDIX I	19
Number of qualifying homes in RSBD	APPENDIX I	1,987
Number of developments in CSBD	APPENDIX I	24
Number of listings represented by Home Labelling realtors	APPENDIX I	41,650
Number of Home Labelling listings	APPENDIX I	333

Table K-7. Enbridge's verified 2015 savings by scorecard and program

Program	Draft Utility-Reported Savings*				Verification Results		Verified Savings	
	Gross Annual (m^3)	Gross Cumulative (m^3)	Net Annual (m^3)	Net Cumulative (m^3)	Gross Realization Rate**†	Net-to-Gross†	Gross Cumulative (m^3)	Net Cumulative (m^3)
Resource Acquisition								
Home Energy Conservation	7,956,225	120,488,487	6,762,791	102,415,214	100%	85%	120,488,487	102,415,214
Prescriptive Commercial	6,858,765	117,938,979	5,750,534	98,693,722	97%	86%	114,897,650	98,862,563
Custom Commercial	14,007,133	210,800,594	12,326,277	185,504,523	91%	21%	192,840,383	40,105,236
RunitRight	536,821	2,684,105	536,821	2,684,105	100%	53%	2,684,105	1,434,923
Custom Multi-family	7,363,563	152,593,766	5,890,850	122,075,013	91%	38%	139,592,777	53,699,388
C&I Custom New Construction	4,091,779	102,294,475	3,027,916	75,697,912	91%	22%	93,578,986	20,231,777
Custom Industrial	22,195,244	336,500,502	11,097,622	168,250,251	100%	36%	337,417,582	122,387,967
Prescriptive Industrial	561,521	10,826,785	398,824	7,593,008	100%	70%	10,826,785	7,593,008
Custom Industrial Ag	611,305	7,856,800	366,783	4,714,080	99%	32%	7,815,133	2,467,184
Total RA	**64,182,357**	**1,061,984,493**	**46,158,419**	**767,627,826**	**96%**	**44%**	**1,020,141,888**	**449,197,259†**
Low Income								
LI Multi-Family	3,425,023	69,505,240	3,397,177	69,226,782	101%	100%	70,147,603	70,426,062
Single Family	1,146,633	28,410,725	1,139,959	28,343,978	99%	100%	28,067,264	28,132,657
Total LI	**4,571,656**	**97,915,965**	**4,537,136**	**97,570,759**	**100%**	**100%**	**98,214,867**	**98,558,719**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
** The gross realization rate for C&I prescriptive, single family low income, and multi-family low income includes the removal rate for some measures, which was previously included in the net-to-gross adjustment. See APPENDIX C for more detail.
†These values are rounded.

The EC entered the appropriate metrics into the Enbridge scorecard calculator. The resulting shareholder incentive results can be found in Table K-8. The total shareholder incentive is $6,228,081.

Table K-8. Enbridge DSMSI results

Scorecard	DSMSI
Resource Acquisition	$2,632,886
Low Income	$1,745,422
Residential Savings by Design	$1,076,493
Commercial Savings by Design	$418,269
Home Labelling	$616,397
Total	**$6,489,467**

Union LRAM

The inputs into the Union LRAM calculation are:

- Verified net annual energy savings by rate class and installation month using the best available information. When the installation month was in the previous year (2014), the EC assigned the savings to January.
- The annual delivery rate for each rate class.

To determine verified savings by month and rate class, the EC completed the following activities:

- **Prescriptive savings:** The EC identified the best available information for estimating energy savings, which is the currently (in 2017) approved TRM. The EC determined the prescriptive savings using the new source, summed the annual gross verified savings by month, rate class, and free rider rate, then applied the appropriate free rider rate to get annual verified net savings, and summed across the rate class to get annual verified net savings by month and rate class.
- **Custom savings:** The EC applied the measure-level CPSV and NTG ratios (which is the best available information) to the population of tracking data, then summed the verified annual savings across measures to the project level. The project-level verified annual net savings were summed by month and rate class.
- **Combined savings:** The EC summed prescriptive and custom savings by month and rate class to get the appropriate inputs to the LRAM calculation.

The EC input the summed savings by month and rate class to the utility calculator to produce the appropriate LRAM, shown in Table K-10. Table K-9 shows the results of the Union LRAM calculation by rate class.

Table K-9. Union LRAM results

Rate Class	Utility-Reported Draft LRAM	Verified LRAM
M4 Industrial	$77,105	$73,713
M5 Industrial	$38,366	$36,565
M7 Industrial	$33,512	$31,937
T1 Industrial	$2,789	$777
T2 Industrial	$1,050	$389
20 Industrial	$7,002	$6,845
100 Industrial	$5,578	$1,565
Total	**$165,411**	**$151,791**

Table K-10. Union LRAM inputs: annual net savings by rate class and install month

	Annual Savings, m^3												
Rate Class	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Total**
M4 Industrial	3,047,615	1,948,820	187,744	516,114	288,277	504,318	316,656	575,169	999,059	1,179,258	338,434	1,599,088	11,500,552
M5 Industrial	549,188	197,089	39,849	91,536	33,136	152,621	225,133	345,791	244,373	398,629	655,516	759,439	3,692,300
M7 Industrial	4,057,380	1,564,748	146,484	1,088,644	937,508	287,820	730,468	966,154	1,148,522	2,308,289	1,517,892		14,753,910
T1 Industrial	488,717		25,403	134,317	428,661	13,026	20,953	159,394	71,880	60,903	187,670		1,590,924
T2 Industrial	2,157,693			215,126	113,884	213,895		608,794	1,958,773	934,278	6,518,291	1,460,111	14,180,847
20 Industrial	340,326		116,932	44,372		158,512	214,125	946,951	112,483	227,511	645,161		2,806,372
100 Industrial			55,730	3,996		890,098	15,432	12,715	288,853	94,058	79,185		1,440,066
Total	10,640,920	3,710,657	572,142	2,094,103	1,801,467	2,220,290	1,522,766	3,614,968	4,823,944	5,202,927	9,942,149	3,818,638	49,964,971

Enbridge LRAM

The inputs into the Enbridge LRAM calculation are:

- Verified net annual energy savings by rate class and installation month using the best available information
- The annual delivery rate for each rate class

To determine verified savings by month and rate class, the EC completed the following activities:

- **Prescriptive savings:** The EC identified the best available information for estimating energy savings, which is the currently (in 2017) approved TRM. The EC determined the prescriptive savings using the new source, summed the annual gross verified savings by month, rate class, and free rider rate, then applied the appropriate free rider rate to get annual verified net savings, and summed across the rate class to get annual verified net savings by month and rate class.
- **Custom savings:** The EC applied the measure-level CPSV and NTG ratios (which is the best available information) to the population of tracking data, then summed the verified annual savings across measures to the project level. The project-level verified annual net savings were summed by month and rate class.
- **Combined savings:** The EC summed prescriptive and custom savings by month and rate class to get the appropriate inputs to the LRAM calculation.

The EC put the summed savings by month and rate class, shown in Table K-12 into our own calculator to produce the appropriate LRAM. Table K-11 shows the results of the Enbridge LRAM calculation by rate class.

Table K-11. Enbridge LRAM results

Rate Class	LRAM
110	$11,662
115	$2,836
135	$239
145	$834
170	$584
Total	**$16,155**

Table K-12. Enbridge LRAM inputs: annual net savings by rate class and install month

	Annual Savings, m^3												
Rate Class	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Total**
110			19,412			131,272	543,323	36,241		90,262	2,248,631	54,568	3,123,710
115				50,456		1,602		43,292		58,030	1,645,016	17,994	1,816,390
135											106,318	10,628	116,946
145						10,926	10,595			4,996	233,091	36,474	296,083
170							105,099	848		6,474	422,496	57,618	592,535
Total	0	0	19,412	50,456	0	143,801	659,018	80,381	0	159,763	4,655,551	177,282	5,945,664

APPENDIX L. PROGRAM SPENDING

This section reports additional program spending detail for Union and Enbridge.

Union

Table L-1. Union Resource Acquisition scorecard spending

Spending Area	Actual Spent
Residential	
Residential Incentives	$3,552,367
Residential Administration	$527,197
Residential Evaluation	$397,650
Residential Promotion Costs	$972,997
Total Residential Program	**$5,450,210**
Commercial/Industrial	
Commercial/Industrial Incentives	$7,547,776
Commercial/Industrial Administration	$2,924,084
Commercial/Industrial Evaluation	$100,200
Commercial/Industrial Promotion Costs	$796,336
Total Commercial/Industrial Program	**$11,368,397**

Table L-2. Union Large Volume scorecard spending

Spending Area	Actual Spent
Large Industrial T1/T2/R100 Incentives	$2,219,151
Large Industrial T1/T2/R100 Administration	$863,933
Large Industrial T1/T2/R100 Evaluation	$122,498
Large Industrial T1/T2/R100 Promotion Costs	$4,134
Total Large Industrial T1/T2/R100 Program	**$3,209,716**

Table L-3. Union Low Income scorecard spending

Spending Area	Actual Spent
Low Income Incentives	$5,449,462
Low Income Administration	$859,796
Low Income Evaluation	$196,171
Low Income Promotion Costs	$1,195,605
Total Low Income	**$7,701,035**

Table L-4. Union Market Transformation scorecard spending

Spending Area	Actual Spent
Optimum Home Incentives	$736,173
Optimum Home Administration	$386,703
Optimum Home Promotion Costs	$282,464
Total Optimum Home Program	**$1,405,340**

Table L-5. Union portfolio budget spending for research, evaluation, and administration

Spending Area	Residential	C&I	Low Income	Large Industrial	Market Trans-formation	Total
% of Overall	19%	39%	26%	11%	5%	100%
Research	$61,568	$128,422	$86,994	$36,258	$15,875	$329,116
Evaluation	$98,214	$204,861	$138,774	$57,840	$25,324	$525,012
Administration	$409,671	$854,517	$578,856	$241,262	$105,634	$2,189,940
Total DSM Budget	**$569,452**	**$1,187,799**	**$804,624**	**$335,359**	**$146,834**	**$3,044,068**

Enbridge

Table L-6. Enbridge program costs for Resource Acquisition

Resource Acquisition	OEB-Approved Budget	Actual Spending		
		Indirect	Direct	Total
Residential				
HEC	$1,872,720	$8,340,428	$1,021,867	$9,362,295
Residential Total	**$1,872,720**	**$8,340,428**	**$1,021,867**	**$9,362,295**
Commercial				
Comm Prescriptive		$759,387	$0	$759,387
Comm Custom		$1,647,605	$785,017	$2,432,622
RunitRight		-$12,480	$1,471,376	$1,458,896
Multi residential (Comm)		$1,485,719	$41,350	$1,527,069
New Construction (Comm)		$43,624	$125	$43,749
Commercial Total	**$8,252,370**	**$3,923,856**	**$2,297,867**	**$6,221,724**
Industrial				
Custom Industrial (excl. Agriculture)		$1,450,240	$581,814	$2,032,054
Prescriptive Industrial		$27,150	$0	$27,150
Agriculture		$96,698	$10,805	$107,502
Industrial Total	**$4,318,700**	**$1,574,088**	**$592,619**	**$2,166,706**

Table L-7. Enbridge program costs for Low Income

Low Income	OEB-Approved Budget	Actual Spending		
		Indirect	Direct	Total
Single Family - Part 9	$4,655,790	$3,765,116	$679,500	$4,444,616
Multi Residential - Part 3	$2,208,300	$1,758,240	$353,506	$2,111,746
Totals	**$6,864,090**	**$5,523,356**	**$1,033,006**	**$6,556,362**

Table L-8. Enbridge program costs for Market Transformation

Market Transformation	OEB-Approved Budget	Actual Spending		
		Indirect	Direct	Indirect
SBD Residential	$2,493,900	$1,282,840	$749,183	$2,032,022
Home Labelling	$1,428,000	$1,540	$119,700	$121,241
SBD Commercial	$969,000	$615,359	$275,105	$890,464
Totals	**$4,890,900**	**$1,899,739**	**$1,143,988**	**$3,043,727**

Table L-9. Enbridge incremental budget spend

Incremental Cost	OEB-Approved Budget	Actual Spending		
		Indirect	Direct	Total
Unallocated	$291	$0	$0	$0
Collaboration Fund	$1,000,000	$0	$53,014	$53,014
Green Button Initiative	$300,000	$0	$0	$0
Integrated Resource Planning Study	$300,000	$0	$0	$0
Potential Study Update	$50,000	$0	$0	$0
DSM IT System	$0	$0	$0	$0
Strategic Energy Management	$370,000	$179	$60,284	$60,462
Low Income New Construction	$250,000	$0	$1,101	$1,101
O-Power	$2,650,000	$0	$444,801	$444,801
Totals	**$4,920,291**	**$179**	**$559,200**	**$559,378**

APPENDIX M. COST-EFFECTIVENESS METHODOLOGY

This appendix describes the detailed process used to verify the cost-effectiveness calculations, and recalculate cost-effectiveness results based on annual verification activities.

The OEB requires the utilities to deliver portfolios that are cost effective at the "program" level. Each utility defines "program" differently from the other utility, and both utilities define "program" differently from the OEB, as shown in Table M-1. Throughout this report, the EC has used the OEB definitions. The relevant cost effectiveness results will be based on the utilities' definition of program.

Table M-1. 2015 "Programs" as defined by the OEB, Enbridge, and Union

<table>
<tr><th colspan="2">Union</th><th colspan="2">Enbridge</th></tr>
<tr><th>Union-Defined Programs</th><th>OEB-Defined Programs</th><th>Enbridge-Defined Programs</th><th>OEB-Defined Programs</th></tr>
<tr><td rowspan="4">Residential Program

Commercial/Industrial Program</td><td>Home Reno Rebate</td><td rowspan="3">Resource Acquisition</td><td>Home Energy Conservation</td></tr>
<tr><td>Energy Savings Kit</td><td>Commercial and Industrial Prescriptive</td></tr>
<tr><td>Commercial and Industrial Prescriptive</td><td>Custom Commercial and Industrial</td></tr>
<tr><td>Commercial and Industrial Custom</td><td rowspan="2">Low Income</td><td>Home Winterproofing</td></tr>
<tr><td rowspan="2">Low-Income Program</td><td>Home Weatherization</td><td>Low income Multi-Residential – Affordable Housing</td></tr>
<tr><td>Low Income Multi-Family</td><td rowspan="4">Market Transformation</td><td>Residential Savings by Design</td></tr>
<tr><td>Large Volume Program</td><td>Large Volume</td><td>Commercial Savings by Design</td></tr>
<tr><td rowspan="2">Market Transformation</td><td rowspan="2">Optimum Home</td><td>Home Rating</td></tr>
<tr><td>Run it Right</td></tr>
</table>

To calculate cost effectiveness, the EC first built a cost-effectiveness model using the utilities' methodology and assumptions, as detailed in their 2015 tracking /audit tool workbooks. This step had several goals, including:

- Building a comprehensive model that could easily be modified to assess the impact of changing assumptions and methodology to calculate the TRC, TRC-Plus, and PAC tests
- Ensuring consistency of cost-effectiveness calculations by regrouping both utilities in the same model[29]
- Taking a deep dive into current utility models, making sure cost-effectiveness calculations were consistent with industry best practices

The EC model was verified to confirm that the TRC and TRC-Plus results (and PAC results where available) were initially identical to the utilities' results on a line-by-line basis and at the aggregate level.[30]

[29] Because Union's workbook did not include PAC calculations, we initially aligned those calculations on Enbridge's methodology.

[30] In some cases, Union's program costs were grouped together for several programs, and have been prorated to each program to calculate the PAC using gas savings by program. Enbridge's overhead costs have been kept at "Program type" level (e.g. Low Income, Resource Acquisition) to ensure that the EC's initial results are consistent with Enbridge's PAC results by program.

The EC model was then modified to adjust gross savings using realization rates and free ridership from the annual savings verification activities and the provisional spillover rate. Because the realization rates for other savings (electricity, water) were generally either not available or much less precise, the gas realization rates were used for all savings.

A series of observations are made in the results section regarding some calculations and assumptions that could be reviewed to better reflect best practices, including the discount rate, the use of a gas benefit adder for the PAC test, and water avoided costs. The impacts of alternative approaches to cost-effectiveness calculations have been calculated using the model with verified savings (i.e., after applying the realization rates and net-to-gross ratios).

Results

Table M-2 and Table M-3 show summary results for Union the TRC, TRC-Plus, and PAC tests, including the cost-benefit ratio and the net present value. Table M-4 and Table M-5 show the same information for Enbridge. While there is a general drop in cost-effectiveness results following the verification of savings, almost all OEB-defined programs still pass the cost-effectiveness threshold for both the TRC-Plus and the PAC tests. The only exceptions are the Home Reno Rebate program[31] and the RunitRight[32] program, shown in tables at the end of this section. In both cases, those programs were not cost-effective when using utility draft reported savings, before any verification-related adjustment. There are additional tables located at the end of this section with more detailed results. When using the utility definition of savings, all programs pass the threshold.

Table M-2. Union summary of cost-effectiveness ratio results

<table>
<tr><th rowspan="2">Scorecard</th><th colspan="3">Draft using Utility-Reported Savings*</th><th colspan="3">Final Verified Ratio</th></tr>
<tr><th>TRC</th><th>TRC-Plus**</th><th>PAC**</th><th>TRC</th><th>TRC-Plus</th><th>PAC</th></tr>
<tr><td>Residential Resource Acquisition</td><td>1.2</td><td rowspan="2">3.0</td><td rowspan="2">8.0</td><td>1.0</td><td>1.2</td><td>2.3</td></tr>
<tr><td>Commercial and Industrial Resource Acquisition</td><td>2.9</td><td>3.3</td><td>3.8</td><td>12.0</td></tr>
<tr><td>Low Income</td><td>1.0</td><td>1.1</td><td>0.9</td><td>1.3</td><td>1.4</td><td>1.1</td></tr>
<tr><td>Large Volume</td><td>4.7</td><td>5.4</td><td>26.3</td><td>6.0</td><td>6.9</td><td>10.2</td></tr>
<tr><td>Total Portfolio</td><td>2.9</td><td>3.3</td><td>8.1</td><td>2.9</td><td>3.3</td><td>6.8</td></tr>
</table>

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

[31] The Home Reno Rebate program is not required to be cost effective; only the utility-defined Residential program must be cost effective.
[32] The RunitRight program is not required to be cost effective; only the utility-defined Resource Acquisition program must be cost effective.

Table M-3. Union summary of cost-effectiveness net present value results

Scorecard	Draft Net Present Value (M$) using Utility-Reported Savings*			Final Verified Net Present Value (M$)		
	TRC	TRC-Plus**	PAC**	TRC	TRC-Plus	PAC
Residential Resource Acquisition	96.7	120.4	117.9	0.4	2.6	6.8
Commercial and Industrial Resource Acquisition				105.4	128.0	124.7
Low Income	(0.02)	1.0	(1.1)	1.7	3.1	0.6
Large Volume	70.2	83.6	81.1	27.6	32.6	29.4
Total Portfolio	**166.9**	**205.1**	**197.9**	**135.2**	**166.3**	**161.5**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

Table M-4. Enbridge summary of cost-effectiveness ratio results

Scorecard	Draft using Utility-Reported Savings*			Final Verified Ratio		
	TRC**	TRC-Plus	PAC	TRC	TRC-Plus	PAC
Resource Acquisition	3.3	3.8	6.0	2.3	2.7	2.7
Low Income	2.1	2.5	2.5	1.7	2.0	1.9
Total Portfolio	**3.1**	**3.6**	**5.2**	**2.2**	**2.6**	**2.5**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Enbridge only reported TRC-Plus and PAC in its filings for 2015.

Table M-5. Enbridge summary of cost-effectiveness net present value results

Scorecard	Draft Net Present Value (M$) using Utility-Reported Savings*			Final Verified Net Present Value (M$)		
	TRC**	TRC-Plus	PAC	TRC	TRC-Plus	PAC
Resource Acquisition	123.2	149.7	120.4	50.1	61.8	40.9
Low Income	9.2	11.8	10.7	6.0	8.1	6.2
Total Portfolio	**132.4**	**161.6**	**131.1**	**56.1**	**69.9**	**47.1**

* The utility-reported values reflect the savings presented in the utility's tracking workbook, not in the draft 2015 report. The utility changed the energy savings values for some projects after submitting the 2015 report but before delivering the data for evaluation, resulting in a small change.
**These values were calculated using the utility-reported draft savings results. Enbridge only reported TRC-Plus and PAC in its filings for 2015.

As very low net-to-gross factors were applied to the Large Volume and C&I (Enbridge) custom sectors, the TRC, TRC-Plus, and PAC net values for these sectors dropped significantly.

It is interesting to note that because both savings and costs are affected by the net-to-gross factor, the impact on the TRC and TRC-Plus ratios is far less significant. In addition, a high realization rate (135%) was applied to Union's Large Volume savings, resulting in an increase of the TRC-Plus ratio, even with a net-to-gross factor of only 12%.

Cost-effectiveness framework

Enbridge and Union use divergent cost-effectiveness frameworks to calculate their 2015 results:

- **Non-energy benefit (NEB) adder:** Enbridge uses a 15% NEB adder for both the TRC and the PAC, while Union does not include the adder in their TRC calculations.[33]

[33] Union's workbook did not include PAC results. WE calculated the PAC for Union using no NEB adder.

- **Discount rate:** Union uses its weighted average cost of capital (WACC) to discount future values, while Enbridge uses a real discount rate of 4%.

It should also be noted that Enbridge applies a real discount rate to streams of current values. Enbridge notes in the cost-effectiveness workbook provided to the EC that "the Board is of the view that the gas utilities should use a discount rate (real) of 4% when screening prospective DSM programs to determine if they are cost effective for consideration [as] part of the new 2015 to 2020 multi-year DSM plan. This discount rate is consistent with that used in the electricity Conservation First framework ensuring that all possible energy conservation programs are screened in a consistent manner."

The Independent Electricity System Operator's (IESO) Conservation and Demand Management (CDM) Energy Efficiency Cost Effectiveness Guide[34] confirms the 4% discount rate in its Appendix A, but states however that "when performing a cost-effectiveness assessment, the discount rate should be applied to "real" (inflation-adjusted) streams of benefits and costs." (p.21)

It is the EC's opinion that a real discount rate should indeed be used only on real streams of benefits and costs. When working with streams of current (nominal) values, a nominal discount rate should instead be used.

Finally, the use of a NEB adder for the PAC test is questionable. The 15% adder accounts for the non-energy benefits associated with DSM programs, such as environmental, economic, and social benefits.[35] While DSM programs (mostly those aimed at low income customers) may produce some NEBs at the utility level, such as reduced arrearages, bad debt, and disconnects, the bulk of NEBs are usually at the societal level (reduced GHG and other pollutants) and the participant level (increase comfort, health and safety, etc.), both of which are outside the scope of the PAC test.

The EC did not find any clear indication in OEB decisions or other documentation that the adder should be applied to the PAC. The following excerpt seems to suggest that it should indeed be applied only to the TRC:[36]

> On October 23, 2014, the Minister of Energy amended his Conservation First directive to the OPA and made it mandatory that electricity distributor CDM programs are screened using the TRC test and "include a 15% adder to account for the non-energy benefits associated with the electricity CDM programs, such as environmental, economic, and social benefits." To effectively align natural gas DSM programs with electricity CDM programs and take into consideration government objectives outlined in the Conservation Directive to the OPA, the Board has concluded that the same approach should be used for screening DSM programs.
>
> The Board will adopt an enhanced TRC test, or the "TRC-Plus" test, which the gas utilities should use to screen all potential DSM programs when developing their multi-year DSM plans. The gas utilities should directly apply a 15% non-energy benefit adder to the benefit side of the TRC test calculation.

[34] March 2015. Conservation and Demand Management Energy Efficiency Cost Effectiveness Guide. Independent Electricity System Operator (IESO).

[35] 2015-2020 Natural Gas Framework (EB-2014-0134), p. 33

[36] 2015-2020 Natural Gas Framework (EB-2014-0134). Ontario Energy Board, p. 33. In addition, IESO's March 2015 Conservation and Demand Management Energy Efficiency Cost Effectiveness Guide clearly states that the adder is to be used only with the TRC. (pp. 31, 32)

The EC team noted that water avoided costs are based on water rates. This has been confirmed by Union: "Water avoided costs are based on average water rates from 17 municipalities across Union's service territory. This information was used as a proxy to avoided water costs. Avoided water costs and the method of estimating them were filed in Union's Board-approved 2015-2020 plan." (Union's response to EC's questions on 2015 avoided costs.)

As is the case for gas and electricity, water avoided costs should only include the marginal impact from reduced consumption. Fixed costs (which, in our experience, can represent about 75% to 80% of water costs) must be excluded. On the other hand, water rates are often predominantly or exclusively variable,[37] notably to promote conservation, and are thus a bad proxy of avoided costs.

To simulate the impact of a reduction of water avoided costs, the EC reduced water avoided costs provided by the utilities by 75%. The impact on the TRC-Plus test is slight but not negligible. There is no impact on the PAC, as only gas avoided costs are included in this second test.

To produce results that are more comparable between the two gas utilities, and more consistent with DSM cost-effectiveness best practices, the EC modified results as follows:

- Including a 15% NEB adder in Union's avoided costs for the calculation of the TRC-Plus
- Removing the 15% NEB adder for PAC calculations
- Using a 4% real discount rate (since both utilities use streams of benefits expressed in nominal dollars, the real rate was converted to a nominal rate of 5.74% using Union's inflation factor of 1.68%)
- Adjusting the water savings benefits to better reflect real avoided costs

With this new set of assumptions, Union's cost-effectiveness results are increased, while Enbridge's are decreased. All sectors and portfolios remain cost-effective for both the TRC-Plus and the PAC.

Recommendations

This analysis has shown the robustness of DSM results, as cost-effectiveness is generally maintained through the adjustment of claimed savings, net-to-gross factors, discount rates, and water avoided costs.

The EC has the following recommendations results from the cost-effectiveness analysis:

- **Allocate "sector"-level administrative cost and overhead to each individual program and report program-level cost-effectiveness results.** Explicit allocation of general administration and evaluation costs will allow for easier cost-effectiveness calculations at the program level.
- **Use a consistent real discount rate of 4% for both Enbridge and Union when using "real" (inflation-adjusted) streams of benefits and costs.**
- **Explore the possibility of better defining water avoided costs.**
- **Work towards a better uniformity of cost-effectiveness methods and assumptions between the two gas utilities.** There is always a balance to be found between uniform methods and the need to account for the specific situation of each utility. The EC found, however, major discrepancies that could

[37] The City of Toronto, for example, uses a completely variable rate structure.

be reduced, such as the discount rate, the use of an NEB adder, the format of reporting results, and the allocation of administration and overhead costs by program.

Table M-6. Union Low Income TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	TRC Costs (equipment)	TRC Value (equipment)	TRC Ratio (equipment)	Program Admin Costs	TRC Ratio (program)
Utility-Reported Draft Results								
LI Multi-Family Custom	261,801	1,977,229	577,341	1,977,229	(1,399,888)	0.29	122,815	0.27
LI Multi-Family Prescriptive	589,561	456,435	1,693,096	456,435	1,236,660	3.71	276,572	2.31
Home Weatherization Program	1,341,780	3,453,109	4,927,199	3,453,109	1,474,090	1.43	629,450	1.21
LI Multi-Family Custom - Contrax	57,832	187,055	140,562	187,055	46,493	0.75	27,130	0.66
Utility-Reported Draft Total	**2,250,974**	**6,073,828**	**7,338,197**	**6,073,828**	**1,264,368**	**1.21**	**1,055,967**	**1.03**
Final Verified Results								
LI Multi-Family Custom	261,801	1,977,229	676,896	1,977,229	(1,300,333)	0.34	122,811	0.32
LI Multi-Family Prescriptive	589,643	456,499	1,997,719	456,499	1,541,219	4.38	276,602	2.73
Home Weatherization Program	1,341,765	3,453,070	6,036,321	3,453,070	2,583,250	1.75	629,424	1.48
LI Multi-Family Custom - Contrax	57,832	187,055	166,626	187,055	(20,429)	0.89	27,129	0.78
Final Verified Total	**2,251,042**	**6,073,854**	**8,877,562**	**6,073,854**	**2,803,708**	**1.46**	**1,055,967**	**1.25**

Table M-7. Union Resource Acquisition TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	TRC Costs (equipment)	TRC Value (equipment)	TRC Ratio (equipment)	Program Admin Costs	TRC Ratio (program)
Utility-Reported Draft Results								
Prescriptive	9,283,248	93,710,064	27,327,806	9,370,064	17,957,742	2.92	531,898	2.76
Agriculture & Greenhouse-Banner	1,406,652	1,464,459	3,017,406	1,464,459	1,552,947	2.06	80,596	1.95
Agriculture & Greenhouse-Contrax	17,779,246	12,334,170	38,785,681	12,334,170	26,451,511	3.14	1,018,689	2.90
Commercial & Institutional Buildings-Banner	1,324,819	4,310,368	3,695,020	4,310,368	(615,348)	0.09	75,908	0.84
Commercial & Institutional Buildings-Contrax	6,277,602	3,575,446	25,100,079	3,575,446	21,524,633	7.02	359,685	6.38
Industrial-Banner	1,287,371	1,559,799	3,265,762	1,559,799	1,705,963	2.09	73,762	2.00
Industrial-Contrax	15,424,080	11,560,886	38,455,282	11,560,886	26,894,396	3.33	883,746	3.09
Energy Savings Kit	1,644,462	139,175	9,133,806	139,175	8,994,632	65.63	310,472	20.31
Home Reno Rebate	3,254,128	12,866,720	9,071,117	12,866,720	(3,795,603)	0.71	614,375	0.67
Utility-Reported Draft Total	**57,681,609**	**57,181,085**	**157,851,959**	**57,181,085**	**100,670,874**	**2.76**	**3,949,131**	**2.58**
Final Verified Results								
Prescriptive	9,307,088	9,170,777	31,971,550	9,170,777	22,800,773	3.49	552,470	3.29
Agriculture & Greenhouse-Banner	1,346,544	1,401,880	3,247,121	1,401,880	1,845,240	2.32	79,931	2.19
Agriculture & Greenhouse-Contrax	17,019,510	11,807,111	41,348,724	11,807,111	29,541,614	3.50	1,010,281	3.23
Commercial & Institutional Buildings-Banner	1,268,208	4,126,179	4,036,407	4,126,179	(89,771)	0.98	75,281	0.96
Commercial & Institutional Buildings-Contrax	6,009,349	3,422,661	27,091,413	3,422,661	23,668,752	7.92	356,716	7.17
Industrial-Banner	1,232,360	1,493,146	3,491,739	1,493,146	1,998,593	2.34	73,153	2.23
Industrial-Contrax	14,764,984	11,066,870	39,698,891	11,066,870	28,632,021	3.59	876,452	3.32
Energy Savings Kit	1,666,803	151,348	3,969,508	151,348	3,818,160	26.23	313,261	8.54
Home Reno Rebate	3,254,128	12,866,720	10,414,786	12,866,720	(2,451,934)	0.81	611,586	0.77
Final Verified Total	**55,868,974**	**55,506,693**	**165,270,139**	**55,506,693**	**109,763,446**	**2.98**	**3,949,131**	**2.78**

Table M-8. Union Large Volume TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	TRC Costs (equipment)	TRC Value (equipment)	TRC Ratio (equipment)	Program Admin Costs	TRC Ratio (program)
Utility-Reported Draft Results								
Large Industrial-T1	5,743,536	2,813,262	13,175,552	2,813,262	10,362,290	4.68	115,020	4.50
Large Industrial-T2	38,382,453	13,967,830	69,505,342	13,967,830	55,537,512	4.98	768,645	4.72
Large Industrial-R100	5,131,627	1,305,055	6,628,785	1,305,055	5,323,730	5.08	102,766	4.71
Utility-Reported Draft Total	**49,257,616**	**18,086,146**	**89,309,678**	**18,086,146**	**71,223,532**	**4.94**	**986,431**	**4.68**
Final Verified Results								
Large Industrial-T1	1,445,698	709,008	4,737,064	709,008	4,028,056	6.68	115,810	5.74
Large Industrial-T2	9,598,272	3,540,164	26,209,242	3,540,164	22,669,079	7.40	768,884	6.08
Large Industrial-R100	1,270,020	322,986	2,236,874	322,986	1,913,888	6.93	101,737	5.27
Final Verified Total	**12,313,990**	**4,572,158**	**33,183,180**	**4,572,158**	**28,611,022**	**7.26**	**986,431**	**5.97**

Table M-9. Enbridge overall TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	Program Costs	Overhead	TRC Costs	TRC Value	TRC Ratio
Final Verified Results								
Resource Acquisition	28,335,894	23,636,918	77,654,832	3,912,353	5,639,080	33,188,351	50,105,561	2.34
Low Income	4,565,042	6,494,130	14,162,389	1,033,006	617,349	8,144,485	6,017,905	1.74

Table M-10. Enbridge Residential TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Final Verified Results							
Home Energy Conservation	6,762,791	7,790,602	17,154,904	1,021,867	8,812,469	8,342,435	1.95

Table M-11. Enbridge Commercial TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Final Verified Results							
Commercial Prescriptive	5,671,517	3,569,834	17,625,767	-	3,569,834	14,055,934	4.94
Commercial Custom	4,519,626	4,178,176	11,459,659	785,017	4,963,192	6,496,466	2.31
Run It Right	286,985	105,031	243,445	1,471,376	1,576,407	(1,332,963)	0.15
Multi-Residential	2,375,972	2,053,398	7,034,099	41,350	2,094,748	4,939,351	3.36
New Construction	884,643	2,664,670	7,599,092	125	2,664,795	4,934,298	2.85
Final Verified Total	**13,738,742**	**12,571,109**	**43,962,062**	**2,297,867**	**14,868,976**	**29,093,086**	**2.96**

Table M-12. Enbridge Industrial TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Final Verified Results							
Industrial Custom	7,161,652	2,640,877	14,786,259	10,805	2,651,681	12,134,577	5.58
Industrial Prescriptive	475,461	368,272	1,391,453	581,814	950,086	441,367	1.46
Agriculture	197,247	266,058	360,154	-	266,058	94,096	1.35
Final Verified Total	**7,834,360**	**3,275,207**	**16,537,866**	**592,619**	**3,867,826**	**12,670,040**	**4.28**

Table M-13. Enbridge Low Income TRC results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Final Verified Results							
Low Income Part 9	1,143,282	3,406,633	3,749,834	679,500	4,086,132	(336,298)	0.92
Low Income Part 3	3,421,760	3,087,497	10,412,555	353,506	3,441,003	6,971,552	3.03
Final Verified Total*	**4,565,042**	**6,494,130**	**14,162,389**	**1,033,006**	**7,527,136**	**6,635,254**	**1.88**

*This total does not include the Low Income overhead amount, which is why the results are different from the Low Income row in Table M-9.

Table M-14. Union Low Income PAC results

Program	Annual net savings (m3)	Program-level Incentives/ Promotion	Program-level general admin. costs	Portfolio Budget	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results**								
Low Income	2,251,107	6,645,067	1,055,967	804,624	6,618,986	7,701,034	(1,082,048)	0.86
Final Verified Results								
Low Income	2,251,042	6,645,067	1,055,967	804,624	8,284,628	7,701,034	583,274	1.08

**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

Table M-15. Union Resource Acquisition PAC results

Program	Annual net savings (m3)	Program-level Incentives/ Promotion	Program-level general admin. costs	Portfolio Budget	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results**								
Commercial Prescriptive	9,283,248	2,831,233	531,898	208,905	25,120,221	3,363,131	21,757,089	7.47
Commercial Custom	7,602,421	977,281	435,592	171,081	17,790,153	1,412,874	16,377,279	12.59
Small Industrial	16,711,451	2,257,424	957,508	376,065	38,912,289	3,214,932	35,697,357	12.10
Agriculture & Greenhouse	19,185,899	2,278,174	1,099,285	431,749	41,358,032	3,377,460	37,980,572	12.25
Residential	4,898,590	4,525,364	924,847	569,452	11,493,323	5,450,211	6,043,112	2.11
Utility-Reported Draft Total	**57,681,609**	**12,869,476**	**3,949,131**	**1,757,251**	**134,674,017**	**16,818,607**	**117,855,410**	**8.01**
Final Verified Results								
Commercial Prescriptive	9,307,088	2,831,233	552,470	216,985	29,874,992	3,383,704	26,491,289	8.83
Commercial Custom	7,277,557	977,281	431,997	169,668	19,318,893	1,409,278	17,909,615	13.71
Small Industrial	15,997,344	2,257,424	949,605	372,961	42,428,192	3,207,029	39,221,164	13.23
Agriculture & Greenhouse	18,366,054	2,278,174	1,090,212	428,185	44,474,009	3,368,386	41,105,623	13.20
Residential	4,920,932	4,525,364	924,847	569,452	12,254,926	5,450,211	6,804,716	2.25
Final Verified Total	**55,868,974**	**12,869,476**	**3,949,131**	**1,757,251**	**148,351,013**	**16,818,607**	**131,532,406**	**8.82**

**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

Table M-16. Union Large Volume PAC results

Program	Annual net savings (m3)	Program-level Incentives/ Promotion	Program-level general admin. costs	Portfolio Budget	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results**								
Large Industrial-T1	5,743,536	477,540	115,020	39,104	11,600,801	592,560	11,008,241	19.58
Large Industrial-T2	38,382,453	1,359,669	768,645	261,318	66,797,160	2,128,314	64,668,846	31.39
Large Industrial-R100	5,131,627	386,076	102,766	34,937	5,918,686	488,842	5,429,844	12.11
Utility-Reported Draft Total	**49,257,616**	**2,223,285**	**986,431**	**335,359**	**84,316,647**	**3,209,716**	**81,106,931**	**26.27**
Final Verified Results								
Large Industrial-T1	1,445,698	477,540	115,810	39,372	4,512,275	593,350	3,918,925	7.60
Large Industrial-T2	9,598,272	1,359,669	768,884	261,399	25,947,942	2,128,553	23,819,389	12.19
Large Industrial-R100	1,270,020	386,076	101,737	34,588	2,173,247	487,813	1,685,433	4.46
Final Verified Total	**12,313,990**	**2,223,285**	**986,431**	**335,359**	**32,633,463**	**3,209,716**	**29,423,747**	**10.17**

**These values were calculated using the utility-reported draft savings results. Union only reported TRC in its filings for 2015.

Table M-17. Enbridge Residential PAC results

Program	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results				
Home Energy Conservation	20,382,468	9,362,295	11,020,173	2.18
Final Verified Results				
Home Energy Conservation	15,833,554	9,362,295	6,471,259	1.69

Table M-18. Enbridge Commercial PAC results

Program	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results				
Commercial Prescriptive	18,785,522	759,387	18,026,134	24.74
Commercial Custom	35,425,654	3,006,848	32,418,806	11.78
Run It Right	542,289	1,458,896	(916,607)	0.37
Multi-Residential	22,201,798	1,527,069	20,674,730	14.54
New Construction	13,685,301	43,749	13,641,552	312.81
Utility-Reported Draft Total	**906,640,564**	**6,795,949**	**83,844,615**	**13.34**
Final Verified Results				
Commercial Prescriptive	13,883,037	759,387	13,123,650	18.28
Commercial Custom	9,525,149	3,006,848	6,518,301	3.17
Run It Right	243,445	1,458,896	(1,215,451)	0.17
Multi-Residential	6,396,804	1,527,069	4,869,735	4.19
New Construction	2,659,747	43,749	2,615,997	60.79
Final Verified Total	**32,708,182**	**6,795,949**	**25,912,232**	**4.81**

Table M-19. Enbridge Industrial PAC results

Program	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results				
Industrial Custom	31,091,685	2,032,054	29,059,631	15.30
Industrial Prescriptive	1,385,792	27,150	1,358,642	51.04
Agriculture	894,031	107,502	786,529	8.32
Utility-Reported Draft Total	**33,371,509**	**2,166,706**	**31,204,802**	**15.40**
Final Verified Results				
Industrial Custom	14,735,667	2,032,054	12,703,614	7.25
Industrial Prescriptive	1,230,060	27,150	1,202,910	45.31
Agriculture	360,154	107,502	252,652	3.35
Final Verified Total	**16,325,882**	**2,166,706**	**14,159,176**	**7.53**

Table M-20. Enbridge Low Income PAC results

Program	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results				
Low Income Part 9	5,178,114	4,444,616	733,498	1.17
Low Income Part 3	12,691,944	2,111,746	10,580,198	6.01
Utility-Reported Draft Total	**178,700,528**	**6,556,362**	**11,313,696**	**2.73**
Final Verified Results				
Low Income Part 9	3,731,189	4,444,616	(713,427)	0.84
Low Income Part 3	9,596,574	2,111,746	7,484,828	4.54
Final Verified Total*	**13,327,763**	**6,556,362**	**6,771,401**	**2.03**

*This total does not include the Low Income overhead amount, which is why the results are different from the Low Income row in Table M-21.

Table M-21. Enbridge overall PAC results

Program	PAC Benefits	PAC Costs	PAC Value	PAC Ratio
Utility-Reported Draft Results				
Resource Acquisition	144,394,541	23,964,031	120,430,511	6.03
Low Income	17,870,058	7,173,711	10,696,347	2.49
Utility-Reported Draft Total	**162,264,599**	**31,137,742**	**131,126,858**	**5.21**
Final Verified Results				
Resource Acquisition	64,867,618	23,964,031	40,903,587	2.71
Low Income	13,327,763	7,173,711	6,154,052	1.86
Final Verified Total	**78,195,381**	**31,137,742**	**47,057,639**	**2.51**

Table M-22. Union Low Income TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	TRC Costs (equipment)	TRC Value (equipment)	TRC Ratio (equipment)	Program Admin Costs	TRC Ratio (program)
Final Verified Results								
LI Multi-Family Custom	261,801	1,977,229	778,431	1,977,229	(1,198,798)	0.39	122,811	0.37
LI Multi-Family Prescriptive	589,643	456,499	2,297,377	456,499	1,840,877	5.03	276,602	3.13
Home Weatherization Program	1,341,765	3,453,070	6,941,769	3,453,070	3,488,698	2.01	629,424	1.70
LI Multi-Family Custom - Contrax	57,832	187,055	191,620	187,055	4,565	1.02	27,129	0.89
Final Verified Total	**2,251,042**	**6,073,854**	**10,209,196**	**6,073,854**	**4,135,342**	**1.68**	**1,055,967**	**1.43**

Table M-23. Union Resource Acquisition TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	TRC Costs (equipment)	TRC Value (equipment)	TRC Ratio (equipment)	Program Admin Costs	TRC Ratio (program)
Final Verified Results								
Prescriptive	9,307,088	9,170,777	36,767,282	9,170,777	27,596,505	4.01	552,470	3.78
Agriculture & Greenhouse-Banner	1,346,544	1,401,880	3,734,189	1,401,880	2,332,308	2.66	79,931	2.52
Agriculture & Greenhouse-Contrax	17,019,510	11,807,111	47,551,033	11,807,111	35,743,922	4.03	1,010,281	3.71
Commercial & Institutional Buildings-Banner	1,268,208	4,126,179	4,641,868	4,126,179	515,690	1.12	75,281	1.10
Commercial & Institutional Buildings-Contrax	6,009,349	3,422,661	31,155,125	3,422,661	27,732,464	9.1	356,716	8.24
Industrial-Banner	1,232,360	1,493,146	4,015,500	1,493,146	2,522,354	2.69	73,153	2.56
Industrial-Contrax	14,764,984	11,066,870	45,653,724	11,066,870	34,586,854	4.13	876,452	3.82
Energy Savings Kit	1,666,803	151,348	4,564,935	151,348	4,413,586	30.16	313,261	9.83
Home Reno Rebate	3,254,128	12,866,720	11,977,004	12,866,720	(889,716)	0.93	611,586	0.89
Final Verified Total	**55,868,974**	**55,506,693**	**190,060,660**	**55,506,693**	**134,553,967**	**3.42**	**3,949,131**	**3.20**

Table M-24. Union Large Volume TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	TRC Costs (equipment)	TRC Value (equipment)	TRC Ratio (equipment)	Program Admin Costs	TRC Ratio (program)
Final Verified Results								
Large Industrial-T1	1,445,698	709,008	5,447,623	709,008	4,738,615	7.68	115,810	6.60
Large Industrial-T2	9,598,272	3,540,164	30,140,629	3,540,164	26,600,465	8.51	768,884	6.99
Large Industrial-R100	1,270,020	322,986	2,572,405	322,986	2,249,419	7.96	101,737	6.06
Final Verified Total	**12,313,990**	**4,572,158**	**38,160,657**	**4,572,158**	**33,588,499**	**8.35**	**986,431**	**6.87**

Table M-25. Enbridge overall TRC-Plus results

Scorecard	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	Program Costs	Overhead	TRC Costs	TRC Value	TRC Ratio
Final Verified Results								
Resource Acquisition	28,335,894	23,636,918	89,303,057	3,912,353	5,639,080	33,188,351	61,753,786	2.69
Low Income	4,565,042	6,494,130	16,286,748	1,033,006	617,349	8,144,485	8,142,263	2.00

Table M-26. Enbridge Residential TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Utility-Reported Draft Results							
Home Energy Conservation	6,762,791	7,790,602	22,077,884	1,021,867	8,812,469	132,654,158	2.51
Final Verified Results							
Home Energy Conservation	6,762,791	7,790,602	19,728,139	1,021,867	8,812,469	10,915,671	2.24

Table M-27. Enbridge Commercial TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Utility-Reported Draft Results							
Commercial Prescriptive	5,750,534	3,640,863	30,989,923	-	3,640,863	27,349,060	8.51
Commercial Custom	12,326,277	11,395,046	42,631,687	785,017	12,180,063	30,451,624	3.50
Run It Right	536,821	196,467	542,289	1,471,376	1,667,843	(1,125,554)	0.33
Multi-Residential	5,890,850	5,091,080	24,316,449	41,350	5,132,430	19,184,019	4.74
New Construction	3,027,916	9,120,516	39,043,342	125	9,120,641	29,922,701	4.28
Utility-Reported Draft Total	**27,532,399**	**29,443,972**	**137,523,689**	**2,297,867**	**31,741,839**	**105,781,850**	**4.33**
Final Verified Results							
Commercial Prescriptive	5,671,517	3,569,834	20,269,633	-	3,569,834	16,699,799	5.68
Commercial Custom	4,519,626	4,178,176	13,178,607	785,017	4,963,192	8,215,415	2.66
Run It Right	286,985	105,031	279,961	1,471,376	1,576,407	(1,296,446)	0.18
Multi-Residential	2,375,972	2,053,398	8,089,214	41,350	2,094,748	5,994,466	3.86
New Construction	884,643	2,664,670	8,738,956	125	2,664,795	6,074,161	3.28
Final Verified Total	**13,738,742**	**12,571,109**	**50,556,372**	**2,297,867**	**14,868,976**	**35,687,396**	**3.40**

Table M-28. Enbridge Industrial TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Utility-Reported Draft Results							
Industrial Custom	11,097,622	4,092,276	33,723,828	10,805	4,103,080	29,620,748	8.22
Industrial Prescriptive	398,824	304,562	1,553,550	581,814	886,376	667,174	1.75
Agriculture	366,783	494,737	894,031	-	494,737	399,294	1.81
Utility-Reported Draft Total	**11,863,229**	**4,891,575**	**36,171,410**	**592,619**	**5,484,194**	**30,687,216**	**6.60**
Final Verified Results							
Industrial Custom	7,161,652	2,640,877	17,004,197	10,805	2,651,681	14,352,516	6.41
Industrial Prescriptive	475,461	368,272	1,600,171	581,814	950,086	650,084	1.68
Agriculture	197,247	266,058	414,177	-	266,058	148,119	1.56
Final Verified Total	**7,834,360**	**3,275,207**	**19,018,546**	**592,619**	**3,867,826**	**15,150,720**	**4.92**

Table M-29. Enbridge Low Income TRC-Plus results

Program	Annual net savings (m3)	Measure Incremental Costs	TRC-Plus Benefits	Program Costs	TRC Costs	TRC Value	TRC Ratio
Utility-Reported Draft Results							
Low Income Part 9	1,139,959	3,398,252	5,253,138	679,500	4,077,752	1,175,386	1.29
Low Income Part 3	3,397,177	3,073,287	14,695,099	353,506	3,426,793	11,268,305	4.29
Utility-Reported Draft Total	**4,537,136**	**6,471,539**	**19,948,237**	**1,033,006**	**7,504,545**	**12,443,691**	2.66
Final Verified Results							
Low Income Part 9	1,143,282	3,406,633	4,312,309	679,500	4,086,132	226,177	1.06
Low Income Part 3	3,421,760	3,087,497	11,974,438	353,506	3,441,003	8,533,435	3.48
Final Verified Total*	**4,565,042**	**6,494,130**	**16,286,748**	**1,033,006**	**7,527,136**	**8,759,612**	**2.16**

*This total does not include the Low Income overhead amount, which is why the results are different from the Low Income row in Table M-25.

APPENDIX N. SPILLOVER ESTIMATE

This appendix describes the source of the estimated value used for spillover and how it was added to the free ridership estimate to produce the NTG ratio for custom projects.[38]

A spillover study is currently being conducted on Ontario gas utilities' custom projects from 2013 and 2014; however, those results are not yet available. The OEB asked the EC to conduct secondary source research to identify an estimate that might reasonably be applied to the Ontario DSM programs as an estimate for the 2015 clearance of accounts. The EC selected a 3.4% spillover rate based on a study in Massachusetts.[39] This is the most applicable value for the Ontario DSM programs because:

- Massachusetts has a similar climate to Ontario's major population centers, so it is likely that similar measures are being implemented
- The spillover value is specifically for custom gas C&I measures, which is the same program type
- The programs in Massachusetts and Ontario are mature and in leading jurisdictions
- The Massachusetts study looked at both "like" and "unlike" spillover[40]
- The rate is within the anticipated range of results expected for spillover from custom gas C&I programs, not an extreme outlier
- The study is relatively recent, from 2014-15.

The major differences from the Ontario spillover study are as follows:

- It only *quantifies* (provides a savings estimate for) like spillover, not unlike spillover.
- The study was conducted on customers who had participated in the program 15-27 months prior, not four or five years ago. This provides for less time since the program measure for spillover to occur.

The spillover estimate was added to the measured free ridership rate from the CPSV/NTG study (APPENDIX H). Table N-1 and Table N-2 show the free ridership, spillover, and NTG adjustment factors.

The NTG adjustment factors were applied to the verified gross savings to produce verified net savings.

[38] Spillover is only added to custom projects in C&I and Large Volume, not Low Income.

[39] Tetra Tech. "2014-15 Commercial and Industrial Natural Gas Programs Free-ridership and Spillover Study" for National Grid, Eversource, Unitil, Berkshire Gas, Columbia Gas of MA, and Liberty Utilities. Revised August 10, 2015.

[40] Like spillover refers to energy efficient equipment installed by a participant due to program influence that is identical to the equipment they received through the program. Unlike spillover is installed equipment due to program influence that is different from what they received through the program.

Table N-1. Union free ridership, spillover, and NTG adjustment factors by subset

Program	Free Ridership Adjustment†	Spillover Addition	Net-to-Gross Adjustment†
C&I Custom Comm & Inst Buildings	44%	3.4%	47%
C&I Custom Ag and Greenhouse	41%	3.4%	44%
C&I Custom Industrial	39%	3.4%	43%
Large Industrial R100	8%	3.4%	12%
Large Industrial T1	9%	3.4%	13%
Large Industrial T2	8%	3.4%	11%

†These values are rounded.

Table N-2. Enbridge CPSV and NTG adjustment factors

Program	Free Ridership Adjustment†	Spillover Addition	Net-to-Gross Adjustment†
Custom Commercial	17%	3.4%	21%
C&I Custom New Construction	18%	3.4%	22%
Custom Multi-family	35%	3.4%	38%
Custom Industrial Ag	28%	3.4%	32%
Custom Industrial	33%	3.4%	36%
RunitRight	50%	3.4%	53%

†These values are rounded.

APPENDIX O. FINAL ANNUAL VERIFICATION EM&V PLAN

Below is the detailed plan for the 2015 verification. The plan was largely implemented as written; however, there was a large divergence from the original schedule.

DNV·GL

Natural Gas Demand Side Management - Detailed Plan for 2015 Annual Verification

submitted to the Ontario Energy Board

Date: January 13, 2017

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1 INTRODUCTION

This document has been prepared for the Ontario Energy Board (OEB) and outlines the detailed plan for conducting the annual verification of Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) programs delivered in 2015. These verifications will be conducted by the Evaluation Contractor (EC) team.

The overall objectives of the evaluations are to:

- Provide an independent opinion on whether the Lost Revenue Adjustment Mechanism (LRAM), DSM Variance Account (DSMVA), and DSM Shareholder Incentive (DSMSI) were reasonable, appropriate, and calculated correctly.
- Recommend future evaluation research opportunities to enhance the assumptions used to calculate DSMSI and LRAM amounts.
- Recommend changes to improve input assumptions, verification procedures, and the overall verification process.

The LRAM, DSMVA, and DSMSI are based on the following metrics:

- LRAM: the verified natural gas energy savings (in annual cubic meters) by rate class (rounded to the nearest 1,000 cubic meters) and the cost of the natural gas by rate class for the program year.
- DSMVA: the actual money collected, by rate class, for implementing DSM programs during the program year and the actual DSM costs incurred by the programs.
- DSMSI: the actual program achievements compared to the scorecard metrics for that program, the weight placed on each metric within each scorecard, and the maximum incentive achievable for that scorecard.

Therefore, the information that must be verified for 2015 includes the program natural gas savings and the program achievements compared to the scorecard metrics. The EC will also review the money collected and spent by the programs but will not conduct a full financial audit of the reported amounts. The OEB may conduct financial audits of the gas utilities DSM spending as it sees fit. The verified savings and program achievements will be used to confirm the LRAM and DSMSI amounts.

The remainder of this document provides the following:

- An overview of the 2015 programs and their scorecard metrics
- A list of the data, documentation, and other information necessary to conduct the verification
- A list of the activities that will be conducted as part of the verification
- An accounting of the expected verification outcomes and the process for reviewing those outcomes
- A proposed schedule for completing the verification

While some information related to the verification of custom projects (i.e. Custom Project Savings Verification, or CPSV) can be found in this document, it is not considered part of the "annual verification" and the details are located elsewhere.

2 REPORTED METRICS TO VERIFY

To verify the LRAM and DSMSI, the EC must verify the reported utility achievements for each scorecard, as well as verify the energy savings achieved by each rate class. Table 2-1 and Table 2-2 show the 2015 targets, weights, and maximum shareholder incentive by scorecard (resource acquisition, large volume, low income, and market transformation) for Union and Enbridge, respectively. It also shows the reported 2015 achievement for each utility. Because some scorecards are a compilation of the achievements of multiple programs, Table 2-3 and Table 2-4 show the scorecard metrics and energy savings achievements by program.

Table 2-1. Union's Reported 2015 achievement, target, weight, and maximum shareholder incentive by scorecard

Scorecard	2015 Target	2015 Reported Achievement	% of Target	Weight	Maximum Shareholder Incentive (if 150% of target achieved)
Union					
Resource Acquisition	816,561,818 CCM	938,905,035 CCM	130%	90%	$5,761,833
	1,245 deep savings participants	2,537 participants	308%	5%	
	8.88% of commercial whole building natural gas use saved	8.24% saved	68%	5%	
Large Volume	206,256,017 Rate 1 CCM	78,919,835 CCM	-23%	60%	$1,862,877
	1,029,841,387 Rate T2/100 CCM	499,103,360 CCM	-3%	40%	
Low Income	26,000,000 single family CCM	33,504,841 CCM	158%	60%	$2,810,129
	17,600,000 multi-family CCM	16,948,695 CCM	93%	40%	
Market Transformation	30% of homes built by participating builders were 20% more efficient than OBC	50% of homes	306%	100%	$566,721
TOTAL					**$11,001,560**

Table 2-2. Enbridge's Reported 2015 achievement, target, weight, and maximum shareholder incentive by scorecard

Scorecard	2015 Target	2015 Reported Achievement	% of Target	Weight	Maximum Shareholder Incentive (if 150% of target achieved)
Enbridge					
Resource Acquisition	1,011,900,000 CCM	767,627,826 CCM	52%	92%	$6,482,744
	762 deep savings participants	5,646 participants	1385%	8%	
Low Income	24,100,000 single family CCM	28,343,978 CCM	135%	50%	$2,495,721
	68,700,000 multi-family CCM	69,226,782 CCM	102%	45%	
	40% of Part 3 participants enrolled	65% enrolled	224%	5%	
Residential Savings by Design (Market Transformation)	18 Builders enrolled	19 Builders enrolled	113%	20%	$1,076,493
	1,111 homes built 20% more efficient than OBC	1,987 of homes	258%	13%	
Commercial Savings by Design (Market Transformation)	18 New developments enrolled	24 developments enrolled	150%	33%	$418,269
Home Labelling (Market Transformation)	5,000 Realtor commitments	41,650 Realtor commitments	466%	17%	$616,397
	4,500 Ratings performed	336 Ratings performed	7%	17%	
TOTAL					**$11,089,624**

Table 2-3. Union 2015 reported achievement by program

Program	2015 Reported Achievement
Union Gas	
Home Reno Rebate	58,923,165 CCM 2,537 Deep savings participants
Energy Savings Kit	19,567,373 CCM
C&I Overall	8.24% of whole building natural gas use saved
Commercial Custom	678,002,610 CCM
Commercial Prescriptive	182,411,887 CCM
Large Volume Rate T1	78,919,835 CCM
Large Volume Rates T2/100	499,103,360 CCM
Low Income Weatherization	33,504,841 CCM
Low Income Multi-Residential Housing	16,948,695 CCM
Optimum Home	50% of homes built by participating builders were 20% more efficient than OBC

Table 2-4. Enbridge 2015 reported achievement by program

Program	2015 Reported Achievement
Enbridge	
Residential Home Energy Conservation	102,415,214 CCM 5,646 Deep savings participants
Commercial Custom	383,277,447 CCM
Industrial Custom	172,964,331 CCM
Commercial Prescriptive	98,693,722 CCM
Industrial Prescriptive	7,593,008 CCM
Run it Right	2,684,105 CCM
Low Income Home Winterproofing	28,343,978 CCM
Low Income Multi-Residential Housing	69,226,782 CCM

Program	2015 Reported Achievement
	65% of Part 3 participants enrolled
Residential Savings by Design	19 Builders enrolled 1,987 homes built 20% more efficient than OBC
Commercial Savings by Design	24 New developments enrolled
Home Labelling	41,650 Realtor commitments 336 Ratings performed

3 ACTIVITIES

To verify the information reported in section 2, the EC will conduct the activities outlined in Table 3-1 and Table 3-2. To prepare for the program-specific activities, the EC will request tracking data and documentation, specified in section 4. For all programs, the EC will first review the reported savings and metrics from the tracking data and compare them to the summarized information in the gas utilities' annual report to ensure consistency. We will also recreate the reported DSMVA, LRAM, and DSMSI values using the reported savings and scorecard achievements to confirm that the calculations were done correctly.

Once the program-specific verifications are completed, the EC will assemble the verified scorecard results and calculate the verified LRAM, DSMVA, and DSMSI results as necessary. We will also document any recommendations that may improve the annual verification process going forward.

Table 3-1. 2015 Annual verification activities for Union, by program

Program	Metrics	Activity
Union Gas		
Home Reno Rebate **Energy Savings Kit** **Low Income Weatherization** **Low Income Multi-Residential Housing**	Natural gas savings (CCM) Number of deep savings participants	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for a census (or the full population) of measures. Verify the number of deep savings participants by reviewing the detailed documentation for a sample of participants. Apply the results of the CPSV / NTG study, where appropriate.
Commercial Custom	Natural gas savings (CCM) Average percent of whole building energy use saved by the program	Confirm that the necessary factors (such as NTG assumptions) were applied correctly and that recommendations from previous evaluations were adopted. Apply the results of the CPSV / NTG study. Collect the annual billing information for a census of participants and compare the verified energy savings to the annual energy use to confirm the percent of whole building natural gas use saved.
Commercial Prescriptive	Natural gas savings (CCM) Average percent of whole building energy use saved by the program	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for a census of measures. Collect the annual billing information for a census of participants and compare verified energy savings to the annual energy use to confirm the percent of whole building natural gas use saved.

Program	Metrics	Activity
Large Volume	Natural gas savings (CCM)	Confirm that the necessary factors (such as NTG assumptions) were applied correctly and that recommendations from previous evaluations were adopted. Apply the results of the CPSV / NTG study.
Optimum Home	Percent of homes built by participating builders that are 20% more efficient than OEB	Review the procedure used for determining the scorecard metric to confirm whether it leads to accurate results.

Table 3-2. 2015 Annual verification activities for Enbridge, by program

Program	Metrics	Activity
Enbridge		
Residential Home Energy Conservation **Low Income Home Winterproofing** **Low Income Multi-Residential Housing**	Natural gas savings (CCM) Number of deep savings participants Percent of Part 3 participants enrolled	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for a census of measures. Verify the number of deep savings participants by reviewing the detailed documentation for a sample of participants. Review documentation to confirm the Part 3 participant low income scorecard metric. Apply the results of the CPSV / NTG study, where appropriate.
Commercial and Industrial Custom	Natural gas savings (CCM)	Confirm that the necessary factors (such as NTG assumptions) were applied correctly and that recommendations from previous evaluations were adopted. Apply the results of the CPSV / NTG study.
Commercial and Industrial Prescriptive	Natural gas savings (CCM)	Confirm that the measure-level inputs for prescriptive measures were appropriate and confirm that the savings were calculated correctly for a census of measures.
Run it Right	Natural gas savings (CCM)	Conduct a desk review of a sample of participants to verify the reasonableness of the claimed savings.
Residential Savings by Design **Commercial Savings by Design** **Home Labelling**	Builders enrolled Number of efficient homes Number of developments Number of realtor commitments Number of ratings performed	Review the procedure used for determining the scorecard metrics to confirm whether it leads to accurate results.

4 WHAT INFORMATION IS NECESSARY

DNV GL will request data and documentation in two waves. The first documentation request will address the tracking data for each program, documentation and support for prescriptive savings calculations, assumptions and adjustments (such as NTG assumptions) for custom savings projects, billing data for Union commercial customers, and an explanation for how metrics for market transformation programs are counted and tracked. The second documentation request will be significantly smaller, requesting documentation on a sample of Run it Right and Home Reno Rebate / Residential Home Energy Conservation participants.

The detailed data requested as part of the two documentation requests are shown in Table 4-1. Per the schedule outlined in section 6, the EC will send a formal documentation request for Round 1 on January 6th, with delivery due January 20th. The EC will send a formal documentation request for Round 2 on January 31st at the latest, with delivery due on February 14th.

Table 4-1. Detailed data requested for each documentation request

Documentation Request	Requested Information
Union	
Round 1: Jan 6 **Due by: Jan 20**	A copy of Year 2015 verification and evaluation studies A copy of any previous verification and evaluation studies that apply to Year 2015 savings calculations A download of the Union Year 2015 tracking data for all programs with all fields except those that include personally identifiable information such as name, address, telephone number, or account ID. A copy of operational and quality assurance documentation associated with the tracking database A copy of the spreadsheets or other documentation that confirms the reported market transformation achievements for Year 2015. Year 2015 whole-building billing data for all commercial program participants.
Round 2: Jan 31 **Due by: Feb 14**	Full documentation for a number (25 or more) of participants of the Home Reno Rebate program and Low Income Weatherization program. Full documentation for at least one Optimal Home to confirm that it meets program requirements. Full documentation for at least one builder participating in Optimal Home.
Enbridge	
Round 1: Jan 6 **Due by: Jan 20**	A copy of Year 2015 verification and evaluation studies A copy of any previous verification and evaluation studies that apply to Year 2015 savings calculations A download of the Enbridge Year 2015 tracking data for all programs with all fields except those that include personally identifiable information such as name, address, telephone number, or account ID. A copy of operational and quality assurance documentation associated with the tracking database A copy of the spreadsheets or other documentation

Documentation Request	Requested Information
	that confirms the reported market transformation achievements for Year 2015. Documentation that confirms the Part 3 enrollment percentage
Round 2: Jan 31 **Due by: Feb 14**	Full documentation for a number (25 or more) of participants of the Home Energy Conservation program and Low Income Weatherization program. Full documentation for at least one Residential Savings by Design home to confirm that it meets program requirements. Full documentation for at least one builder participating in Residential Savings by Design. Full documentation for at least one Commercial Savings by Design development to confirm that it meets program requirements. Full documentation for at least one builder participating in Commercial Savings by Design. Full documentation of at least one realtor commitment and subsequent ratings performed for Home Labeling.

5 OUTCOMES AND REVIEW PROCESS

The annual verification process will produce verified energy savings and scorecard achievements (by utility, scorecard, and program) for the 2015 program year. It will also produce updated LRAM, DSMVA, and DSMSI amounts that can be used in the clearance of accounts proceedings. The EC will assemble the verification methodology, reported achievements, and verified results into a single report for review and comment by the OEB and Evaluation Advisory Committee (EAC). The EC will also include recommendations for future improvements, high-level results from additional evaluation studies conducted on the 2015 program year data (such as the CPSV / NTG study), and the full reports of those studies in attached appendices. In effect, the annual verification process will produce a report that summarizes all of the recent evaluation and verification studies completed, their outcomes, and how they were applied to the 2015 program year.

At a high level, the verification report will include the following sections:

- **Executive Summary:** This section will summarize the introduction and objective of the document and report on the verified scorecard achievements for the 2015 program year. The Executive Summary will also include the verified LRAM, DSMVA, and DSMSI amounts.
- **Introduction:** This section will introduce the verification study, its objectives, and how the document reports the accomplishments.
- **Methodology:** This section will summarize the evaluation and verification activities undertaken to verify the 2015 program year savings and scorecard metrics. The section will be a high-level summary of the activities and use appendices to provide additional detail.
- **Results:** This section will report on the results of the annual verification and summarize the high-level results of additional evaluation activities. It will also report on the application of those results to the LRAM, DSMVA, and DSMSI calculations and the final outcomes.
- **Conclusions:** This section will summarize the LRAM, DSMVA, and DSMSI final results and summarize any recommendations made throughout the annual verification report, including those made in the additional evaluation reports.

The EC team proposes an unusual review structure to coordinate with the CPSV / NTG study and meet an aggressive March 31, 2016 deadline. We propose to distribute an incomplete draft report that includes all of the necessary verification factors EXCEPT the final results of the CPSV / NTG study on March 10. The next two weeks (until March 24th) would be used for review, comment, and addressing the comments on the annual verification report, minus the CPSV / NTG results. When the CPST / NTG results are finalized, on or just before March 31, they would be incorporated into the annual report, which would be finalized without an additional round of review.

The entire schedule is shown in section 6.

6 SCHEDULE

This section outlines the project tasks and schedule for the 2015 annual verification. The schedule is shown in Table 6-1, which lists each verification task and the start and end dates for completing that task. Bolded rows (and green-filled cells) are "super" tasks. The indented, non-bolded (and blue-filled cells) rows are sub-tasks within that super-task.

The schedule is aggressive and designed to limit interference with the CPSV / NTG study as much as possible. It is also designed to produce a final report on March 31st to meet OEB reporting requirements.

Table 6-1. Schedule of deliverables

Task	Dec	Jan	Feb	Mar
Detailed plan				
Initial tracking data review		6th	17th	
Initial data request		6th		
Initial data delivery		20th		
Identify sample for detailed review		31st		
Documentation request		31st		
Final documentation delivery			14th	
Tracking savings certification		20th		3rd
Confirm match with reporting		20th - 27th		
Assemble assumptions and adjustments		20th - 27th		
Recreate savings estimates		27th	17th	
Confirm/verify errors with utilities			17th	3rd
Documentation review				
Run it Right analysis			15th	3rd
Deep savings analysis			27th	3rd
Enbridge Part 3 analysis			27th	3rd
Market transformation analysis			15th	3rd
Union commercial percentage analysis			15th	3rd
Verified results		30th		31st
Verify DSMVA, LRAM, DSMSI calculations		30th	10th	
Assemble tracking and documentation results			17th	10th
Produce verified scorecard metrics			17th	10th
Apply CPSV / NTG results				31st
Reporting			17th	31st
Write recommendations			17th	15th
Draft results without CPSV / NTG				10th – 24th
Final results with all factors				31st
Project Management				

The EC has highlighted the tasks that require utility involvement and the dates of that involvement, in Table 6-2. There are two documentation delivery periods: one for the initial tracking data, and a follow-up period to deliver detailed documentation for a sample of measures from select programs. There are also two review periods: one for discussing any discrepancies from the tracking savings certification, and one for the overall draft report.

EAC involvement is also necessary to complete the annual assessment. The EC requests that the EAC review and comment on the draft report from March 10th through the 24th.

Table 6-2. Utility involvement during 2015 annual verification activities

Utility Involvement	Dec	Jan	Feb	Mar
Assemble and deliver initial tracking data		6th – 20th		
Assemble and deliver requested documentation		31st	14th	
Discuss discrepancies in reporting sums and certified savings			17th	3rd
Review draft report				10th - 24th

APPENDIX P. FINAL CPSV/NTG REPORT

Below is the final 2015 CPSV/NTG report. It does not include the spillover results.

ONTARIO GAS DSM EVALUATION CONTRACTOR

2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation

Ontario Energy Board

Date: October 12, 2017

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GLOSSARY OF TERMS AND KEY CONCEPTS

Action	**A DSM measure that generates savings through optimization, maintenance or repair of existing systems. Actions (vs. equipment) were categorized for the populations of measures based on tracking database information provided by the utilities for sample design.**
Adjustment factor	The adjustment factors are ratios of savings that allow evaluation findings from a sample of projects to be applied to and "adjust" the population of program savings. Realization rates, and ratios are other common terms.
Attribution	The portion of a measure that is attributable to the program being evaluated, which is the complement of free ridership (1-FR) for that program.
Baseline, base case	Energy use / equipment in place if the program measure had not been done
Building envelope	Exterior surfaces (e.g., walls, windows, roof, and floor) of a building that separate the conditioned space from the outdoors.
Capacity expansion (CE)	Measure that allows customer to increase production/productivity
CCM	Cumulative Cubic meters (cumulative m^3)
Code	Measure required by regulations for safety, environmental, or other reasons
C&I	Commercial and Industrial
Computer-aided technical interviews (CATI)	Structured surveys administered by a third-party survey firm that require clearly defined skip logic and structured formats, CATI surveys are a lower cost data collection approach suitable for structured gathering of information from large samples of respondents
Custom Program savings verification (CPSV)	Activities related to the collection, analysis, and reporting of data for purposes of measuring gross custom program impacts.
Customer - Enbridge	DNV GL identified unique customers based on the Con_acc_num and the contact information provided by Enbridge. A customer may have multiple site addresses, decision makers, Con_acc_nums, and utilities. Customers could only be identified for records for which we received contact information.
Customer - Union	DNV GL identified unique customers based on the AIMS ID and the contact information provided by Union. A customer may have multiple site addresses, decision makers, AIMS IDs, and utilities. Customers could only be identified for records for which we received contact information.
Customer Incentive	An incentive is a transfer payment from the utility to participants of a DSM program. Incentives can be paid to customers, vendors or other parties as part of a DSM program.
Demand side management (DSM)	Modification of perceived customer demand for a product through various methods such as financial incentives, education, and other programs
Early replacement (ER)	Measure that replaces a piece of equipment that is not past EUL and in good operating condition
Domain	Grouping of like projects. A domain may be defined as projects within a specific sector or a category of measure types, enduses or other.
Dual Baseline	Savings calculation approach which addresses or combines the savings associated with early replacement and the savings after the early replacement period.
Early replacement Period (ER Period)	Years that the existing equipment would have continued to be in use. This is the same as RUL.
Energy Advisors	Energy Advisors are utility and/or program staff who provide information to customers about energy saving opportunities and program participation, this term includes, but is not limited to, Enbridge's Energy Solutions Consultants and Union's Account Managers
Estimated useful life (EUL)	Typically, the median number of years that the measure will remain in service
Ex ante	Program claimed or reported inputs, assumptions, savings, etc.

Ex post	Program inputs, assumptions, savings, etc… which are verified after the claimed savings are finalized. Does not include assessment of program influence. Synonym for verified gross savings.
Free riders (FR)	Program participants who would have installed a measure on their own initiative even without the program. The free ridership rate is the percentage of customers who are free riders.
Gross savings	Gross savings are changes in energy consumption and/or demand directly caused by program-related actions by participants regardless of reasons for participation
In situ	Existing measure, conditions, and settings
Incremental cost	The difference in purchase price, at the time of purchase, between the efficient measure and the base case measure. In some early retirements and retrofits, the full cost of the efficient technology is the incremental cost.
In-depth interviews (IDI)	Structured technical interviews administered by evaluation engineers and market researchers either in person or more frequently, over the phone, IDIs offer more flexibility than CATIs and are best leveraged for complex projects and topics.
Industry standard practice (ISP)	Common measure implemented within the industry
Input assumptions	Assumptions such as operating characteristics and associated units of resource savings for a list of DSM technologies and measures
Lifetime cumulative savings	Total natural gas savings (CCM) over the life of a DSM measure. Can be claimed, gross, or net. Sometimes referred to as just "cumulative" or "lifetime."
LIMF	Low Income Multifamily Program
Maintenance (Maint.)	Repair or maintain, restore to prior efficiency
Measure – Enbridge	Measures are identified in the tracking data as a unique combination of project code, project sub code, and ESM project ID. Multiple measures may belong to the same project.
Measure – Union	Measure refers to a project # in the tracking data. When referring to Union programs, measure and project are used interchangeably as there is one level provided in the tracking data.
Measurement and Verification (M&V)	Verification of savings using methods not including attribution assessment.
MF	Multifamily
Net savings	Net savings are changes in energy consumption or demand that are attributable to an energy efficiency program, taking into consideration whether the program influenced a customer's decision to undertake an energy efficiency measure or not.
Net-to-gross ratio (NTG)	Is an adjustment factor that reduces gross savings due to net savings, considering both free riders and spillover, the NTG ratio can be less than or greater than 1.0
New construction (NC)	New buildings or spaces
Non-early replacement period (non-ER period)	Years after the ER period up to the EUL
Normal replacement (NR)	Measure that replaces a piece of equipment that is past EUL and in good operating condition
Persistence	The extent to which a DSM measure remains installed, and performing as originally predicted, in relation to its EUL
Program evaluation	Activities related to the collection, analysis, and reporting of data for purposes of measuring program impacts from past, existing, or potential program impacts

Project - Enbridge	Projects are identified in the tracking data based on the project code. A project may have multiple measures.
Project – Union	Projects are identified in the tracking data based on project # or project ID. When referring to Union programs, measure and project are used interchangeably as there is one level provided in the tracking data.
Remaining useful life (RUL)	The number of years that the existing equipment would have remained in service. This is the same as ER Period.
Realization Rate	A combination of adjustment factors, which represents ratios between two savings values. For example, the final realization rate is the ration between evaluated savings and program claimed savings.
Replace on burnout (ROB)	Measure that replaces a failed or failing piece of equipment
Retrofit add-on (REA)	Measure reduces energy use through modification of an existing piece of equipment
Site	Sites are identified based on unique site addresses provided by Union and Enbridge through the contact information data request. A site may have multiple units of analysis, measures, and projects. Sites are identified only for records for which we received contact information.
Spillover (SO)	Participants' adoption of energy efficiency measures due to influence by a utility's program-related information and marketing efforts. Non-participant spillover is not included in this study. Participant Spillover will be provided in a separate volume.
System optimization (OPT)	Improve system or system settings to exceed prior efficiency
TSER	Telephone Supported Engineering Review
Unit of Analysis – Enbridge	The level at which the data are analyzed, which is an aggregation of tracked measures by con_acc_num, year (2015), and measure type (building shell, controls, greenhouse, heat recovery, HVAC, operational improvements, other equipment, process heat, and steam and hot water).
Unit of Analysis - Union	The level at which the data are analyzed, which is an aggregation of tracked measures by AIMS ID, year (2015), and measure type (agriculture and greenhouse, building shell, controls, cogeneration, HVAC, heat recovery, maintenance, new construction, optimization, other equipment, process heat, and steam and hot water).
Vendors	Program trade allies, business partners, contractors and suppliers who work with program participants to implement energy saving measures

1 Executive summary

This report has been prepared for the Ontario Energy Board (OEB) and provides the gross savings verification – custom program savings verification (CPSV) – and net savings – free-ridership (FR) – results for a subset of programs in Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) portfolio delivered in 2015.

The overall objectives of the evaluation are to develop:

- Verified gross savings for 2015 custom commercial, industrial, low income multifamily and large volume projects
- Free-ridership savings for 2015 custom commercial, industrial and large volume projects
- A free-ridership rate for Enbridge's 2015 RunitRight program

The programs included in this study are provided in Table 1.

Table 1-1. CPSV, FR, and SO by program

Program		CPSV	FR
Union			
Custom	Large Volume	✓	✓
	Commercial & Industrial*	✓	✓
	Low Income Multi-Residential	✓	
Enbridge			
Custom	Commercial*	✓	✓
	Industrial	✓	✓
	Low Income Multi-Family	✓	
RunitRight			✓

*Custom Market-Rate Multi-Residential projects are included as a part of this program.

A spillover study of 2013-2014 programs has also been initiated; however, the results from that effort are not included in this report.

1.1 Background

Enbridge and Union deliver energy efficiency programs under the Demand Side Management Framework for Natural Gas Distributors (2015-2020)[1] developed by the OEB. For the 2015 program year, as directed by the board, both utilities "rolled-over" their 2014 plans into 2015 to allow them the time necessary to redesign their programs before implementing them in 2016.

In April 2016, the OEB hired an Evaluation Contractor (EC) team led by DNV GL to develop an overall evaluation, measurement, and verification (EM&V) plan. The objectives of the plan were to:

- Assess portfolio impacts to determine annual savings results, shareholder incentive and lost revenue amounts, and future year targets.

[1] EB-2014-0134

- Assess the effectiveness of energy efficiency programs on their participants and/or market, including results on various scorecard items.
- Identify ways in which programs can be changed or refined to improve their performance.

Under the plan, the DNV GL team conducted a verification of gross savings (CPSV) and net-to-gross (NTG) study of the 2015 program year. This report is a result of that study.

An evaluation advisory committee (EAC) was formed to provide input and advice to the OEB on the evaluation and audit of DSM results. The EAC consists of representatives from non-utility stakeholders, independent experts, staff from the Independent Electricity System Operator (IESO), and observers from the Environmental Commissioner of Ontario and the Ministry of Energy. The DNV GL team worked closely with the EAC throughout this study and received comment, advice, and input on methodology and results. We thank them for their involvement.

1.2 Methodology summary

The results presented in this report are based on data collection from the following five primary sources, supplemented with secondary source information:

- Union and Enbridge tracking databases
- Union and Enbridge project documentation
- In-Depth Interviews with a sample of participating customers
- In-Depth Interviews with a sample of participating vendors
- On-site visit to a sample of participating customer sites

The data collection with samples of participating customers and vendors included site visits and telephone interviews supporting a detailed measurement and verification (M&V) analysis, and in-depth interviews supporting assessment of free ridership. Table 2 shows the targeted and completed data collection activities and the timeframe in which they were completed.

Table 1-2. Data collection activities*

Target Group	Activity	Targeted Units of Analysis	Completed Units of Analysis	Timeframe
Enbridge				
Participating Customers	M&V Site Visit (On-site)	41	61	Jan, 2017 - Mar, 2017
	TSER Interview	38	37	Jan, 2017 - Apr, 2017
	In-Depth Interview	149	151	Jan, 2017 - Apr, 2017
Participating Vendors	In-Depth Interview	~30	20	Mar, 2017- Apr, 2017
Union				
Participating Customers	M&V Site Visit (On-site)	59	106	Jan, 2017 - Mar, 2017
	TSER Interview	22	30	Jan, 2017 - Apr, 2017
	In-Depth Interview	122	203	Jan, 2017 - Apr, 2017
Participating Vendors	In-Depth Interview	~30	15	Mar, 2017- Apr, 2017
Overall				
Participating Customers	M&V Site Visit (On-site)	100	167	Jan, 2017 - Mar, 2017
	TSER Interview	60	67	Jan, 2017 - Apr, 2017
	In-Depth Interview	271	354	Jan, 2017 - Apr, 2017
Participating Vendors	In-Depth Interview	⩽62	35	Mar, 2017- Apr, 2017

*This table reports the number of units of analysis targeted and completed as units of analysis were used to design the sample before customers and sites had been identified. Units of Analysis are a slight aggregation of utility tracking records as described in APPENDIX I.

At a high level, the gross savings verification (CPSV) and NTG study employed the following methodology:

- **Receive program data and documentation.** The evaluation started with a review of the program tracking data, which formed the basis of the sample, and an initial review of the program documentation. Once the sample was selected, additional documentation was provided by the program to describe the energy efficiency measures and support the tracking savings estimates, also called the ex ante estimates.
- **Design and select the sample.** The tracking data was used to design and select a sample. Full documentation and contact information was requested for all sites within the sample. The CPSV sample was designed as a subset of the NTG sample.
- **Collect data.** Data was collected to verify the ex ante energy savings and estimate NTG ratios.
- **Analyze the results.** The collected data was used to verify the gross savings and estimate NTG ratios at each site.
- **Report the results.** The final step was to report the results.

1.3 Results

The outcome of the exercise produced verified gross savings and net savings for the 2015 programs studied. Table 1-3 provides the results of the evaluation for Union Custom programs and Table 1-4 provides the results of the evaluation for Enbridge Custom programs and RunitRight.

Table 1-3: Union custom programs verified gross and net savings results**

Program	Claimed Savings	Gross Realization Rate	Verified Gross Savings	Net-to-Gross	Net Savings
Commercial and Industrial Custom	1,473,918,718	97.96%	1,443,912,081	40.63%	586,724,222
Custom Large Volume	1,250,879,698	135.00%	1,688,715,391	7.98%	134,835,163
Custom Low Income Multi-Family	5,920,660	89.06%	5,272,940	95.00%*	5,009,293

*Custom Low Income Multi-family NTG was not evaluated as part of this evaluation. 95% is the deemed NTG for the program.
**Ratios in this table have been rounded and are the effective overall ratios, calculated by first applying the ratios by domain and then dividing the total net savings by the total verified savings.

Table 1-4: Enbridge custom programs and RunitRight verified and net savings results**

Program	Claimed Savings	Gross Realization Rate	Verified Gross Savings	Net-to-Gross	Net Savings
Custom C&I and Market Rate Multi-residential	810,605,950	95.21%	771,756,978	27.58%	212,848,819
Custom Low Income Multi-Family	63,801,575	91.48%	58,365,681	100.00%*	58,365,681
RunitRight	2,712,210	N/A	2,712,210	50.06%	1,357,732

*Custom Low Income Multi-family NTG was not evaluated as part of this evaluation. 100% is the deemed NTG for the program. RunitRight Gross savings were not evaluated as part of this evaluation.
*Ratios in this table have been rounded and are the effective overall ratios, calculated by first applying the ratios by domain and then dividing the total net savings by the total verified savings.

1.4 Findings

Key findings from the study include:

- Free ridership for the programs is high
- Correcting for Union's "influence adjustment" (which derated gross savings pre- customer incentive for likely partial free riders) led to the high gross RR for Large Volume
- Both utilities generally produce solid ex ante engineering estimates of savings and much of the variation in gross RRs is driven by changes in operating conditions that are often hard to control for in ex ante savings estimation

- Both utilities could provide better supporting documentation of assumptions and inputs in their savings estimates and each could benefit from investing in a modern program tracking database with document storage capabilities

1.5 Recommendations

Recommendations from the evaluation are summarized in Table 1-5 to Table 1-8. In the tables the primary outcomes of the recommendation are classified into four categories: reduce costs, increase savings, increase (or maintain) customer satisfaction and decrease risk (multiple types of risk are in this category including risk of adjusted savings, risk to budgets or project schedules, and others). For a more thorough explanation of recommendations, see section 7.

Table 1-5: Energy savings and program performance recommendations

#	Energy Savings and Program Performance Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
ES1	The utilities should continue in their commitment to accuracy.	✓	✓				✓	✓
ES2	Evaluate free-ridership for the programs annually and consider coupling the free-ridership evaluation with process evaluation			✓		✓		
ES3	Error ratios from this report inform sample design for future evaluation.			✓	✓			✓
ES4	Align the program design with cumulative net goals	✓	✓			✓		
ES5	Do not pay incentives until after installation is complete.	✓	✓					✓
ES6	Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.	✓	✓					✓
ES7	Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.	✓	✓	✓				✓

#	Energy Savings and Program Performance Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
ES8	Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.	✓	✓			✓		✓
ES9	Consider establishing an official definition for EUL and implementing a study to define EULs for program measures	✓	✓	✓				✓
ES10	Track metrics for how long it takes from the final installation verification to the posting of incentive payments.	✓	✓				✓	
ES11	Increase transparency of "influence adjustments" and do not include in gross savings	✓				✓	✓	✓
ES12	Conduct a process evaluation to improve Large Volume influence on customer projects	✓				✓	✓	
ES13	Consider approaches to market that leverage third-party vendors.	✓	✓		✓	✓		

Table 1-6: Verification process recommendations

#	Verification Process Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
VP1	Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.	✓	✓		✓			✓
VP2	The verification and utility staff should agree to a code of conduct for each role during onsite visits.	✓	✓	✓			✓	

Table 1-7: Documentation and Support recommendations

#	Documentation and Support Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DS1	Take steps to improve documentation: • Include explicit sources for all inputs and assumptions in the project documentation. • Store background studies and information sources with the project files and make them available to evaluators. • Provide evaluators full access to customer data. • Provide pre- and post-installation photos, where available. • Document and provide internal M&V documents where available. • Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification	✓	✓			✓		✓
DS2	Ensure that incremental costs are supported by invoices or other documentation	✓	✓					✓
DS3	Increase the amount of documentation and source material for projects that have greater energy savings.	✓	✓					✓
DS4 A	Digitize and file project documentation for all projects as they are completed and paid during project closeout.	✓	✓		✓			✓
DS4 B	Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.			✓	✓			✓

#	Documentation and Support Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DS5	Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner.	✓			✓			✓
DS6	Use a consistent summary workbook.		✓		✓			✓

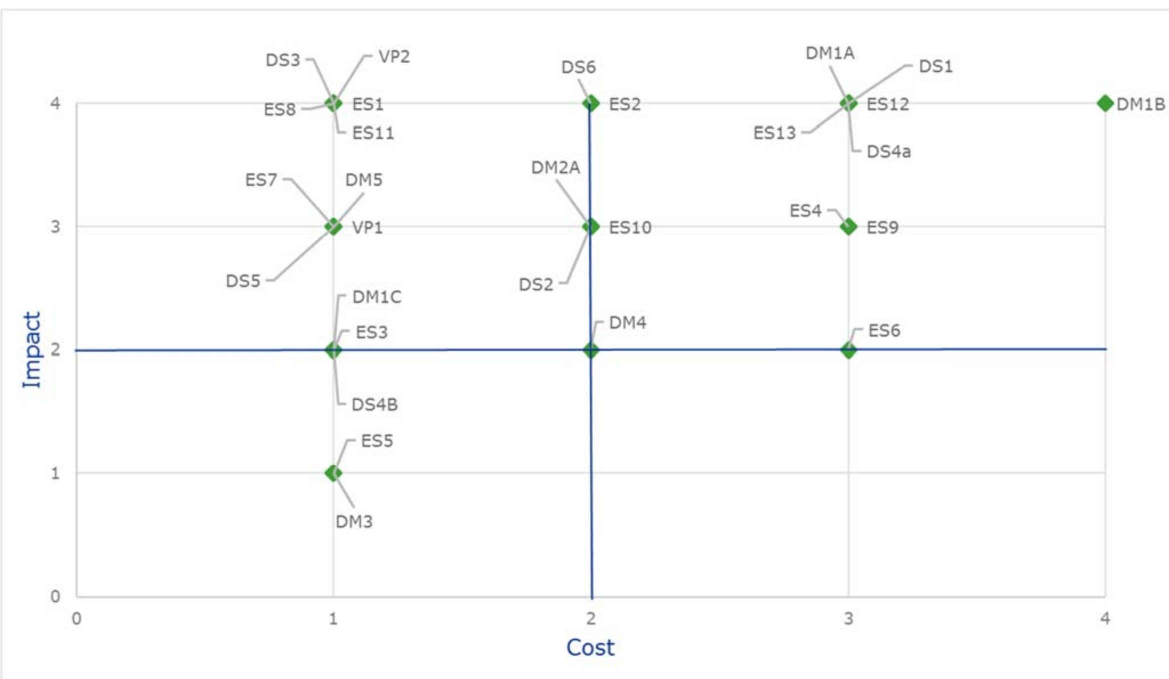
Table 1-8: Data management recommendations

#	Data Management Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DM1 A	Track contacts associated with projects in the program tracking database.	✓	✓		✓			✓
DM1 B	Strongly consider investing in relational program tracking databases.	✓	✓		✓			✓
DM1 C	Include structure for improved data integrity in the evaluator request for contact information for the 2016 and 2017 savings verification and evaluation.			✓	✓		✓	
DM2 A	Consider offering bonus incentives early in the year to combat the "hockey stick" phenomenon where a large percent of projects get closed in the fourth quarter of the year (which results in rushed QC for data).	✓	✓		✓			✓
DM3	Track and provide to evaluators dates for key milestones in the project.	✓	✓		✓			✓
DM4	Maintain a customer identifier in the database to clearly identify related sites.	✓	✓		✓		✓	

#	Data Management Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DM5	Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking extracts provided to evaluators.	✓	✓			✓		✓

Figure 1-1 shows an approximate cost vs. impact relation ship for each of the recommendations on a 4 point scale. The upper left quadrant of the figure shows the recommendations that are relatively low cost that would have a high impact. Those in the upper right are recommendations where both cost and impact are high.

Figure 1-1: Approximate Cost vs. Impact of each recommendation



2 Introduction

This report has been prepared for the Ontario Energy Board (OEB) and provides the gross savings verification – custom program savings verification (CPSV) – and net savings – free-ridership (FR) – results for a subset of programs in Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) portfolio delivered in 2015.

The overall objectives of the evaluation are to develop:

- Verified gross savings for 2015 custom commercial, industrial, low income multifamily and large volume projects
- Free-ridership savings for 2015 custom commercial, industrial and large volume projects
- A free-ridership rate for Enbridge's 2015 RunitRight program

The programs included in this study are provided in Table 2-1.

Table 2-1. CPSV, FR, and SO by program

Program		CPSV	FR
Union			
Custom	Large Volume	✓	✓
	Commercial & Industrial*	✓	✓
	Low Income Multi-Residential	✓	
Enbridge			
Custom	Commercial*	✓	✓
	Industrial	✓	✓
	Low Income Multi-Family	✓	
RunitRight			✓

*Custom Market-Rate Multi-Residential projects are included as a part of this program.

A spillover study of 2013-2014 programs has also been initiated; however, the results from that effort are not included in this report.

2.1 Background

Enbridge and Union deliver energy efficiency programs under the Demand Side Management Framework for Natural Gas Distributors (2015-2020)[2] developed by the OEB. For the 2015 program year, as directed by the board, both utilities "rolled-over" their 2014 plans into 2015 to allow them the time necessary to redesign their programs before implementing the updated plans in 2016.

In April 2016, the OEB hired an Evaluation Contractor (EC) team led by DNV GL to develop an overall evaluation, measurement, and verification (EM&V) plan. The objectives of the plan were to:

- Assess portfolio impacts to determine annual savings results, shareholder incentive and lost revenue amounts, and future year targets.

[2] EB-2014-0134

- Assess the effectiveness of energy efficiency programs on their participants and/or market, including results on various scorecard items.
- Identify ways in which programs can be changed or refined to improve their performance.

Under the plan, the DNV GL team conducted a CPSV and net-to-gross (NTG) study of the 2015 program year. This report is a result of that study.

An evaluation advisory committee (EAC) was formed to provide input and advice to the OEB on the evaluation and audit of DSM results. The EAC consists of representatives from utility representatives, non-utility stakeholders, independent experts, staff from the Independent Electricity System Operator (IESO), and observers from the Environmental Commissioner of Ontario and the Ministry of Energy. The DNV GL team worked closely with the EAC throughout this study and received comment, advice, and input on methodology and results. We than them for their involvement.

2.2 Methodology summary

The results presented in this report are based on data collection from the following five primary sources, supplemented with secondary source information:

- Union and Enbridge tracking databases
- Union and Enbridge project documentation
- In-Depth Interviews with a sample of participating customers
- In-Depth Interviews with a sample of participating vendors
- On-site visit to a sample of participating customer sites

The data collection with samples of participating customers and vendors included site visits and telephone interviews supporting a detailed measurement and verification (M&V) analysis, and in-depth interviews supporting assessment of free ridership. Table 2-2 shows the targeted and completed data collection activities and the timeframe in which they were completed.

Table 2-2. Data collection activities*

Target Group	Activity	Targeted	Completed	Timeframe
Enbridge				
Participating Customers	M&V Site Visit (On-site)	41	61	Jan, 2017 - Mar, 2017
	TSER Interview	38	37	Jan, 2017 - Apr, 2017
	In-Depth Interview	149	151	Jan, 2017 - Apr, 2017
Participating Vendors	In-Depth Interview	~30	20	Mar, 2017- Apr, 2017
Union				
Participating Customers	M&V Site Visit (On-site)	59	106	Jan, 2017 - Mar, 2017
	TSER Interview	22	30	Jan, 2017 - Apr, 2017
	In-Depth Interview	122	203	Jan, 2017 - Apr, 2017
Participating Vendors	In-Depth Interview	~30	15	Mar, 2017- Apr, 2017
Overall				
Participating Customers	M&V Site Visit (On-site)	100	167	Jan, 2017 - Mar, 2017
	TSER Interview	60	67	Jan, 2017 - Apr, 2017
	In-Depth Interview	271	354	Jan, 2017 - Apr, 2017
Participating Vendors	In-Depth Interview	≤62	35	Mar, 2017- Apr, 2017

*This table reports the number of units of analysis targeted and completed as units of analysis were used to design the sample before customers and sites had been identified. Units of Analysis are a slight aggregation of utility tracking records as described in APPENDIX I.

At a high level, the CPSV and NTG study employed the following methodology:

- **Receive program data and documentation.** The evaluation started with a review of the program tracking data, which formed the basis of the sample, and an initial review of the program documentation. Once the sample was selected, additional documentation was provided by the program to describe the energy efficiency measures and support the tracking savings estimates, also called the ex ante estimates.
- **Design and select the sample.** The tracking data was used to design and select a sample. Full documentation and contact information was requested for all sites within the sample. The CPSV sample was designed as a subset of the NTG sample.
- **Collect data.** Data was collected to verify the ex ante energy savings and estimate NTG ratios.
- **Analyze the results.** The collected data was used to verify the gross savings and estimate NTG ratios at each site.
- **Report the results.** The final step was to report the results.

Key features of the methodology include:

- The **sample design** employed a stratified random sample that targeted 10% relative precision with 90% confidence at the program level. Details of the sampling methods are presented in APPENDIX I. Final sample achievements are provided in APPENDIX A.
- **Ratio estimation** was used to expand sample results to the population. The evaluation collected data on all projects that a customer contact could speak to rather than only the first selected. This means that the evaluation exceeded the targeted number of sampled units in the measure level sample design. In the expansion, weights were adjusted to eliminate potential bias from this data collection strategy by assigning a weight of one (1) to non-randomly selected units. In our calculation of sampling error (+/-, confidence intervals, relative precision and error ratios), we used two tailed 90-percent confidence limits and clusters defined by customers to appropriately estimate error when multiple units are collected from a single source.[3] The approach used is described in APPENDIX M.
- The **gross savings verification** used a combination of on-site data collection and interviews to collect primary data. Calculation of lifetime gross savings used a dual baseline approach to more accurately estimate savings for early replacement measures. More information on the verification approach is provided in APPENDIX B, APPENDIX O, and APPENDIX P. Detailed site reports for each of the sites visited or called are provided in a volume 2 and 3 of this report.
- The **NTG methodology** included data collection from participating customers and vendors. The data collection instrument outlines are provided in APPENDIX N. NTG scoring methods are provided in APPENDIX J and APPENDIX K.

2.2.1 Understanding Statistical Error

Statistical error is reported for all of the ratio results in this report. The studies were designed with sample designs targeting 10% relative precision with 90% confidence (90/10) based on the best available assumptions at the start of the evaluation. Table 2-3 describes each of the statistics provided in this report.

The relative precision of some of the ratios is low because the ratios themselves are small. Relative precision is the absolute precision (+/- quantity) divided by the estimated ratio. For example, if a ratio is 5% with absolute precision of +/-5%, the relative precision is very bad (5%/5% = 100% relative error) but in absolute terms we still are 90% confident the ratio is below 10%, which is useful information. We reported the relative precision in all cases at the 90 percent confidence level. That is, whether the relative precision is large or small, we have the same 90 percent confidence that the range defined by the point estimate +/- the absolute error captures the true unknown value. The “midpoint” estimate is the best (statistically most likely) estimate, while the confidence interval is calculated as an interval around that point. Thus, in all cases, we reported the best point estimate, with a symmetric 90% confidence interval (using the t-score for a 2-tailed 90% confidence interval).

[3] Where a single site had two contacts, the site was used as the cluster to ensure conservative (higher) error estimates.

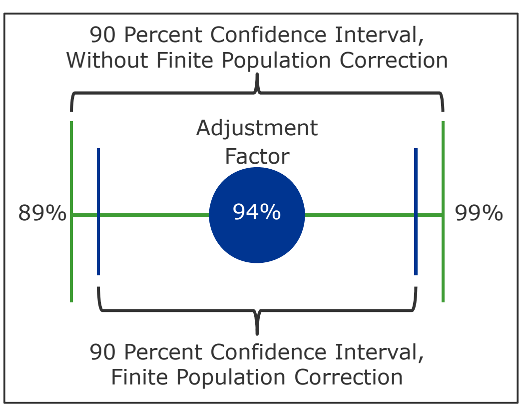
Table 2-3: Relevant statistics.

Term	Definition
Ratio / Adjustment factor	A point estimate of the evaluation findings expressed as a percent.
+ / - or Absolute Precision	If the evaluation were repeated several times selecting samples from the same population, 90%[4] of the time the ratio would be within this range of the ratio
Confidence interval	The upper bound is defined by the ratio plus the absolute precision. the lower bound is defined by the ratio minus the absolute precision.
Relative Precision	The relative precision is calculated as the absolute precision divided by the ratio itself. By convention, relative precisions are the statistic that are targeted in sampling (i.e., 90/10 is a relative precision metric)
Error Ratio	The error ratio is an approximation of the coefficient of variation (cv) that is used in sample design. It is calculated as a function of relative precision.
Finite population correction (FPC)	FPC is a factor that reduces the measured error of samples drawn from small populations (less than 300). FPC applies when the ratio is applied to the same population from which the sample was drawn. Statistics reported in the body of this report all employ the FPC factor.

Figure 2-1 shows an example:

- the adjustment factor (ratio) as a blue point
- the 90% confidence interval *with finite population correction* (blue)
- the 90% confidence interval *without finite population correction* (green)

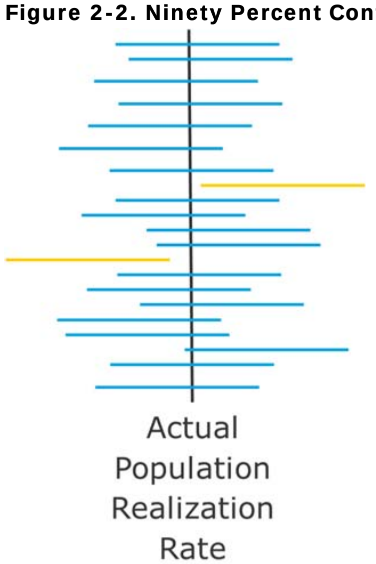
Figure 2-1: Ratio diagram example



[4] 90% is the confidence limit that we are using.

The plus/minus (±) error (%) indicated at the 90% confidence interval is the absolute difference between the estimated percentage and the upper or lower confidence bound. For example, in Figure 2-1, the ratio is 94% and the non-FPC 90% confidence interval is ± 5 percentage points (i.e., 94% ± 5%).[5] Another way of saying this is that there is a 90% probability that the actual ratio for the next year's program lies between 89 and 99%. Figure 2-2 demonstrates this concept by showing twenty hypothetical confidence intervals calculated from twenty different samples of the same population. Eighteen out of twenty (90%) include the true population ratio (overlap the black line representing the true ratio).

Figure 2-2. Ninety Percent Confidence Interval



Note: Each horizontal line represents a confidence interval, while the black vertical line is the actual population realization rate. Yellow confidence intervals do not include the actual ratio.

The relative precision of the ratio is calculated as 5%/94% =5.3%.

For low ratios, relative precisions may be quite high, even when the confidence interval around the ratio is quite narrow. Consider a ratio of 5% with the same 5% absolute precision as in the above example. While the absolute precisions are the same, the latter ratio (5%) has a relative precision of 5%/5% =100%. In absolute terms, we still are 90% confident the ratio is below 10%, despite the very high (100%) relative precision.

We reported the relative precision in all cases at the 90 percent confidence level. That is, whether the relative precision is large or small, we have the same 90 percent confidence that the range defined by the point estimate +/- the absolute error captures the true unknown value. The "midpoint" estimate (the ratio) is the best (statistically most likely) estimate, while the confidence interval is calculated as an interval around that point. Thus, in all cases, we reported the best point estimate, with a symmetric 90% confidence interval (using the t-score for a 2-tailed 90% confidence interval).

[5] The critical value for calculating the confidence interval ± for each adjustment factor is determined using Student's t-distribution and n-1 for the degrees of freedom, where n is the sample size. The critical value for the gross savings adjustment factor is determined using the degrees of freedom based on the minimum sample size for the components of the adjustment factor. The gross savings adjustment factor is a product of the installation rate and the engineering verification factor. For 2-tailed estimates (ratios that could be above or below 100%) the appropriate t-stat used to calculate precision from the standard error is close to 1.645.

3 Union Commercial, Industrial, and Multi-Family Programs

Through its custom program offerings, Union seeks to influence customers to adopt more energy efficient technologies and practices, or do so sooner than they would otherwise have done. The custom programs provide financial incentives, technical expertise, and guidance with respect to energy related decision-making. Union's custom programs differ from the prescriptive and direct install programs as they provide services and varying financial incentives based on overall natural gas savings realized by the customer to address customer-specific needs.

There are three program offerings covered in this section: Union Commercial and Industrial Custom and Low Income Multi-Residential Affordable Housing.

3.1 Commercial and Industrial Custom Program

Union advances customer energy efficiency and productivity by providing a mix of custom incentives, education and awareness to C&I customers across all segments. The objective of the Custom offering is to generate long-term and cost effective energy savings for Union's customers.

The Union Custom program covers opportunities where energy savings are linked to unique building specifications, design concepts, processes and new technologies that are outside the scope of prescriptive and quasi-prescriptive measures. The program and incentives are targeted directly to the end user.

A subset of the projects in these programs is part of the multi-family or multi-residential segment (MR MF).

All projects implemented as part of these programs and claimed in 2015 are included in the CPSV and FR portions of the study.

3.2 Low-income Multi-Family Program (Union)

The Union Low Income Multi-Family (LIMF) program offers multi-family low income housing customers funding for energy audits and both custom and prescriptive incentives to encourage energy efficient upgrades and funding for energy audits. The programs also provide technical services, benchmarking, and education for housing providers, building operators and tenants about their building's energy usage and ways to achieve energy efficiency.

The target markets for both programs are social and assisted housing providers who own and operate Part 3 buildings and private multi-residential building owners that provide housing to low income households.[6]

Custom projects implemented as part of these programs and claimed in 2015 are included in the CPSV portion of the study; 12% of Union's LIMF program savings are from custom projects. An evaluation of this program's net-to-gross (NTG) was not included in this study.

3.3 CPSV results

This section summarizes the gross savings verification (CPSV) results for custom projects in the Union commercial, industrial, multifamily, and low income multi-family programs. For Union, the gross realization rate is made up of two components, the influence correction which removes Union's influence adjustments

[6] "Part 3" references buildings covered by Part 3 of the Ontario Building Code, defined as those exceeding 600 square meters in area or greater than three storeys in height; for residential energy efficiency programs, these are typically multifamily buildings.

from the tracking gross savings, and the engineering adjustment, which provides the difference (expressed as a ratio) between verified savings determined through the CPSV and tracked gross savings estimated by Union prior to applying the influence adjustment. The gross realization rate is the product of the influence correction and the engineering adjustment.

Section 3.3.1 summarizes the data collection efforts, section 3.3.2 describes and presents the influence correction, section 3.3.3 describes and presents the engineering adjustment, section 3.3.4 summarizes the reasons for the discrepancies between the ex ante and ex post gross savings estimates, and section 3.3.5 presents the gross savings realization rate.

3.3.1 Summary of CPSV data collection

Table 3-1 summarizes the CPSV data collection efforts for the Union Custom C&I, and LIMF programs. The table shows the portion of the program that:

- Completed on-site visits
- Completed telephone supported engineering reviews (TSER)
- Did not respond to an evaluation attempt at contact
- Was not contacted by the evaluation team.[7]

The data collected is represented as the number of sites, the number of projects, the number of units of analysis, and cumulative ex ante natural gas savings (ex ante CCM). The proportion of the program in each category is also represented in Figure 3-1. The full sample design and achievement by strata can be found in 8. By collecting data on all measures at a site rather than only the first selected, the evaluation exceeded the targeted number of units despite collecting data from fewer sites. The study had a customer response rate of 64% and achieved the targeted 90/10 relative precision for the gross realization rate at the program overall level shown in Table 3-4).

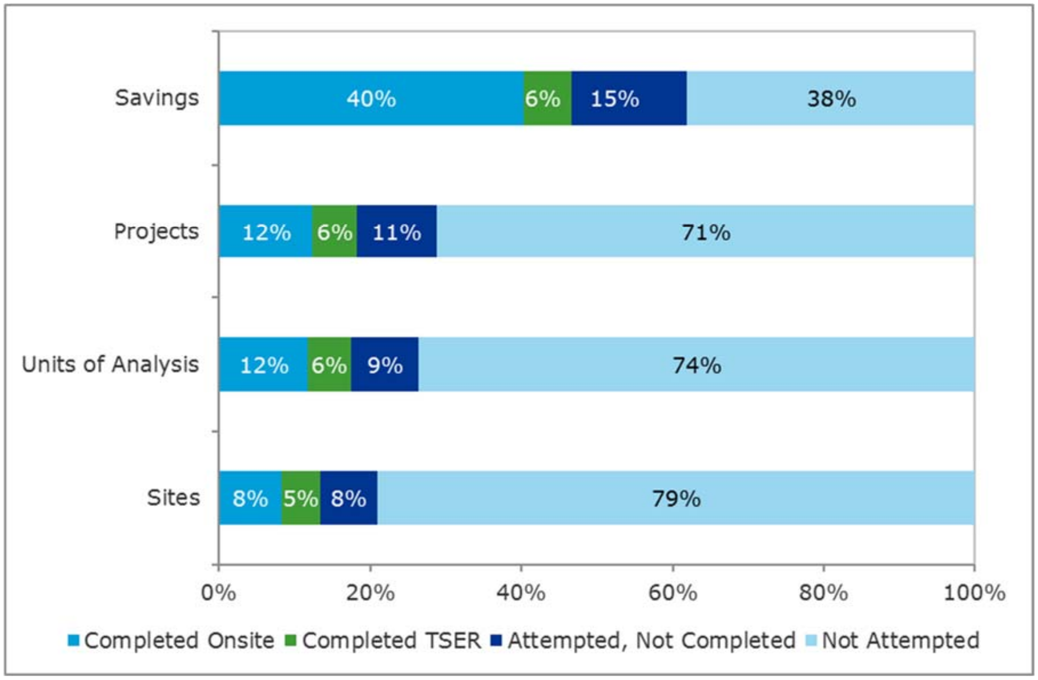
Table 3-1: Summary of CPSV data collection for Union Custom C&I, and LIMF programs*

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed On-Site	38	35	77	62	595,857,289
Completed TSER	22	22	37	30	93,508,182
Attempted Contact, Not Completed		32	66	47	226,355,899
Not Attempted		337	445	389	564,118,008
Total		**426**	**625**	**528**	**1,479,839,378**

* Please see the glossary for definitions of unit of analysis, site, and project.

[7] Sites, projects, or units of analysis where contact was not attempted were either not selected for contact in sampling or in the backup sample and were not contacted due to strata quotas being met.

Figure 3-1: Summary of CPSV data collection for Union Custom C&I, MF, and LIMF programs



3.3.2 Influence correction

The Union Custom C&I, MF, and LIMF programs had some corrections and adjustments that differ from other programs: the influence correction and the engineering adjustment.

The Union implementation team applied a proactive "influence factor" to some measures. The factor represents the portion of the energy savings that, in the opinion of the implementation team, was influenced by the program. In effect, it represents an anticipated free-ridership adjustment. Since the evaluation team is measuring and applying a retrospective free-ridership adjustment based on customer self-reports, the Union influence factor would double-count free-ridership for those measures. Therefore, the evaluation team removed the influence factor to produce a "true" gross savings estimate to which the NTG adjustment could be applied. Because the influence factor was not tracked for the population, we worked with Union to identify the influence factors made to the sample of projects selected for CPSV and reversed the process to calculate a true gross tracking savings. This process resulted in the influence corrections provided below.

Table 3-2 shows the influence correction by domain for the Union Custom C&I, MF, and LIMF programs. The table shows the number of units of analysis (n), influence correction ratio, precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result. Note that Custom Industrial Actions and Custom Commercial & Multi-family received ratios, or influence corrections, of 103% and 101%, respectively. A ratio of 103% indicates that for these measures Union recorded 97% of the gross savings in its database. The positive (greater than 100%) adjustment was made to reported tracked savings to remove the influence factors assigned.

Table 3-2: Influence correction for Union Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse Equipment	15	9	100%	0%	100%	100%	0%	0.00	29%
	Action	20	12	103%	4%	99%	106%	3%	0.07	12%
	Hydronic Insulation	9	9	100%	0%	100%	100%	0%	0.00	8%
	Other Equipment	36	25	100%	0%	100%	100%	0%	0.00	33%
Custom Commercial and LIMF		34	24	101%	2%	100%	103%	2%	0.05	19%
Overall		**114**	**74**	**101%**	**1%**	**100%**	**101%**	**1%**	**0.03**	**100%**

The Other category includes building shell equipment, controls, heat recovery, HVAC, operational improvements, steam separator, reverse osmosis, refractory insulation, high-efficiency iron converters, robotic arms, infrared coating, and damper motor replacement
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
Confidence intervals are mathematically correct, but in practical terms, the influence correction can only be equal to or greater than 100%.

3.3.3 Engineering adjustment

For programs with an influence adjustment, such as the Union Custom C&I, MF, and LIMF programs, the evaluation team defined an "engineering adjustment." This ratio is the difference between verified savings determined through the CPSV and tracked gross savings estimated by Union prior to applying the influence adjustment. These changes are due to differences in calculation methods, effective useful life (EUL), calculation parameters, or other engineering-related adjustments. The engineering adjustment is equivalent to the gross savings realization rate for programs that do not have an influence adjustment.

Table 3-3 shows the engineering adjustment by domain for the Union Custom C&I, MF, and LIMF programs. The table shows the number of units of analysis (n), engineering adjustment ratio (Ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result. Overall, the engineering adjustment was 99%. The measure group with the highest adjustment was Hydronic Insulation, due to different operating conditions (temperatures and hours) reported than were documented in the ex ante calculations at four of nine sites. The measure group with the lowest adjustment was greenhouse equipment, primarily due to measure realization rates of ~80% for 4 of the 15 measures. The discrepancies found at these sites include changes to baseline and efficient conditions.

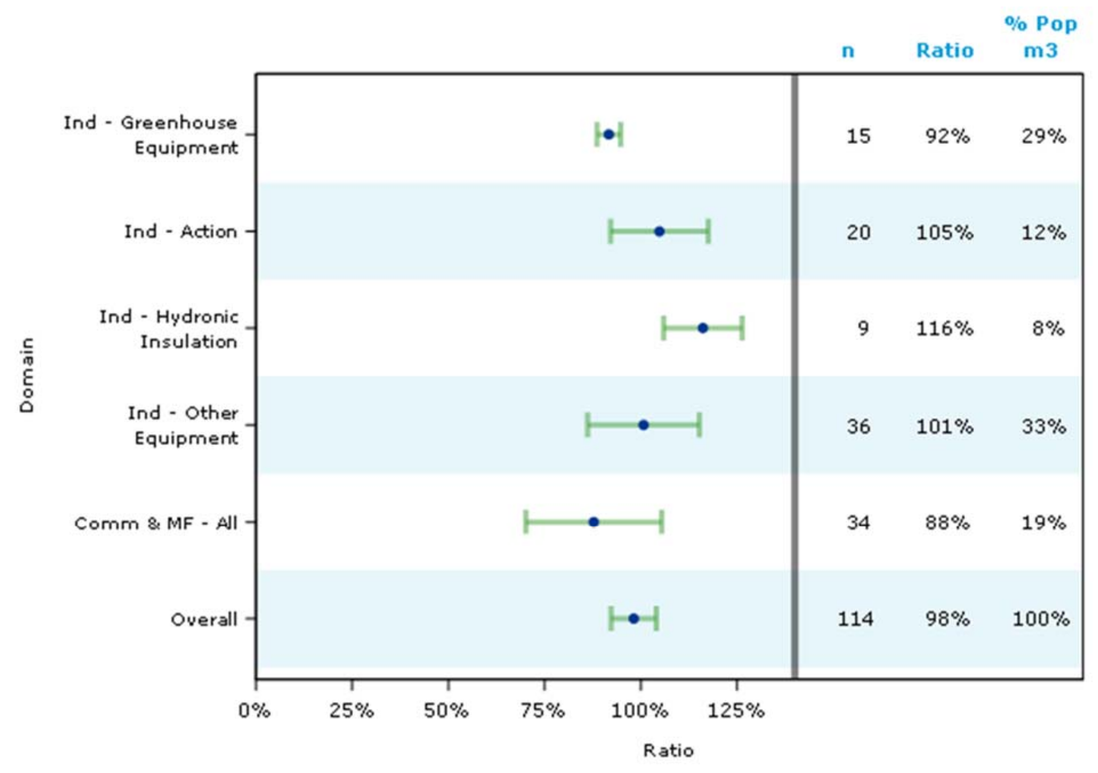
Table 3-3: Engineering adjustment for Union Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse Equipment	15	9	92%	4%	88%	95%	4%	0.06	29%
	Action	20	12	105%	13%	92%	118%	13%	0.24	12%
	Hydronic Insulation	9	9	116%	11%	105%	127%	9%	0.15	8%
	Other Equipment	36	25	101%	15%	86%	116%	15%	0.43	33%
Custom Commercial and Multi-family		34	24	88%	18%	70%	106%	21%	0.59	19%
Overall		**114**	**74**	**98%**	**6%**	**92%**	**105%**	**6%**	**0.33**	**100%**

The Other Equipment category includes building shell equipment controls, heat recovery, HVAC, operational improvements, steam separator, reverse osmosis, refractory insulation, high-efficiency iron converters, robotic arms, infrared coating, and damper motor replacement.
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.

Figure 3-2 also shows the engineering adjustment by domain. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, numeric ratio, and percent of program savings represented by each domain are shown to the right of the plot. Industrial greenhouse equipment and hydronic insulation are the only domains that are statistically significantly different from 100%.

Figure 3-2: Engineering adjustment for Union Custom C&I, and LIMF programs



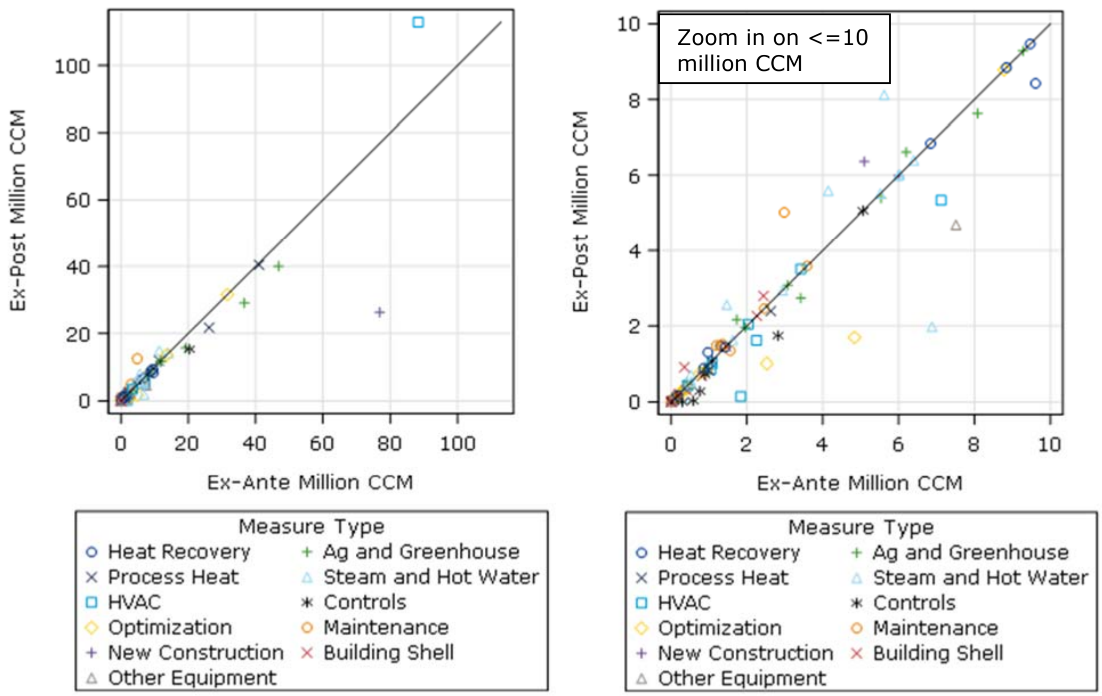
3.3.4 Discrepancy summary

This section presents detailed results for the reasons for and magnitude of the various discrepancies between ex ante and ex-post savings. First we will look at the cumulative savings, then the two key components of cumulative savings: annual savings and the EUL. See APPENDIX Q for additional detail.

Figure 3-3 plots the ex post cumulative savings (with influence corrected) against the ex ante cumulative savings (with influence corrected) for each measure in the sample. The plot on the left shows the full set of measures, while the plot on the right is focused in on the cluster of measures with less than 10 million CCM in both ex ante and ex post. The diagonal line represents a 100% engineering adjustment, or the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post savings were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

Most projects had similar ex post and ex ante savings. The largest two sites had large discrepancies. The largest was a thermal oxidator project that had a realization rate of 127% (upper right) due to operating conditions differences in the ex ante and ex post cases. The second was a new construction project with a 55% realization rate: in this case the code used for the ex ante baseline was outdated at the time that building permits were applied for.

Figure 3-3. Ex post versus ex ante cumulative savings (CCM) with influence corrected - Union C&I and MF, by measure type

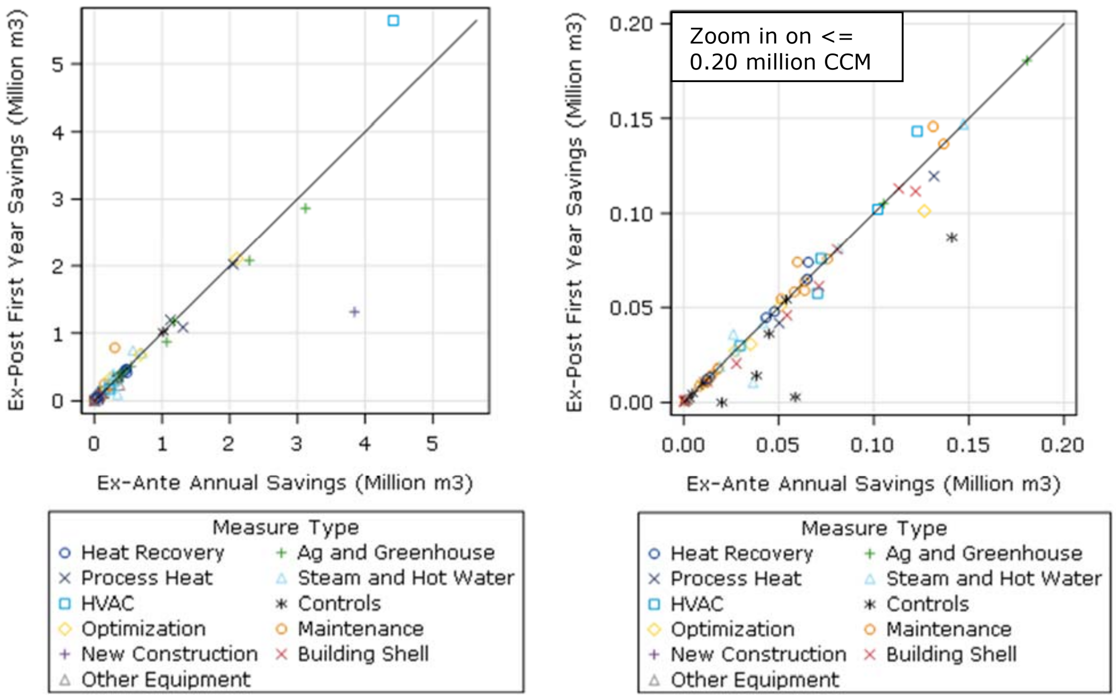


3.3.4.1 First-year savings discrepancies

Figure 3-4 plots the ex post annual savings (with influence corrected) against the ex ante annual savings (with influence corrected) for each measure in the sample. The plot on the left shows the full set of measures, while the plot on the right is focused in on the cluster of measures with less than 0.20 million cubic meters (m^3) in both ex ante and ex post. The diagonal line represents a 100% engineering adjustment, or the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post savings were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

The plot on the left shows a very similar pattern to that of the cumulative savings because the two largest projects and adjustments were each due to discrepancies in annual savings. The plot on the right shows some differences because annual savings were adjusted for several controls projects. There was no pattern to the discrepancies in this case: one was a difference in baseline between ex ante and ex post, one involved additional data provided to the verifier and one lowered production after the program measure was implemented.

Figure 3-4: Ex post versus ex ante annual savings with influence corrected - Union C&I, by measure type

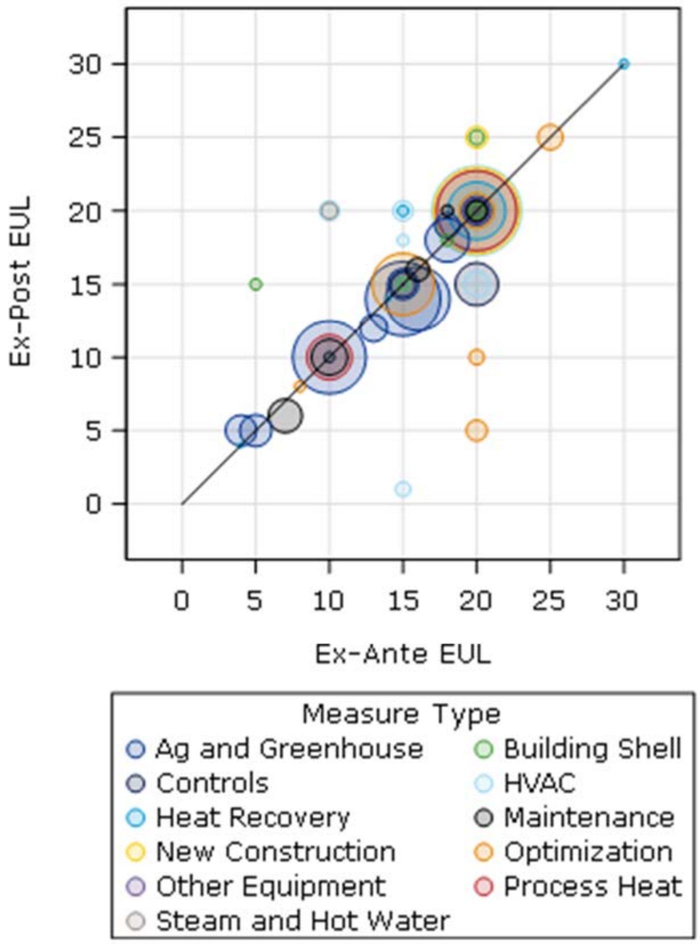


3.3.4.2 Measure life discrepancies

One of the primary discrepancies is a change in EUL between ex ante and ex post. Figure 3-5 plots the ex post EUL against the ex ante EUL for each measure in the sample. Because EULs tend to be discrete numbers, the size of the bubbles in the plot indicate show the relative amount of ex ante savings for the measures at each plotted point (e.g., the larger the bubble, the more savings at that point). The diagonal line represents the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post EUL were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

The plot shows that most EULs had equal ex post and ex ante EULs. The projects with the greatest differences tended to be small to medium sized and differences in EUL went both ways. Some projects had greater EULs in the ex post than the ex ante and vice versa. The overall weighted average EUL adjustment for the program was 99.8%.

Figure 3-5: Ex post versus ex ante effective useful life - Union C&I and MF, by measure type



3.3.5 Gross realization rate

For the Union programs, the gross realization rate is the product of the influence correction and the engineering adjustment. Table 3-4 shows the engineering adjustment by domain for the Union Custom C&I, MF, and LIMF programs. The table shows the number of units of analysis (n), engineering adjustment ratio (Ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

Union's C&I and LIMF programs overall had a 100% gross realization rate, which means that the overall ex post savings are equivalent to the overall ex ante savings, within rounding errors. The Action domain has a gross realization rate pf 108%, the result of an influence correction of 103% and an engineering adjustment of 105%. Likewise, Custom Commercial, and LIMF result in a ratio of 97%, the result of a 101% influence correction and 95% engineering adjustment.

Table 3-4: Gross realization rate for Union Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse Equipment	15	9	92%	4%	88%	95%	4%	0.06	29%
	Action	20	12	108%	14%	94%	122%	13%	0.25	12%
	Hydronic Insulation	9	9	116%	11%	105%	127%	9%	0.15	8%
	Other Equipment	36	25	101%	15%	86%	116%	15%	0.43	33%
Custom Commercial and LIMF		34	24	89%	18%	71%	108%	21%	0.59	19%
Overall		**114**	**74**	**99%**	**6%**	**92%**	**105%**	**7%**	**0.34**	**100%**

The Other Equipment category includes building shell equipment controls, heat recovery, HVAC, operational improvements, steam separator, reverse osmosis, refractory insulation, high-efficiency iron converters, robotic arms, infrared coating, and damper motor replacement.
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating gross savings for the programs.

Table 3-5 shows the influence correction and engineering adjustments that were multiplied to calculate the gross realization rates.

Table 3-5: Gross realization rate components for Union Custom C&I and LIMF programs

Sector	Domain	Influence correction	Engineering Adjustment	Gross Realization Rate
Custom Industrial	Greenhouse Equipment	100%	92%	92%
	Action	103%	105%	108%
	Hydronic Insulation	100%	116%	116%
	Other Equipment	100%	101%	101%
Custom Commercial and LIMF		101%	88%	89%
Overall		**101%**	**98%**	**99%**

3.4 NTG ratio

This section summarizes the free-ridership results for the Union Custom C&I, MF, and LIMF programs. Section 3.4.1 summarizes the data collection efforts, section 3.4.2 presents the net savings realization rate, and section 3.4.3 describes the sources of program attribution.

3.4.1 Summary of participant data collected

Table 3-6 summarizes the NTG ratio data collection efforts for the Union Custom C&I, MF, and LIMF programs. The table shows the portion of the program that:

- Completed an in-depth interview through the NTG battery
- Did not respond to an evaluation attempt at contact

- Was not contacted by the evaluation team.[8]

The data collected is represented as the cumulative ex ante natural gas savings, number of projects, units of analysis, and sites. The portion of the program in each category is also represented in Figure 3-6. The full sample design and achievement by strata can be found in 8. The sample design for the NTG study included attempting an NTG interview with all sites in the CPSV sample plus additional sites. Not all sites in the CPSV sample responded to the NTG interview.

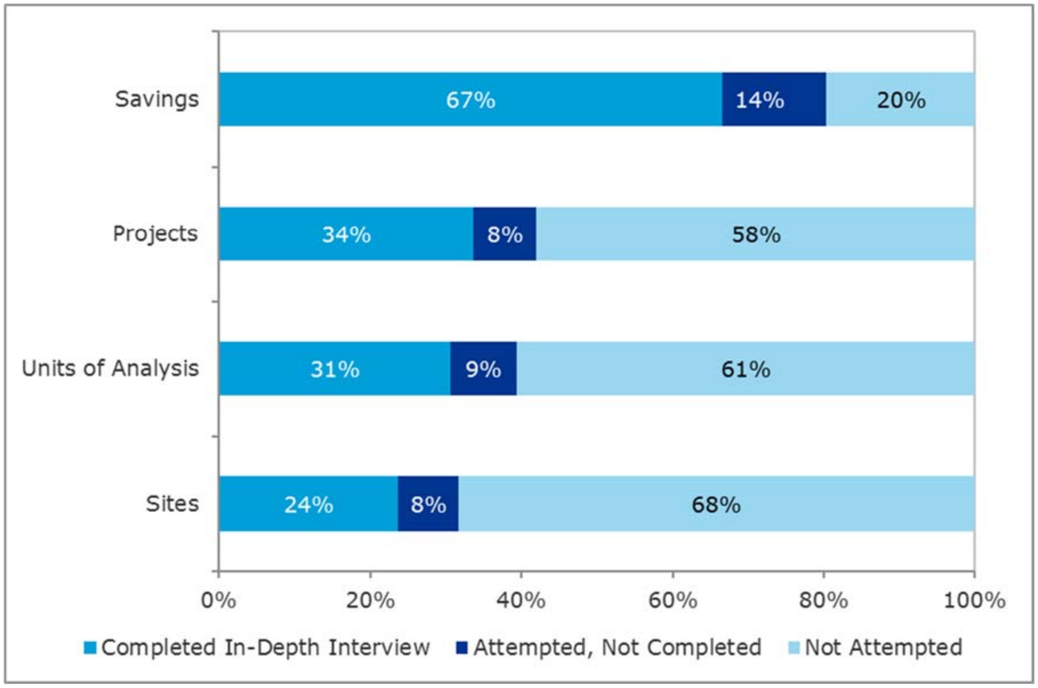
By collecting data on all measures at a site rather than only the first selected, the evaluation exceeded the targeted number of units. The number of completed sites exceed the targeted number of units due to single contacts having multiple sites in the sample/backup. Despite collecting NTG data for 67% of savings in the programs with a customer response rate of 73%, the study did not achieve the targeted 90/10 relative precision for the NTG ratio at the program overall level (shown in Table 3-7). The achieved relative precision was 12%. Relative precision is relative to the ratio result, which for sampling purposes was assumed as 50%. The achieved absolute precision (+/-) of 5% would have met the 90/10 relative precision target had the NTG ratio been at or above the assumed ratio.

Table 3-6: Summary of NTG data collection for Union Custom C&I programs

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed In-Depth Interview	90	92	198	150	980,275,237
Attempted Contact, Not Completed		31	49	43	204,588,592
Not Attempted		266	341	298	289,054,889
Total		**389**	**588**	**491**	**1,473,918,718**

8 Sites, projects, or units of analysis where contact was not attempted were either not selected for contact in sampling or in the backup sample and were not contacted due to strata quotas being met.

Figure 3-6: Summary of NTG data collection for Union Custom C&I, MF, and LIMF programs



3.4.2 Free-ridership

Free-ridership is the sole contributor to the NTG ratio. The evaluation team is also conducting a study of the spillover savings attributable to the program; spillover results will be presented in a later report. Free-ridership is calculated from self-reported responses to survey questions as outlined in APPENDIX C.

Table 3-7 shows the NTG ratio by domain for the Union Custom C&I programs. The table also shows the number of units of analysis (n), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

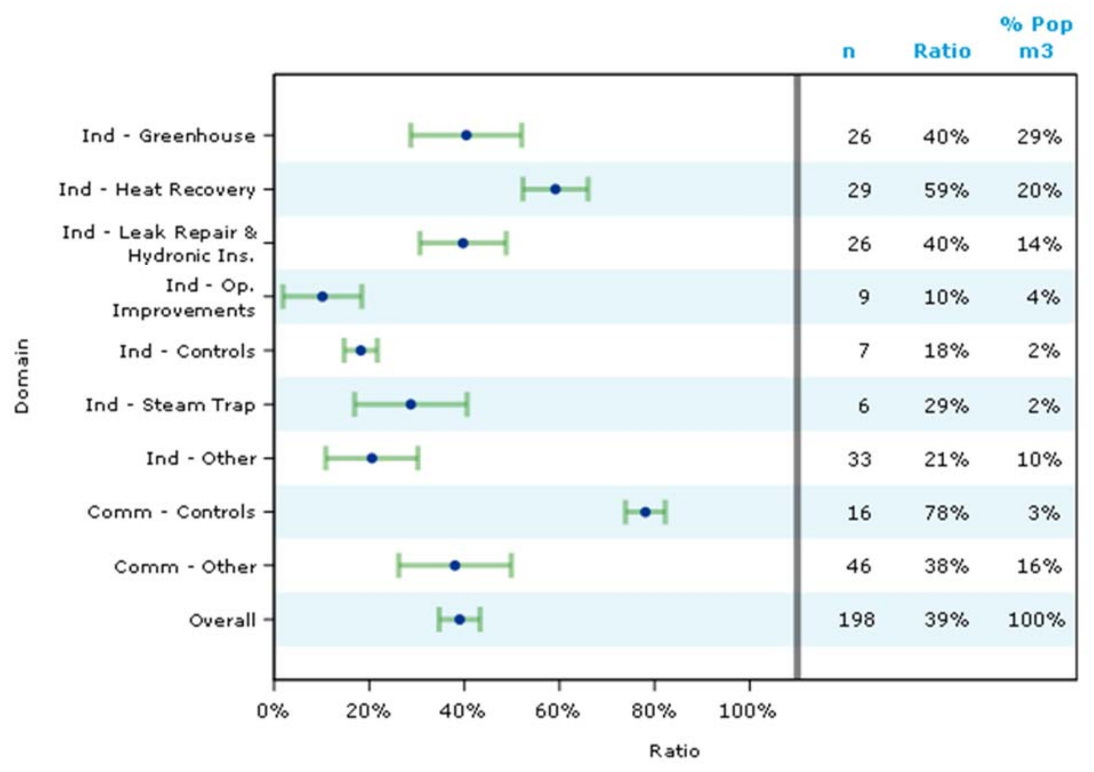
Table 3-7: NTG ratio for Union Custom C&I programs

Sector	Domain	n		NTG Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Meas	Clusts		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse	26	17	40%	12%	28%	52%	30%	0.70	29%
	Heat Recovery	29	21	59%	7%	52%	66%	12%	0.32	20%
	Leak Repair and Hydronic Insulation	26	21	40%	9%	30%	49%	24%	0.63	14%
	Operational Improvements	9	7	10%	9%	1%	19%	85%	1.16	4%
	Controls	7	7	18%	4%	14%	22%	21%	0.29	2%
	Steam Trap	6	6	29%	12%	17%	41%	42%	0.52	2%
	Other	33	23	21%	10%	11%	31%	49%	1.37	10%
Custom Commercial	Controls	16	6	78%	5%	74%	83%	6%	0.07	3%
	Other	46	23	38%	12%	26%	50%	32%	0.90	16%
Overall		**198**	**112**	**39%**	**5%**	**34%**	**44%**	**12%**	**0.76**	**100%**

The Industrial Other category includes: building shell, HVAC, steam separator, reverse osmosis, refractory insulation, boiler, high-efficiency iron converters, robotic arms, duct insulation, infrared coating, and damper motor replacement.
The Commercial Other category includes: building shell, heat recovery, HVAC, hydronic insulation, leak repair, operational improvements, steam traps, high-efficiency washer, domestic hot water upgrade, air handling unit maintenance, and geothermal heating.
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating net savings for the programs.

Figure 3-7 also shows the NTG ratio by domain. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, the numeric ratio, and the percent of program savings represented by each domain are shown to the right of the plot. The confidence intervals for all but the two lowest and two highest performing measures overlap the program overall ratio of 39%.

Figure 3-7: NTG ratio for Union Custom C&I and MF programs



3.4.3 Sources of attribution

As described in APPENDIX K, the NTG ratio is a combination of responses regarding the program's influence on the timing, quantity, and efficiency of the measure installed. This section details the program's effect on each of those sources of attribution and indicates where the program is creating the greatest transformation.

Table 3-8 represents the possible combinations of timing, efficiency, and quantity attribution. A "yes" in the timing, efficiency, or quantity column indicates partial or full attribution for that source. A "no" indicates no attribution for that source. For example, the row that has Yes for timing, efficiency, and quantity reports the portion of the program that indicated that the program had at least partial influence on the timing, efficiency, and quantity for that measure. For some measures, efficiency or quantity may not be applicable questions; for the purposes of this table, the not applicable measures are included as "no" on the non-applicable dimension.

The table also shows the number of customers, measures, and savings that fall into each combination. The portion of the program that falls into each combination of timing, efficiency, and quantity attribution is represented by the number of responses, and the percent of cumulative savings represented by that category.

The table shows that the majority program participation (58% of savings) at least partially influenced by the program. Of the three ways the program can influence program performance, timing is the most common, affecting approximately 49% of the program savings.

Table 3-8. Overview of the sources of attribution for Union Custom C&I programs

Attribution						
Timing	Efficiency	Quantity	Customers*	Units of Analysis	Projects	Percent Savings
Yes	Yes	Yes	11	20	31	14%
Yes	Yes	No	*	*	*	9%
Yes	No	Yes	16	34	44	14%
Yes	No	No	19	25	34	13%
No	Yes	Yes	*	*	*	<1%
No	Yes	No	5	6	6	6%
No	No	Yes	7	7	13	3%
No	No	No	41	55	66	41%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

3.4.3.1 Timing

Respondents answered a sequence of questions that addresses the timing of the equipment installation. First, respondents answered the likelihood of installing the same type of equipment at the same time without the program (DAT1a). Respondents who answered "Later" specified the number of months later in the next question (DAT1b).[9]

Timing was the component most strongly affected by the program. The program affected the timing of projects that account for approximately half of the energy savings. Fifty-two customers accounting for 51% of program savings said they would have installed their measure(s) at the same time. Projects accounting for approximately 17% of savings received full attribution by answering that they never would have installed the measure (13% of savings) or would have delayed the project by 48 months or more (4% of savings). The remaining 33% of savings received partial timing attribution (Table 3-9).

[9] See APPENDIX K for the detailed scoring algorithm.

Table 3-9. Determining the acceleration period, Union Custom C&I programs

DAT1a. Without the utility, how different would the timing have been? DAT1b. Approximately how many months later?						
DAT1a	DAT1b	Customers*	Units of Analysis	Projects	Percent Savings	Timing Attribution
Same Time	N/A	52	69	87	50%	0%
Earlier	N/A	0	0	0	0%	0%
Later	Months < 48	24	43	57	25%	ER baseline credit** for months accelerated
	Months >= 48	*	6	10	4%	100%+ ER baseline credit
	Don't Know/ Refused	8	12	16	7%	ER baseline credit for avg. of DAT1b
Never	N/A	12	20	28	13%	100%
Don't Know/ Refused	N/A	0	0	0	0%	ER baseline credit for avg. of DAT1a

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.
**ER baseline credit reflects credit for a vs. in situ equipment baseline savings during the acceleration period.

3.4.3.2 Efficiency

Respondents answered a sequence of questions that addresses the program's effects on the efficiency level of the installed equipment. First, respondents answered the likelihood of installing the same level of efficiency without the program (DAT2a). Respondents who answered that they would have installed a less efficient option answered a follow-up question (DAT2b) to specify the level of efficiency they would have installed.

The program had less effect on efficiency than timing, affecting approximately one-third (29%) of the program savings (Table 3-10). Approximately one-third (36%) of program savings received zero attribution because the respondents indicated they would have installed the same level of efficiency without the program. Another third (35%) of savings were from measures for which efficiency levels is not applicable such as operational improvements, leak repairs or steam trap replacements.

Table 3-10. Determining efficiency attribution, Union Custom C&I programs

DAT2a. Without the utility, would you have installed the same, higher, or lower efficiency?						
DAT2b. Without the utility, what efficiency would you have installed?						
DAT2a	DAT2b	Customers*	Units of Analysis	Projects	Percent Savings	Efficiency Attribution
Same	N/A/ Skipped	35	44	63	36%	0%
Lower	Standard Efficiency	9	17	25	10%	100%
	Between Standard and High	*	*	6	11%	50%
	Don't Know/ Refused	*	7	9	8%	Average of DAT2b
Higher	N/A/ Skipped	0	0	0	0%	0%
Don't Know/Refused	N/A Skipped	*	*	*	<1%	Average of DAT2a
Not Applicable	N/A	47	77	94	35%	Not Asked

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

3.4.3.3 Quantity

Respondents answered a sequence of questions that addresses the program's effects on the amount of equipment installed. First, respondents answered the likelihood of installing the same amount of equipment (or capacity for measures for which number is not relevant, such as chillers) without the program (DAT3a). Respondents who answered that they would have installed a less or more equipment answered a follow-up question (DAT3b) to specify how the program changed the amount that they installed.

The program had about the same level of effect on quantity as efficiency, affecting approximately one-third (29%) of the program savings (Table 3-11). Approximately two-thirds (66%) of program savings received zero attribution because the respondents indicated they would have installed the same amount without the program.

Table 3-11. Determining quantity/size attribution, Union Custom C&I programs

DAT3a. Without the utility, how different would the quantity/size have been?						
DAT3b. By what percentage did you change the amount installed because of utility?						
DAT3a	DAT3b	Customers*	Units of Analysis	Projects	Percent Savings	Quantity Attribution
Same	N/A	58	84	107	66%	0%
Less	Value < 100%	10	14	29	10%	Value < 50%
	Value ≥ 100%	*	*	*	<1%	Value > 50%
	Don't Know/Refused	6	19	22	4%	Average of DAT3a
More	Value < 100%	0	0	0	0%	Value < 100%
	Value ≥ 100%	0	0	0	0%	Value = 100%
	Don't Know/ Refused	0	0	0	0%	Average of DAT3a
None	N/A	11	22	29	16%	100%
Don't Know/ Refused	N/A	*	*	*	<1%	Average of DAT3
Not Applicable	N/A	7	9	9	4%	Not Asked

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

3.5 Gross and net savings

This section reports the evaluation-verified gross savings in section 3.5.1 and the net savings (including only free-ridership) in section 3.5.2.

3.5.1 Verified gross savings

The program-level gross savings are determined by multiplying tracked savings by the gross realization rate within each primary reporting domain. Table shows the primary domains, tracked savings, gross realization rate (RR), and final verified gross savings. Dividing the overall verified gross savings by the overall tracking savings results in a program-level gross realization rate of 99%.

Table 3-12: Verified gross savings for Union Custom C&I and LIMF programs

Sector	Applied Domain	Cumulative Tracked Savings (m3)	Gross RR	Verified Cumulative Gross Savings (m3)
Custom Industrial	Greenhouse Equipment	428,140,859	91.68%	392,519,540
	Action	177,687,651	107.57%	191,138,606
	Hydronic Insulation	112,443,825	116.13%	130,581,014
	Other Equipment	487,064,029	100.70%	490,473,477
	Total	**1,205,336,364**	**99.95%**	**1,204,712,637**
Custom Commercial and Multi-Family		268,582,354	89.06%	239,199,444
Low Income Multi-Family		5,920,660	89.06%	5,272,940

APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
*Custom Commercial, Market Rate Multi-Family, and Low Income Multi-Family use the combined domain of Customer Commercial and LIMF.

3.5.2 Net savings

Program-level net savings are determined by multiplying the verified savings by the NTG ratio within each primary reporting domain. Table 3-13 shows the primary domains, tracking savings, verified savings, NTG ratio, and the final net savings. Dividing the overall net savings by the overall verified savings results in a program-level NTG ratio of 40%. This is slightly higher than that reported in Table 3-7 due to domain level application of ratios.

Table 3-13: Net savings for Union Custom C&I and LIMF programs

Sector	Applied Domain	Verified Cumulative Gross Savings (m3)	NTG	Net Cumulative Savings (m3)
Custom Industrial	Greenhouse	392,519,540	40.40%	158,577,894
	Heat Recovery	303,555,269	59.14%	179,522,586
	Leak Repair and Hydronic Insulation	226,857,406	39.71%	90,085,076
	Operational Improvements	57,328,381	10.15%	5,818,831
	Controls	34,273,847	18.21%	6,241,267
	Steam Trap	34,875,943	28.74%	10,023,346
	Other	155,302,251	20.57%	31,945,673
	Total	**1,204,712,637**	**40.03%**	**482,214,673**
Custom Commercial and Multi-Family	Controls	33,889,383	78.05%	26,450,663
	Other	205,310,062	38.02%	78,058,885
	Total	**239,199,444**	**43.69%**	**104,509,549**
Low Income Multi-Family		5,272,940	95.00%	5,009,293

The Industrial Other category includes: building shell, HVAC, steam separator, reverse osmosis, refractory insulation, boiler, high-efficiency iron converters, robotic arms, duct insulation, infrared coating, and damper motor replacement.
The Commercial Other category includes: building shell, heat recovery, HVAC, hydronic insulation, leak repair, operational improvements, steam traps, high-efficiency washer, domestic hot water upgrade, air handling unit maintenance, and geothermal heating.
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
*In 2015, all of the Market Rate Multi-Family measures have the Custom Commercial other domain applied based on the measure mix.
**The Low Income Multi-Family NTG ratio is deemed.

4 Union Large Volume

Union encourages the adoption of energy efficient equipment, technologies, and actions via its Large Volume program, which applies to customers in Rate 1 (2015 only) and Rate T2/Rate 100.

The 2015 program uses a direct access budget mechanism for the customer incentive budget process for Rate T2/Rate 100 customers. This mechanism grants each customer direct access to the customer incentive budget they pay in rates. Customers must use these funds to identify and implement energy efficiency projects, or lose the funds which will consequently become available for use by other customers in the same rate class. This "use it or lose it" approach ensures each customer has first access to the amount of incentive budget funded by their rates. The incentive approach for Rate T1 customers remains unchanged from the aggregate pool approach offered in 2014.

The Large Volume program is the only "direct access" program offered in Ontario. It is similar in concept, though not in funding mechanism design, to the standard custom programs offered by the two gas utilities.

Custom projects implemented as part of this program and claimed in 2015 are included in the both the CPSV and FR portions of the study. While most of the Large Volume are custom projects that fall within the scope of this evaluation, a small percent of savings (<1%) come from prescriptive projects.[10]

4.1 CPSV results

This section summarizes the gross savings verification (CPSV) results for the Union Large Volume program. For Union, the gross realization rate is made up of two components, the influence correction which removes Union's influence adjustments from the tracking gross savings, and the engineering adjustment, which provides the difference (expressed as a ratio) between verified savings determined through the CPSV and tracked gross savings estimated by Union prior to applying the influence adjustment.

Section 4.1.1 summarizes the data collection efforts, section 4.1.2 describes and presents the influence correction, section 4.1.3 describes and presents the engineering adjustment, section 4.1.4 summarizes the reasons for the discrepancies between the ex ante and ex post gross savings estimates, and section 4.1.5 presents the gross savings realization rate.

4.1.1 Summary of CPSV data collection

Table 4-1 summarizes the CPSV data collection efforts for the Union Large Volume program. The table shows the portion of the program that:

- Completed on-site visits
- Did not respond to an evaluation attempt at contact
- Was not contacted by the evaluation team.[11]

The data collected is represented as the number of sites, the number of projects, the number of units of analysis, and cumulative ex ante natural gas savings. The proportion of the program in each category is also represented in Figure 8. The full sample design and achievement by strata can be found in 8. By collecting data on all measures at a site rather than only the first selected, the evaluation exceeded the targeted

[10] Union Gas provided the savings from and counts of prescriptive projects that were claimed as part of the Large Volume program via email May 31, 2016.

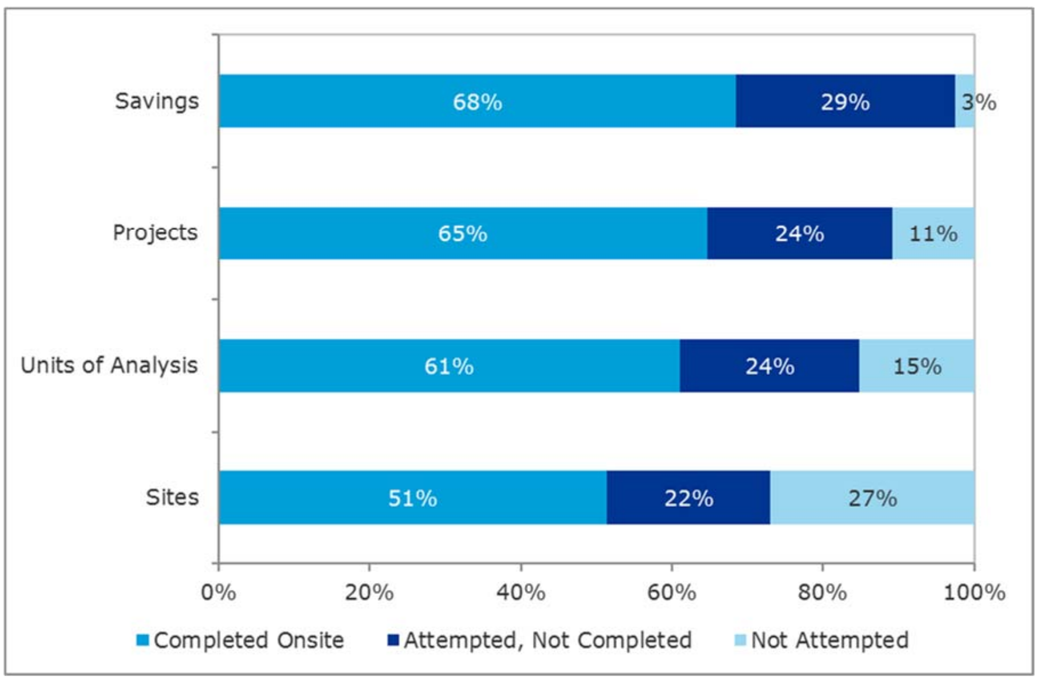
[11] Sites, projects, or units of analysis were not contacted due to strata quotas being met.

number of units despite collecting data from less sites than targeted units. The study did not achieve the targeted 90/10 relative precision for the gross realization rate at the program overall level (shown in Table 4-4). Two primary reasons for the lower than anticipated precision were a large number of influence adjustments that reduced the efficiency of the size based stratification and a lower number of customers in the sample than the data provided for sampling indicated (many customers had multiple AIMs IDs). The customer response rate was 73%.

Table 4-1: Summary of CPSV data collection for Union Large Volume

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed On-Site	21	19	77	44	856,320,533
Attempted Contact, Not Completed		8	29	17	362,135,793
Not Attempted		10	13	11	32,423,372
Total		**37**	**119**	**72**	**1,250,879,698**

Figure 4-1: Summary of CPSV data collection for Union Large Volume



4.1.2 Influence correction

The Union Large Volume program has some corrections and adjustments that differ from other programs: the influence correction and the engineering adjustment.

The Union Large Volume implementation team applied a proactive "influence factor" to some measures. The factor represents the portion of the energy savings that, in the opinion of the implementation team, was influenced by the program. In effect, it represents an anticipated free-ridership adjustment. Since the evaluation team is measuring and applying a retrospective free-ridership adjustment based on customer self-reports, the Union influence factor would double-count free-ridership for those measures. Therefore, the evaluation team removed the influence factor to produce a "true" gross savings estimate to which the NTG adjustment could be applied.

Table 4-2 shows the influence correction by domain for the Union Large Volume program. The table shows the number of units of analysis (n), influence correction ratio (Ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result. Actions (including steam traps and repairs to steam leaks and heat recovery systems) were more likely to have an influence adjustment than equipment. A ratio of 306% indicates that for these measures Union recorded 32.7% of the gross savings in its database. The positive (greater than 100%) adjustment was made to reported tracked savings to remove the influence factors assigned.

Table 4-2: Influence correction for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	24	18	108%	3%	106%	111%	2%	0.06	68%
Action	53	18	306%	131%	175%	438%	43%	1.04	32%
Overall*	**77**	**36**	**174%**	**43%**	**131%**	**217%**	**25%**	**0.88**	**100%**

Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
Confidence intervals are restricted to greater than 100% as all influence corrections were removing reductions in ex ante savings.
*Overall ratio in this table is the sample weighted average and is not used in calculating gross savings for the programs.

4.1.3 Engineering adjustment

For programs with an influence adjustment, such as the Union Large Volume program, the evaluation team defined an "engineering adjustment." This ratio is the difference between verified savings determined through the CPSV and tracked gross savings estimated by Union prior to applying the influence adjustment. These changes are due to differences in calculation methods, EUL, calculation parameters, or other engineering-related adjustments. The engineering adjustment is equivalent to the gross savings realization rate for programs that do not have an influence adjustment.

Table 4-3 shows the engineering adjustment by domain for the Union Large Volume program. The table shows the number of units of analysis (n), the engineering adjustment ratio, precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result. The low realization rate for actions (57%) was primarily the result of changes to EUL due to customer reported maintenance schedules, plant shut downs and RUL of existing equipment limiting the life of the implemented measure. The realization rate for the equipment domain was influenced by large adjustments to two projects.[12]

[12] One project had an ex post EUL of 10 where the ex ante was 1 and another project had an inverted calculation in the ex ante documentation which led to an ex post adjustment of 725%.

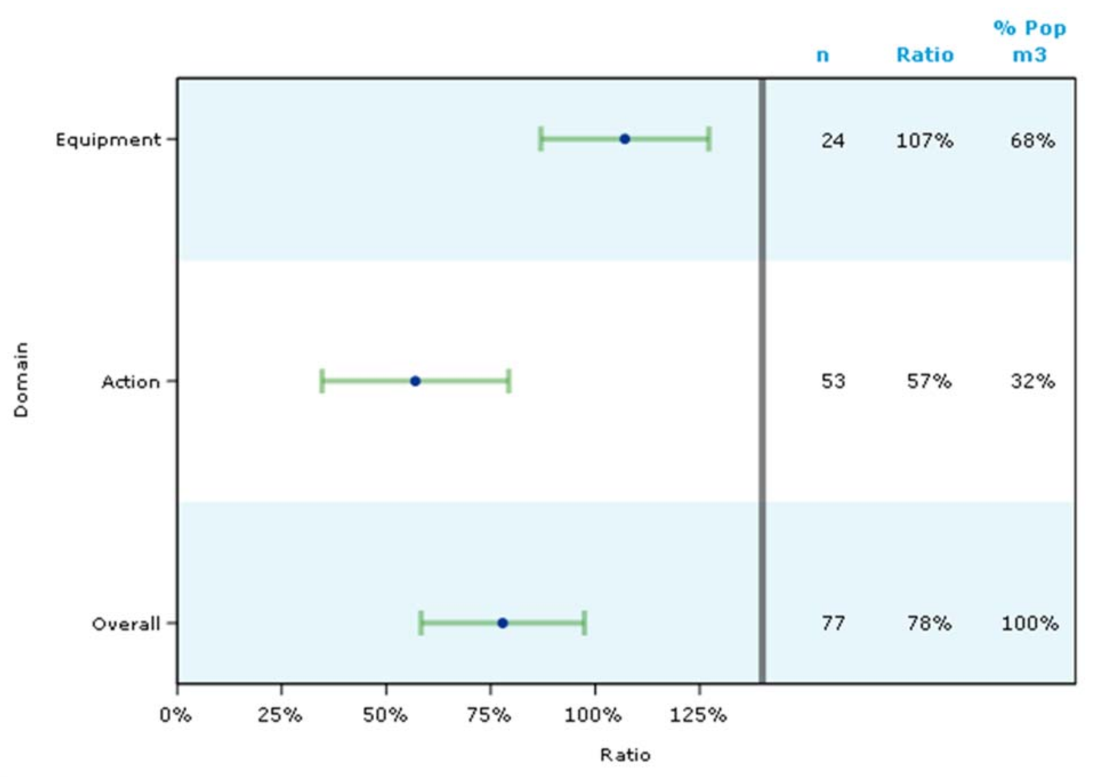
Table 4-3: Engineering adjustment for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	24	18	107%	21%	87%	128%	19%	0.47	68%
Action	53	18	57%	23%	34%	80%	40%	0.97	32%
Overall*	**77**	**36**	**78%**	**20%**	**58%**	**98%**	**26%**	**0.91**	**100%**

APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating gross savings for the programs.

Figure 4-2 also shows the engineering adjustment by domain. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, the numeric ratio, and the percent of program savings represented by each domain are shown to the right of the plot. The confidence bounds indicate that we are 90% confident that the realization rate for overall and for the actions domain are less than 100%.

Figure 4-2: Engineering adjustment for Union Large Volume



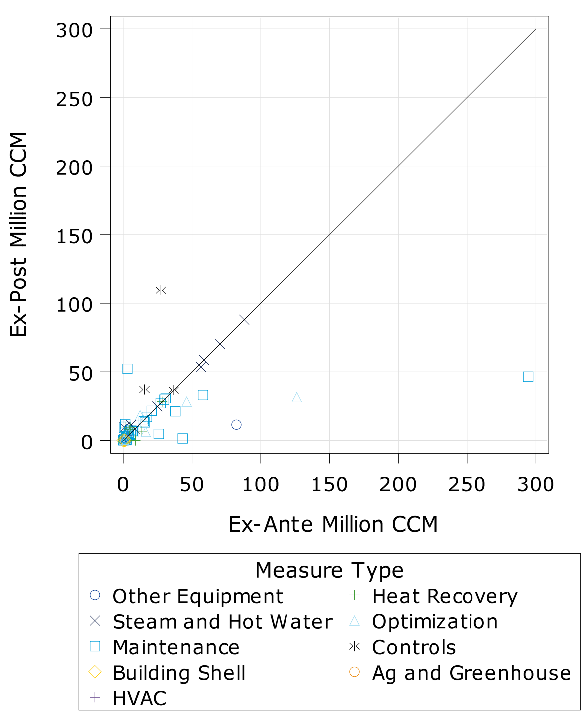
4.1.4 Discrepancy summary

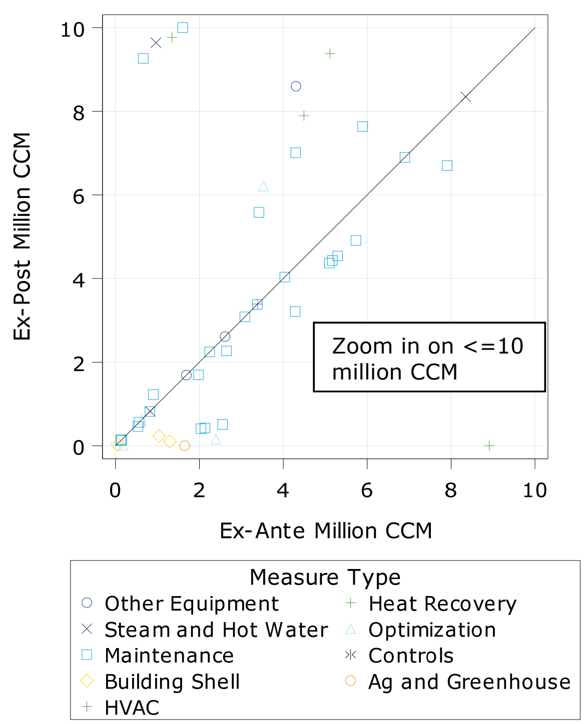
This section presents detailed results for the reasons for and magnitude of the various discrepancies between ex ante and ex-post savings. First we will look at the cumulative savings, then the two key components of cumulative savings: annual savings and the EUL. See APPENDIX Q for additional detail.

Figure 4-3 plots the ex post cumulative savings (with influence corrected) against the ex ante cumulative savings (with influence corrected) for each measure in the sample. The plot on the left shows the full set of measures, while the plot on the right is focused in on the cluster of measures with less than 10 million CCM in both ex ante and ex post. The diagonal line represents a 100% engineering adjustment, or the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post savings were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

The figure shows that most ex post savings were close to ex ante, but there was a lot of variability. The cyan squares are maintenance projects.[13] Maintenance projects had more variation in their realization rates than other projects as reflected in the scatter plots. The largest project in the sample (point on the bottom right of the plot) had a downward adjustment to savings due to a data entry error in the program tracking database.

Figure 4-3. Ex post versus ex ante cumulative savings (CCM) with influence corrected- Union Large Volume, by measure type





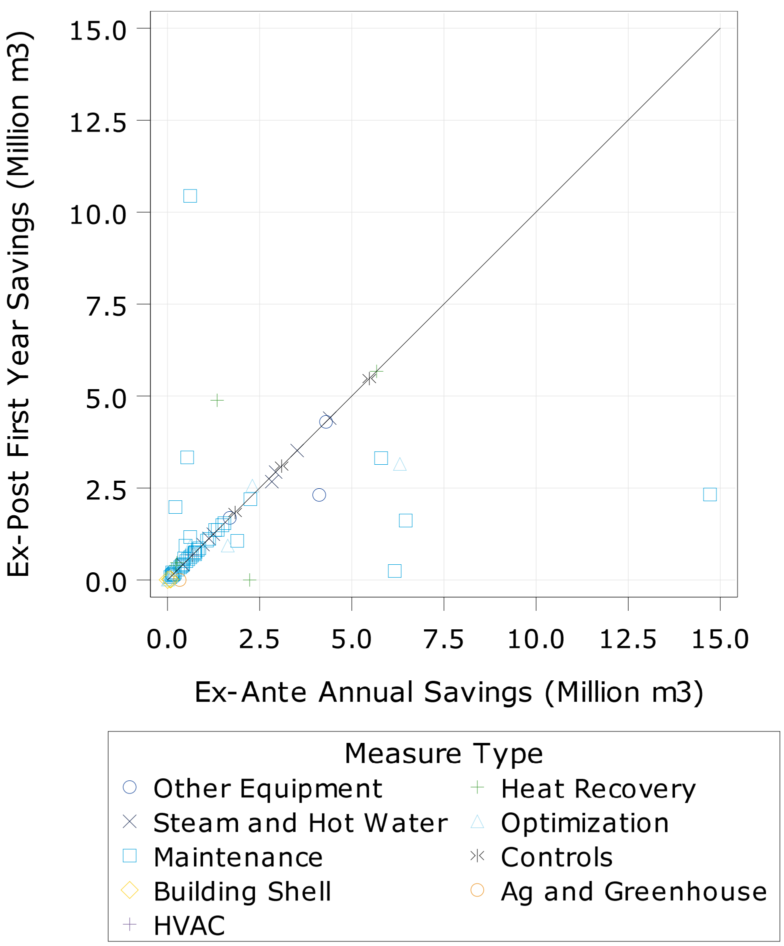
[13] Maintenance measures were a major subset of the action domain reported on in section 4.1.3 .

4.1.4.1 First-year savings discrepancies

Figure 4-4 plots the ex post annual savings (with influence corrected) against the ex ante annual savings (with influence corrected) for each measure in the sample. The plot shows the full set of measures The diagonal line represents a 100% engineering adjustment, or the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post savings were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

Most of the large adjustments to annual savings were for maintenance projects (cyan squares). One optimization project (sky blue triangle) and one heat recovery project (green plus sign) also had significant annual savings adjustments.

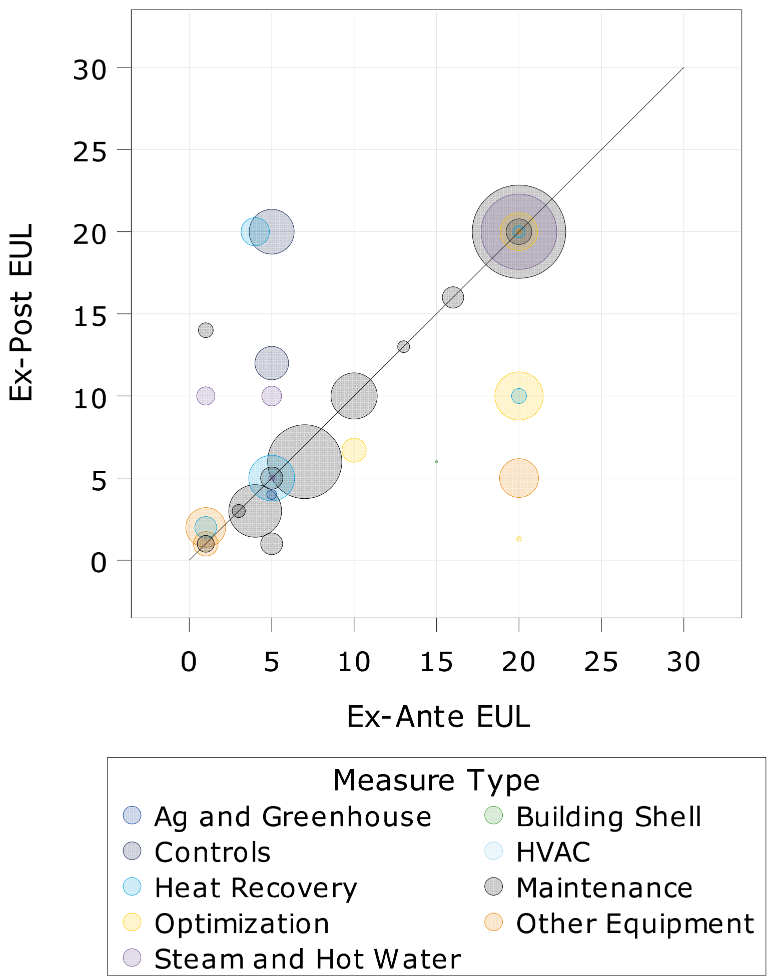
Figure 4-4: Ex post versus ex ante annual savings with influence corrected - Union Large Volume, by measure type



4.1.4.2 Measure-life discrepancies

One of the primary discrepancies is a change in EUL between ex ante and ex post. Figure 4-5 plots the ex post EUL against the ex ante EUL for each measure in the sample. Because EULs tend to be discrete numbers, the size of the bubbles in the plot indicate show the relative amount of ex ante savings for the measures at each plotted point (e.g., the larger the bubble, the more savings at that point). The diagonal line represents the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post EUL were greater than ex ante, while points below the line indicate where ex post were less than ex ante. The figure shows that several significant saving measures had large adjustments to EUL in both directions; overall, the weighted average ratio of ex post to ex ante for Large Volume EULs was 94.8%.

Figure 4-5: Ex post versus ex ante effective useful life - Union Large Volume, by measure type



4.1.5 Gross realization rate

For the Union Large Volume program, the gross realization rate is the product of the influence correction and the engineering adjustment.

Table 4-4 shows the gross realization rate by domain for the Union Large Volume program. The table shows the number of units of analysis (n), the gross realization rate (ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

Table 4-4: Gross realization rate for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	24	18	116%	22%	94%	138%	19%	0.47	68%
Action	53	18	175%	102%	72%	277%	59%	1.43	32%
Overall*	**77**	**36**	**135%**	**48%**	**87%**	**184%**	**36%**	**1.27**	**100%**

APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating gross savings for the programs.

Table 4-5 shows the influence correction and engineering adjustments that were multiplied to calculate the gross realization rates.

Table 4-5: Gross realization rate components for Union Large Volume

Domain	Influence correction	Engineering Adjustment	Gross Realization Rate
Equipment	108%	107%	116%
Action	306%	57%	175%
Overall*	**174%**	**78%**	**135%**

*Overall ratio in this table is the sample weighted average and is not used in calculating gross savings for the programs.

4.2 NTG ratio

This section summarizes the free ridership results for the Union Large Volume program. Section 4.2.1 summarizes the data collection efforts, section 4.2.2 presents the net savings realization rate, and section 4.2.3 describes the sources of program attribution.

4.2.1 Summary of participant data collected

Table 4-6 summarizes the NTG ratio data collection efforts for the Union Large Volume program. The table shows the portion of the program that:

- Completed an in-depth interview through the NTG battery
- Did not respond to an evaluation attempt at contact
- Was not contacted by the evaluation team[14]

The data collected is represented as the cumulative ex ante natural gas savings, the number of projects, the units of analysis, and sites. The portion of the program in each category is also represented in Figure 4-6. The full sample design and achievement by strata can be found in APPENDIX A. The sample design for the NTG study included attempting an NTG interview with all sites in the CPSV sample plus additional sites. Not all sites in the CPSV sample responded to the NTG interview.

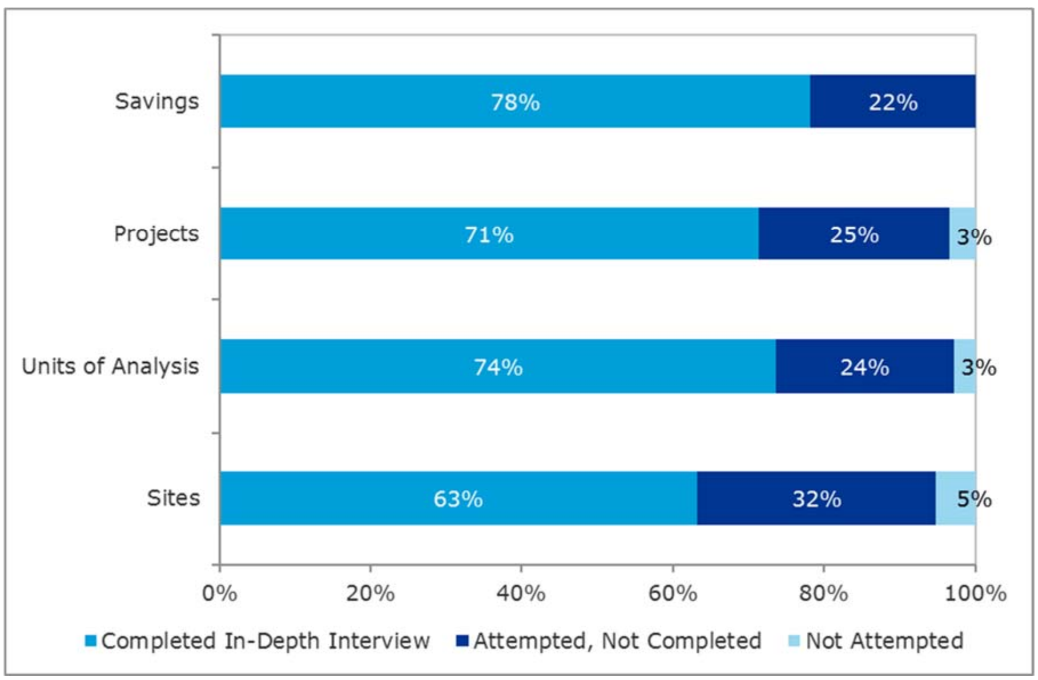
[14] Sites, projects, or units of analysis where contact was not attempted were either not selected for contact in sampling or in the backup sample and were not contacted due to strata quotas being met.

By collecting data on all measures at a site rather than only the first selected, the evaluation exceeded the targeted number of units despite collecting data from less sites than targeted units. The study had a customer response rate of 66% and did not achieve the targeted 90/10 relative precision for the NTG ratio at the program overall level (shown in Table 4-7). Relative precision is relative to the ratio result, which for sampling purposes was assumed as 50%. The achieved absolute precision (+/-) of 2% was very good and would have met the 90/10 relative precision target had the NTG ratio been at or above the assumed ratio.

Table 4-6: Summary of NTG data collection for Union Large Volume

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed In-Depth Interview	32	24	85	53	977,256,930
Attempted Contact, Not Completed		12	30	17	271,898,668
Not Attempted		2	4	2	1,724,100
Total		**38**	**119**	**72**	**1,250,879,698**

Figure 4-6: Summary of NTG data collection for Union Large Volume



4.2.2 Free-ridership

Free-ridership is the sole contributor to the NTG ratio. The evaluation team is also conducting a study of the spillover savings attributable to the program; those results will be presented in a later report. The free-ridership is calculated from self-reported responses to survey questions as outlined in APPENDIX K.

Union's Large Volume program overall had 8% attribution, or 92% free-ridership. Steam traps were the highest performing measure in the program with 21% attribution.

Table 4-7 shows the NTG ratio by domain for the Union Large Volume program. The table shows the number of units of analysis (n), NTG ratio (Ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

Union's Large Volume program overall had 8% attribution, or 92% free-ridership. Steam traps were the highest performing measure in the program with 21% attribution.

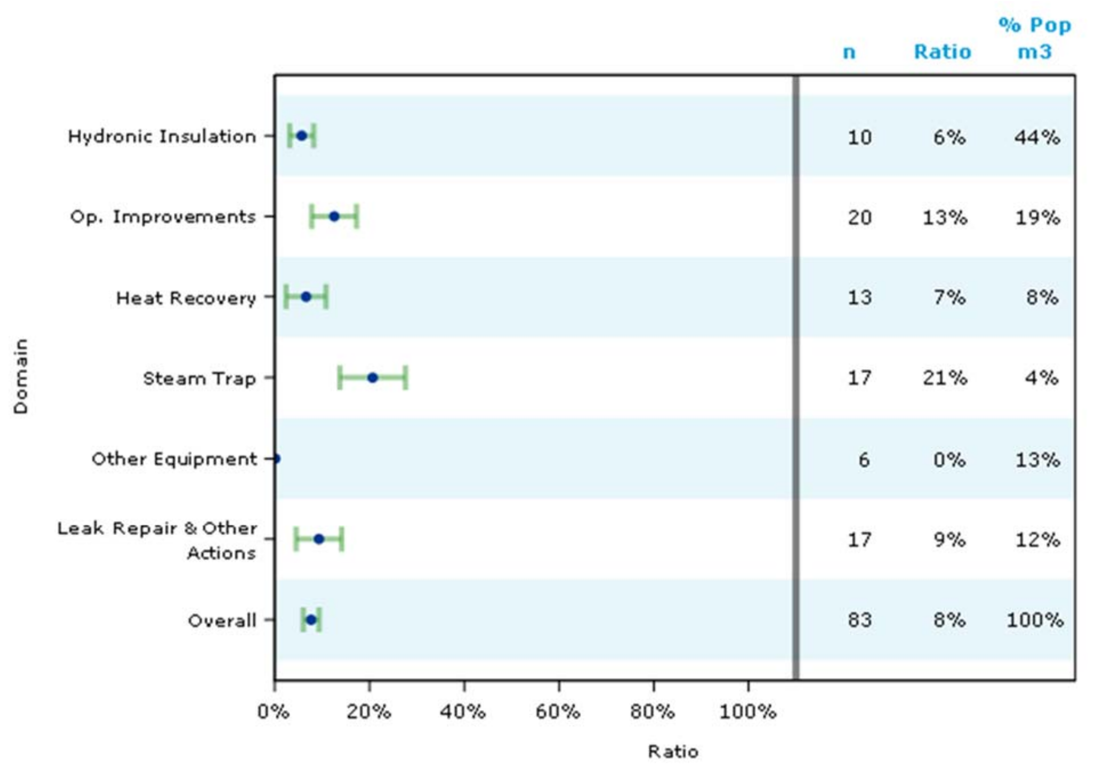
Table 4-7: NTG ratio for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Hydronic Insulation	10	7	6%	3%	3%	9%	51%	0.70	44%
Operational Improvements	20	12	13%	5%	7%	18%	41%	0.79	19%
Heat Recovery	13	10	7%	5%	2%	11%	70%	1.20	8%
Steam Trap	17	11	21%	7%	13%	28%	35%	0.65	4%
Other Equipment	6	6	0%	0%	0%	0%	146%	1.77	13%
Leak Repair and Other Actions	17	11	9%	5%	4%	14%	56%	1.02	12%
Overall*	**83**	**41**	**8%**	**2%**	**6%**	**10%**	**27%**	**1.02**	**100%**

The Other Equipment category includes building shell, steam turbine blades, burner management system, replace flue gas analyzers, infrared polyethylene, and cogeneration transformers.
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating net savings for the programs.

Figure 4-7 also shows the NTG ratio by domain. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, the numeric ratio, and the percent of program savings represented by each domain are shown to the right of the plot.

Figure 4-7: NTG ratio for Union Large Volume



4.2.3 Sources of attribution

As outlined in APPENDIX K, the NTG ratio is a combination of responses regarding the program's influence on the timing, quantity, and efficiency of the measure installed. This section details the program's effect on each of those sources of attribution and indicates where the program is creating the greatest transformation.

Table 4-8 represents the possible combinations of timing, efficiency, and quantity attribution. A "yes" in the timing, efficiency, or quantity column indicates partial or full attribution for that source. A "no" indicates no attribution for that source. For example, the row that has "yes" for timing, efficiency, and quantity reports the portion of the program that indicated that the program had at least partial influence on the timing, efficiency, and quantity for that measure. For some measures, efficiency or quantity may not be applicable questions; for the purposes of this table, the not applicable measures are included as "no" on the non-applicable dimension.

The table also shows the number of customers, measures, and savings that fall into each combination. The portion of the program that falls into each combination of timing, efficiency, and quantity attribution is represented by the number of responses, the cumulative savings in CCM, and the percent of cumulative savings represented by that category.

The table shows that a quarter of program participation (~24% of savings) was at least partially influenced by the program. Of the three ways the program can influence, timing is the most common, affecting approximately 23% of the program savings (sum of the first four rows). Quantity/size affects approximately 14% of the program savings (sum of the rows with quantity equals "yes"), and the program influenced the efficiency levels of less than 1% of the savings in the Large Volume program.

Table 4-8. Overview of the sources of attribution for Union Large Volume

Attribution						
Timing	Efficiency	Quantity	Customers*	Units of Analysis	Projects	Percent Savings
Yes	Yes	Yes	*	*	*	<1%
Yes	Yes	No	0	0	0	0%
Yes	No	Yes	*	6	15	13%
Yes	No	No	7	10	13	11%
No	Yes	Yes	0	0	0	0%
No	Yes	No	0	0	0	0%
No	No	Yes	*	*	*	1%
No	No	No	19	34	54	75%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

4.2.3.1 Timing component

Respondents answered a sequence of questions that addresses the timing of the equipment installation. First, respondents answered the likelihood of installing the same type of equipment at the same time without the program (DAT1a). Respondents who answered "Later" specified the number of months later in the next question (DAT1b).[15]

Timing was the component most strongly affected by the program. The program affected the timing of projects that account for approximately one-fourth of program savings. Twenty out of 33 surveyed customers accounting for 76% of program savings said they would have installed their measure(s) at the same time. The rest indicated some amount of program acceleration, mostly between 1 and 48 months (Table 4-9).

[15] See APPENDIX K for the detailed scoring algorithm.

Table 4-9. Determining the Acceleration period, Union Large Volume

DAT1a. Without the utility, how different would the timing have been?						
DAT1b. Approximately how many months later?						
DAT1a	**DAT1b**	**Customers***	**Units of Analysis**	**Projects**	**Percent Savings**	**Timing Attribution**
Same Time	N/A	20	35	55	76%	0%
Earlier	N/A	0	0	0	0%	0%
Later	Months < 48	10	15	27	19%	ER baseline credit** for months accelerated
	Months ≥ 48	*	*	*	<1%	100%+ ER baseline credit
	Don't Know/ Refused	*	*	*	5%	ER baseline credit for avg. of DAT1b
Never	N/A	*	*	*	<1%	100%
Don't Know/ Refused	N/A	0	0	0	0%	ER baseline credit for avg. of DAT1a

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.
**ER baseline credit reflects credit for a vs. in situ equipment baseline savings during the acceleration period.

4.2.3.2 Efficiency Component

Respondents answered a sequence of questions that addresses the program's effects on the efficiency level of the installed equipment. First, respondents answered the likelihood of installing the same level of efficiency without the program (DAT2a). Respondents who answered that they would have installed a less efficient option answered a follow-up question (DAT2b) to specify the level of efficiency they would have installed.

Respondents reported that program had very little effect on efficiency level (Table 4-10) of the measures implemented. In part, this is because most (58%) of program savings were from measures for which efficiency levels is not applicable such as operational improvements, leak repairs or steam trap replacements. Almost all remaining survey respondents said the program had no effect on the efficiency level of the equipment installed.

Table 4-10. Determining Efficiency Attribution, Union Large Volume

DAT2a. Without the utility, would you have installed the same, higher, or lower efficiency?						
DAT2b. Without the utility, what efficiency would you have installed?						
DAT2a	**DAT2b**	**Customers***	**Units of Analysis**	**Projects**	**Percent Savings**	**Efficiency Attribution**
Same	N/A/Skipped	15	19	24	42%	0%
Lower	Standard Efficiency	*	*	*	<1%	100%
	Between Standard and High	0	0	0	0%	50%
	Don't Know/ Refused	0	0	0	0%	Average of DAT2b
Higher	N/A/Skipped	0	0	0	0%	0%
Don't Know/ Refused	N/A/Skipped	0	0	0	0%	Average of DAT2a
Not Applicable	N/A	17	32	59	58%	Not Asked

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

4.2.3.3 Quantity Component

Respondents answered a sequence of questions that addresses the program's effects on the amount of equipment installed. First, respondents answered the likelihood of installing the same amount of equipment (or capacity for measures for which number is not relevant, such as chillers) without the program (DAT3a). Respondents who answered that they would have installed a less or more equipment answered a follow-up question (DAT3b) to specify how the program changed the amount that they installed.

The program had little effect on the quantity of measures installed. Twenty-one customers accounting for 84% of the program savings said they would have purchased the same amount of equipment without the program (Table 4-11).

Table 4-11. Determining quantity / size attribution, Union Large Volume

DAT3a. Without the utility, how different would the quantity / size have been? DAT3b. By what percentage did you change the amount installed because of utility?						
DAT3a	**DAT3b**	**Customers***	**Units of Analysis**	**Projects**	**Percent Savings**	**Quantity Attribution**
Same	N/A	21	43	66	84%	0%
Less	Value < 100%	*	6	15	9%	Value < 50%
	Value ≥ 100%	0	0	0	0%	Value > 50%
	Don't Know/Refused	*	*	*	5%	Average of DAT3a
More	Value < 100%	0	0	0	0%	Value < 100%
	Value ≥ 100%	0	0	0	0%	Value = 100%
	Don't Know/ Refused	0	0	0	0%	Average of DAT3a
None	N/A	*	*	*	<1%	100%
Don't Know/ Refused	N/A	0	0	0	0%	Average of DAT3
Not Applicable	N/A	*	*	*	1%	Not Asked

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

4.3 Gross and net savings

This section reports the evaluation-verified gross savings in section 4.3.1 and the net savings (including only free-ridership) in section 4.3.2.

4.3.1 Verified gross savings

The program-level gross savings are determined by multiplying the tracking savings by the gross realization rate within each primary reporting domain. Table 4-12shows the primary domains, the tracking savings for that domain, the gross realization rate, and the final verified gross savings for that domain. Dividing the overall verified gross savings by the overall tracking savings results in a program-level gross realization rate of 135%.

Table 4-12: Verified gross savings for Union Large Volume

Domain	Cumulative Tracked Savings (m^3)	Gross RR	Verified Cumulative Gross Savings (m^3)
Equipment	846,481,549	116.08%	982,595,782
Action	404,398,149	174.61%	706,119,609
Overall	**1,250,879,698**	**135.00%**	**1,688,715,391**

4.3.2 Net savings

The program-level net savings are determined by multiplying the verified savings by the NTG ratio within each primary reporting domain. Table 4-13 shows the primary domains, the tracking savings for that domain, the verified savings, the NTG ratio, and the final net savings for that domain. Dividing the overall net savings by the overall verified savings results in a program-level NTG ratio of 8%.

Table 4-13: Net savings for Union Large Volume

Domain	Verified Cumulative Gross Savings (m^3)	NTG	Net Cumulative Savings (m^3)
Hydronic Insulation	635,631,096	5.67%	36,040,283
Heat Recovery	134,997,398	6.59%	8,896,329
Operational Improvements	375,172,128	12.55%	47,084,102
Steam Trap	89,234,963	20.65%	18,427,020
Other Equipment	260,286,951	9.31%	24,232,715
Leak Repair and Other Actions	193,392,855	0.08%	154,714
Overall	**1,688,715,391**	**7.98%**	**134,835,163**

The Other Equipment category includes building shell, steam turbine blades, burner management system, replace flue gas analyzers, infrared polyethylene, and cogeneration transformers
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.

5 Enbridge Commercial, Industrial, and Multi-Residential Programs

Enbridge's custom program offerings encourage commercial and industrial customers to reduce their energy consumption by providing financial incentives, technical expertise, and guidance for energy related decision-making. They differ from the prescriptive and direct install programs as they provide services and varying financial incentives based on overall natural gas savings realized by the customer to address customer-specific needs.

There are three programs covered in this section: Enbridge Commercial Custom, Enbridge Industrial Custom Solutions, and Low Income Multi-Residential Affordable Housing.

5.1 Commercial Custom and Industrial Custom Solutions (Enbridge)

The goal of the Enbridge Commercial Custom offer is to reduce natural gas use through the capture of energy efficiency opportunities in commercial buildings, including retrofits of building components and upgrades at the time of replacement.

The Enbridge Industrial Custom Solutions offer is designed to capture energy savings within the industrial sector by supporting customers through a continuous improvement approach. Industrial Energy Solutions Consultants (ESCs) assist customers with the adoption of energy efficient technologies by overcoming financial, knowledge or technical barriers.

A subset of the measures[16] in the commercial program is part of the multi-family or multi-residential segment.

All measures implemented as part of these programs and claimed in 2015 are included in the CPSV and FR results in the next sections.

5.2 Low-income Multi-Residential Affordable Housing (Enbridge)

This program offers multi-family low-income housing customers incentives to encourage energy efficient upgrades and funding for energy audits. The program also provides technical services, benchmarking, and education for housing providers, building operators, and tenants about their building's energy usage and ways to achieve energy efficiency. Eligible measures include boilers, ventilation systems, building envelope, window upgrades, in-suite water conservation measures (faucet aerators and showerheads), and heat reflector panels.

The target markets for this program are social and assisted housing providers who own and operate Part 3 buildings and private multi-residential building owners that provide housing to low-income households.[17] In addition, Enbridge targets shelters and supportive housing.

[16] Throughout the report we will refer to unique combinations of Enbridge project codes and project sub-codes and measures.

[17] "Part 3" references buildings covered by Part 3 of the Ontario Building Code, defined as those exceeding 600 square meters in area or greater than three storeys in height; for residential energy efficiency programs, these are typically multifamily buildings.

Custom measures implemented as part of these programs and claimed in 2015 are included in the CPSV results; 4% of the Enbridge low income multi-family (LI MF) program savings are from custom measures. We did not include measures implemented as part of this program in the NTG evaluation.

5.3 CPSV results

This section summarizes the gross savings verification (CPSV) energy savings verification results for the Enbridge C&I, MR MF and LIMF Programs. Section 5.3.1 summarizes the data collection efforts, section 5.3.2 presents the gross savings realization rate, and section 5.3.3 summarizes the reasons for the discrepancies between the ex ante and ex post gross savings estimates, and.

5.3.1 Summary of CPSV data collection

Table 5-1 summarizes the CPSV data collection efforts for the Enbridge C&I and LIMF Programs. This includes the number of targeted sites and measures that:

- Had completed on-site visits
- Had completed telephone supported engineering reviews (TSER)
- Did not respond to an evaluation attempt at contact
- Were not contacted by the evaluation team[18]

The data collected is represented as the number of sites, the number of measures, the number of units of analysis, and cumulative ex ante natural gas savings. The proportion of the program in each category is also represented in Figure 5-1. The full sample design and achievement by strata can be found in 8. By collecting data on all measures at a site rather than only the first selected, the evaluation exceeded the targeted number of units despite collecting data from fewer sites and TSER units than targeted. The study had a 57% customer response rate and achieved the targeted 90/10 relative precision for the gross realization rate at the overall program level (shown in Table 5-2).

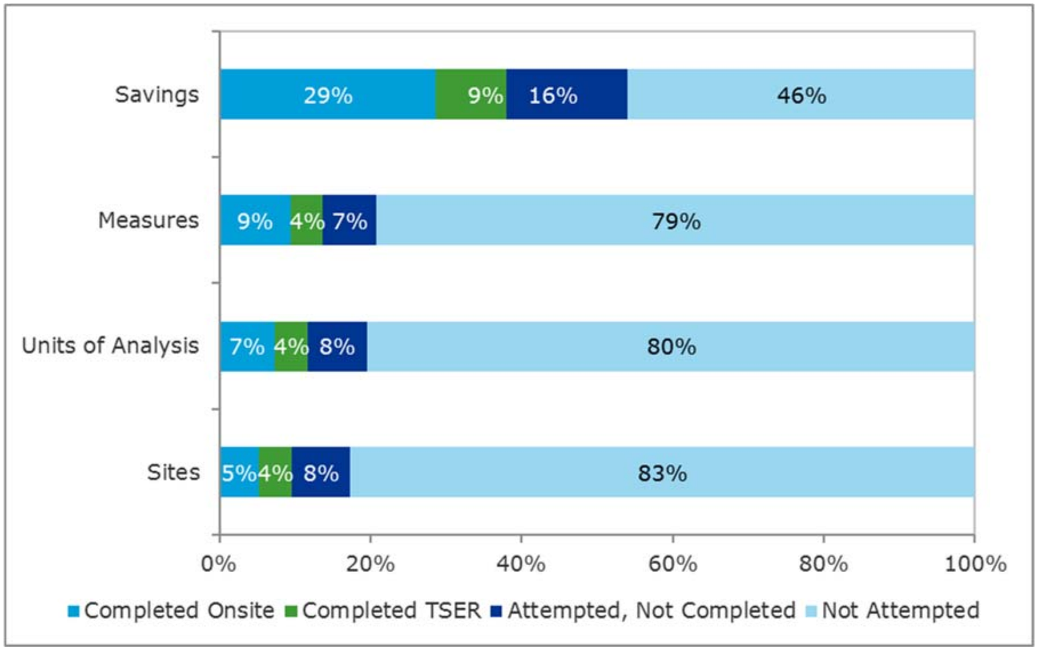
Table 5-1: Summary of CPSV data collection for Enbridge Custom C&I, MF, and LIMF programs*

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed On-Site	40	37	88	61	250,801,165
Completed TSER	38	31	39	37	81,376,035
Attempted Contact, Not Completed		54	66	65	140,499,585
Not Attempted		584	734	670	401,730,740
Total		**706**	**927**	**833**	**874,407,525**

* Please see the glossary for definitions of unit of analysis, site, and measure.

[18] Sites, projects, or units of analysis where contact was not attempted were either not selected for contact in sampling or in the backup sample and were not contacted due to strata quotas being met.

Figure 5-1: Summary of CPSV data collection for Enbridge Custom C&I and LIMF programs



5.3.2 Gross savings realization rate

The gross savings realization rate represents the differences in ex post and ex ante savings due to differences in calculation methods, EUL, calculation parameters, or other engineering-related adjustments. Table 5-2 shows the gross savings realization rate by domain for the Enbridge Custom C&I, MF, and LIMF offerings. The table shows the number of units of analysis (n), gross savings realization rate (Ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

Enbridge's C&I and LIMF programs overall had a sample weighted 92% gross realization rate. These domains were found to have variation in engineering adjustment ratios ranging from 87% to 125%, resulting in an overall engineering correction ratio of 91%. The largest domain for these programs is the combined Custom Commercial and Multi-residential programs, which include all commercial measures as well as all MRMF and LIMF measures. The 88% realization rate is driven by 11 measures with RRs less than 75%. The discrepancies in these measures were mostly due to documentation that did not match what the verifier found onsite, a lack of pre-/post-usage data, differences in billing and simulation results, and EUL changes. The high realization rate for steam traps is primarily due to a change in EUL from 5 years to 6. Relative precision for the programs overall was 10% at 90% confidence.

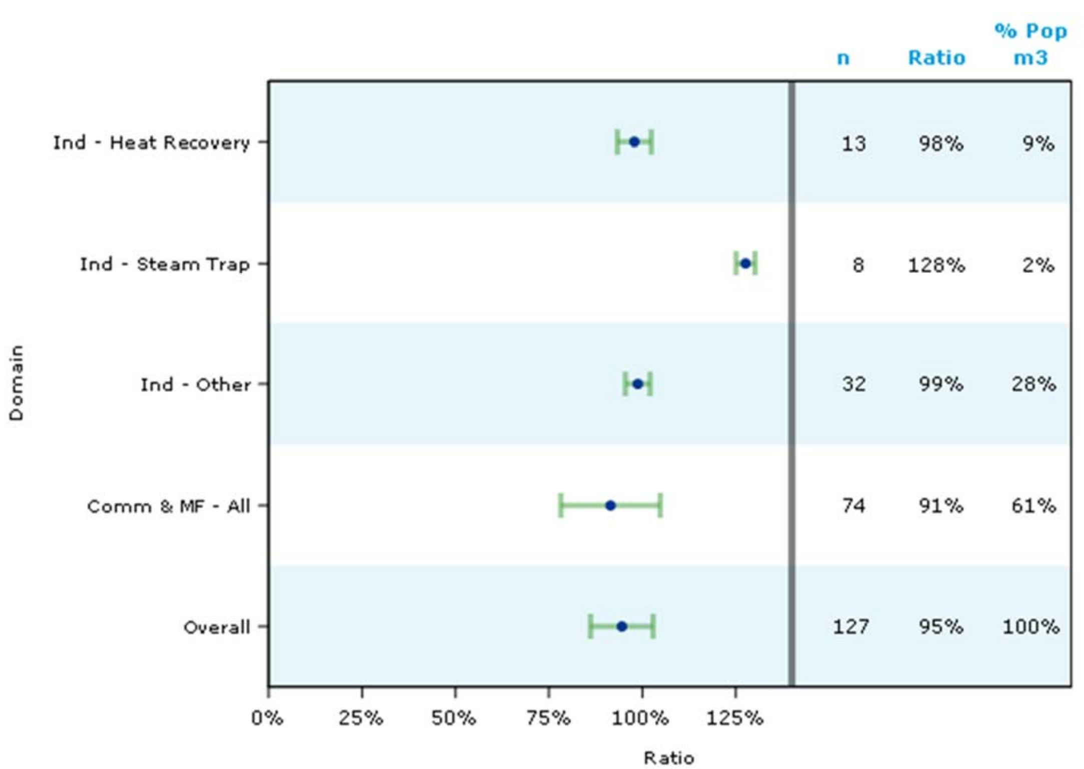
Table 5-2: Gross savings realization rate for Enbridge Custom C&I, and LIMF offerings

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Meas	Custs		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Heat Recovery	13	10	98%	5%	93%	103%	5%	0.09	9%
	Steam Trap	8	8	128%	3%	125%	131%	2%	0.04	2%
	Other	32	25	99%	4%	95%	103%	4%	0.11	28%
Custom Commercial and LIMF		74	41	91%	14%	78%	105%	15%	0.57	61%
Overall*		**127**	**82**	**95%**	**9%**	**86%**	**103%**	**9%**	**0.51**	**100%**

Other industrial: controls, Etools boiler, Etools boiler add-on, Etools insulation, Etools ventilation, other (low temperature spray washer chemical, increase mechanical dewatering, furnace burner tune-up, infrared heater and programable thermostat, low temp catalytic oxidizer, air curtain, and industrial roll-up doors, water heater)
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating gross savings for the programs.

Figure 5-2 also shows the gross savings realization rate by domain. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, the numeric ratio, and the percent of program savings represented by each domain are shown to the right of the plot.

Figure 5-2: Engineering adjustment for Enbridge Custom C&I, MF, and LIMF programs



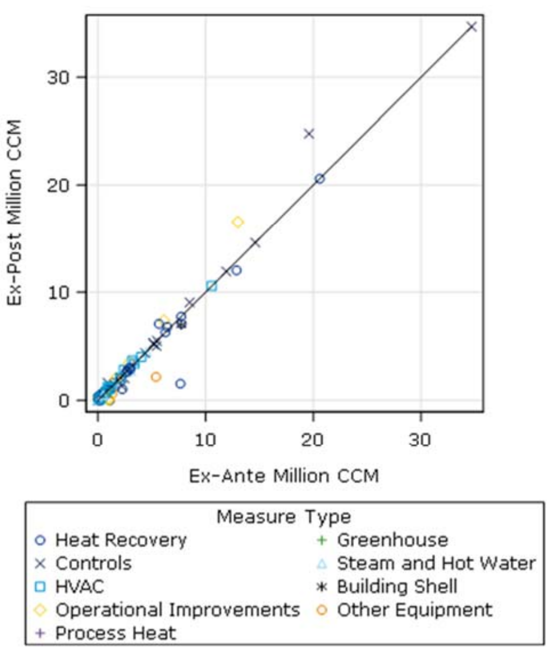
5.3.3 Discrepancy summary

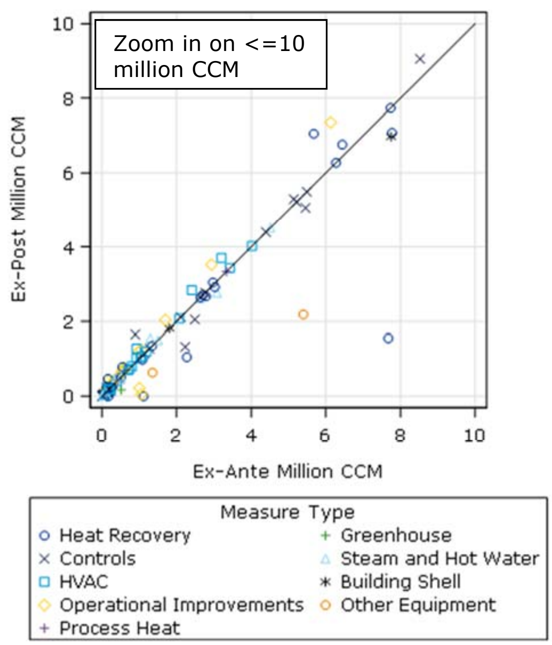
This section presents detailed results for the reasons for and magnitude of the various discrepancies between ex ante and ex-post savings. First we will look at the cumulative savings, then the two key components of cumulative savings: annual savings and the EUL. See APPENDIX Q for additional detail.

Figure 5-3 plots the ex post cumulative savings against the ex ante cumulative savings for each measure in the sample. The plot on the left shows the full set of measures, while the plot on the right is focused in on the cluster of measures with less than 10 million CCM in both ex ante and ex post. The diagonal line represents a 100% engineering adjustment, or the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post savings were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

Most measures had similar ex post and ex ante savings. Heat recovery measures tended to have the largest adjustments. Two heat recovery measures resulted in large negative discrepancies, the largest of which was due to the site contact providing updated measured gas use. Two other large heat recovery measures had positive adjustments (each due to different operating conditions for found in the ex post verification.

Figure 5-3: Ex post versus ex ante cumulative savings (CCM) - Enbridge C&I and MF, by measure type



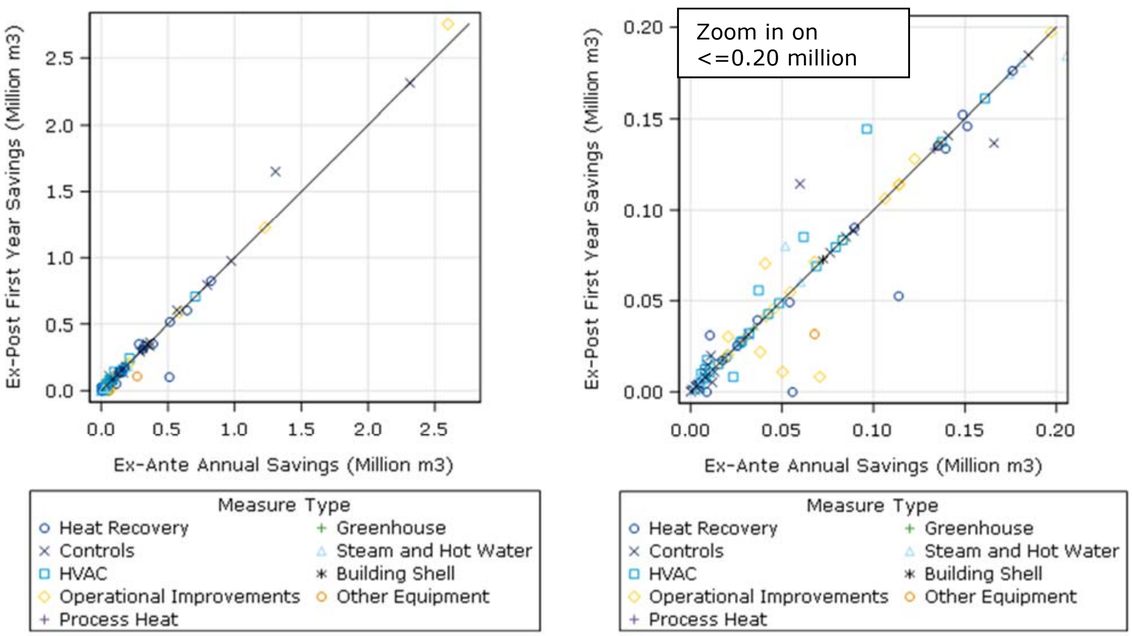


5.3.3.1 First-year savings discrepancies

Figure 5-4 plots the ex post annual savings against the ex ante annual savings for each measure in the sample. The plot on the left shows the full set of measures, while the plot on the right is focused in on the cluster of measures with less than 0.20 million m^3 in both ex ante and ex post. The diagonal line represents a 100% engineering adjustment, or the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post savings were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

Like the cumulative savings, most measures had similar ex post and ex ante savings. At the high level the pattern is consistent in terms of types of measures with large adjustment.

Figure 5-4. Ex post versus ex ante annual savings - Enbridge C&I and MF, by measure type

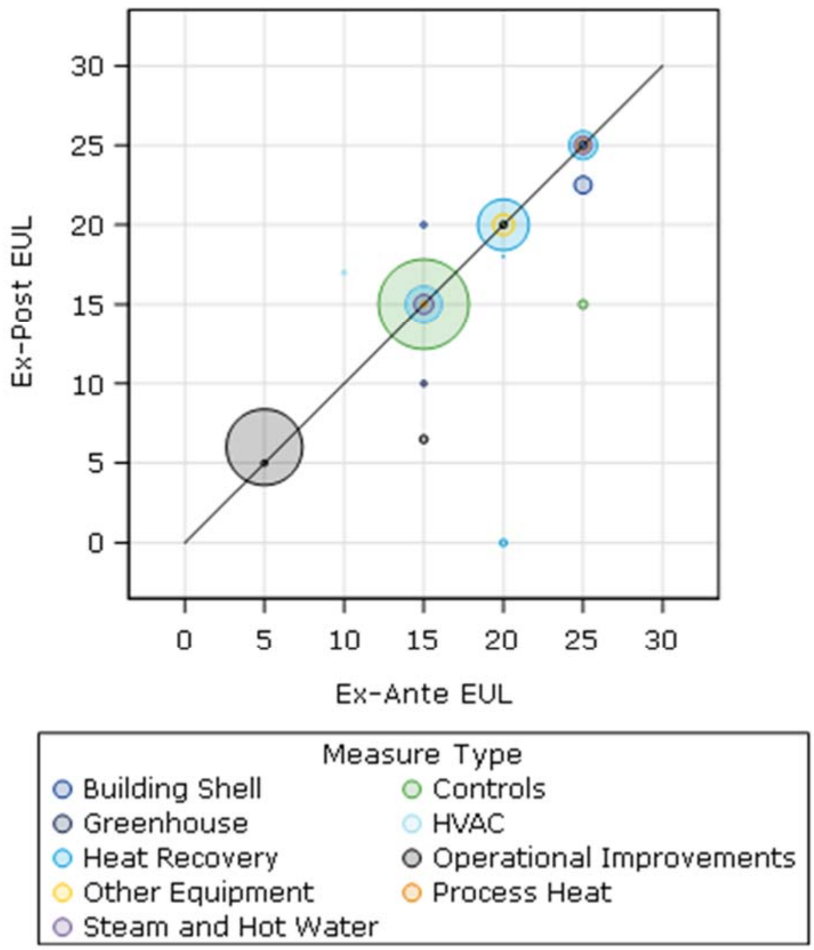


5.3.3.2 Measure life discrepancies

One of the primary discrepancies is a change in EUL between ex ante and ex post. Figure 5-5 plots the ex post EUL against the ex ante EUL for each measure in the sample. Because EULs tend to be discrete numbers, the size of the bubbles in the plot indicate show the relative amount of ex ante savings for the measures at each plotted point (e.g., the larger the bubble, the more savings at that point). The diagonal line represents the plotted value if ex post equals ex ante. Points above the line indicate measures where ex post EUL were greater than ex ante, while points below the line indicate where ex post were less than ex ante.

The plot shows that most savings had equal ex post and ex ante EULs. The greatest differences represented relatively small savings.

Figure 5-5: Ex post versus ex ante effective useful life - Enbridge C&I and MF


30
25
20
15
10
5
0
Ex-Post EUL
0
5
10
15
20
25
30
Ex-Ante EUL
Measure Type
Building Shell
Greenhouse
Heat Recovery
Other Equipment
Steam and Hot Water
Controls
HVAC
Operational Improvements
Process Heat

5.4 NTG ratio

This section summarizes the free-ridership results for the Enbridge Custom C&I program. Section 5.4.1 summarizes the data collection efforts, section 5.4.2 presents the net savings realization rate, and section 5.4.3 describes the sources of program attribution.

5.4.1 Summary of participant data collected

Table 5-3 summarizes the NTG ratio data collection efforts for the Enbridge Custom C&I program. The table shows the portion of the program that:

- Completed an in-depth interview through the NTG battery
- Did not respond to an evaluation attempt at contact
- Was not contacted by the evaluation team[19]

The data collected is represented as the cumulative ex ante natural gas savings, the number of measures, the units of analysis, and sites. The portion of the program in each category is also represented in Figure 5-6. The full sample design and achievement by strata can be found in 8. The sample design for the NTG study included attempting an NTG interview with all sites in the CPSV sample plus additional sites. Not all sites in the CPSV sample responded to the NTG interview.

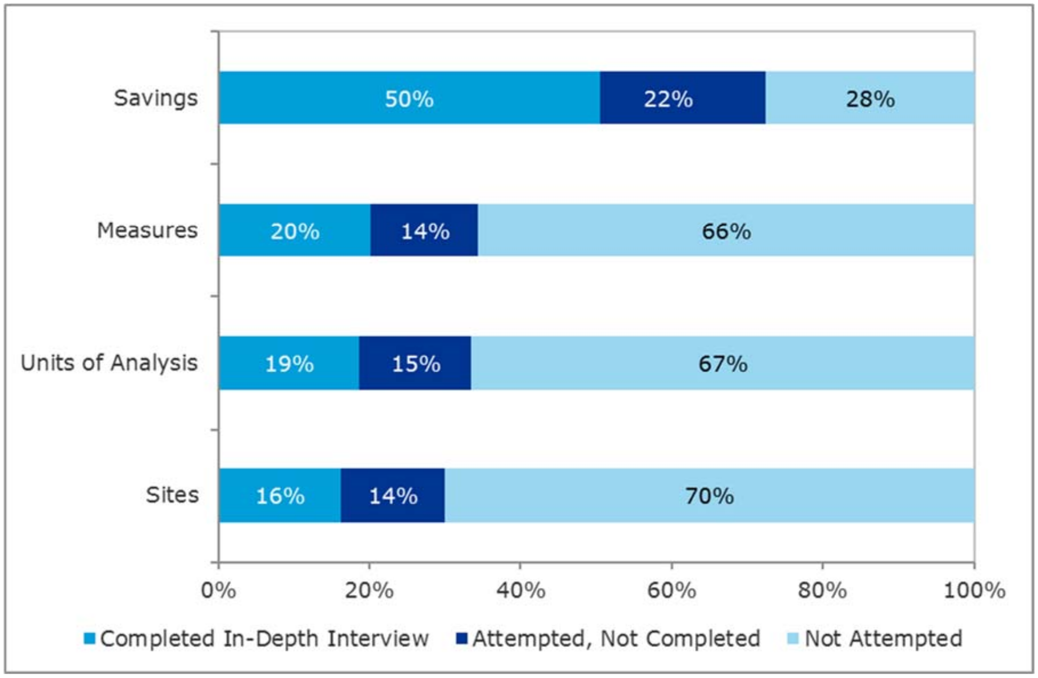
By collecting data on all measures at a site rather than only the first selected, the evaluation fell one short of the targeted number of units despite collecting data from 50% fewer sites than targeted. The study had a 52% customer response rate and achieved a NTG ratio with absolute precision of +/-5% and relative precision of 16% at 90% confidence (shown in Table 5-4). Relative precision is relative to the ratio result, which for sampling purposes was assumed as 50%. The achieved absolute precision (+/-) of 5% would have met the 90/10 relative precision target had the NTG ratio been at or above the assumed ratio.

Table 5-3: Summary of NTG data collection for Enbridge Custom C&I and LIMF programs

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed In-Depth Interview	151	100	162	135	408,890,043
Attempted Contact, Not Completed		84	114	107	178,062,737
Not Attempted		431	527	481	223,653,170
Total		**615**	**803**	**723**	**810,605,950**

[19] Sites, projects, or units of analysis where contact was not attempted were either not selected for contact in sampling or in the backup sample and were not contacted due to strata quotas being met.

Figure 5-6: Summary of NTG data collection for Enbridge Custom C&I programs



5.4.2 Free-ridership

Free-ridership is the sole contributor to the NTG ratio. The evaluation team is also conducting a study of the spillover savings attributable to the program; those results will be presented in a later report. The free-ridership is calculated from self-reported responses to survey questions as outlined in APPENDIX J.

Table 5-4 shows the NTG ratio by domain for the Enbridge Custom C&I programs. The table shows the number of units of analysis (n), NTG ratio (Ratio), precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

Enbridge's C&I programs overall had 29% attribution, or 71% free-ridership. Ventilation measures showed the lowest attribution (4-19% in each sector) while multi-residential other (non-boiler, non-ventilation) showed the highest attribution at 97%. Industrial Heat Recovery measures were the only other domain over 50% attribution at 56%.

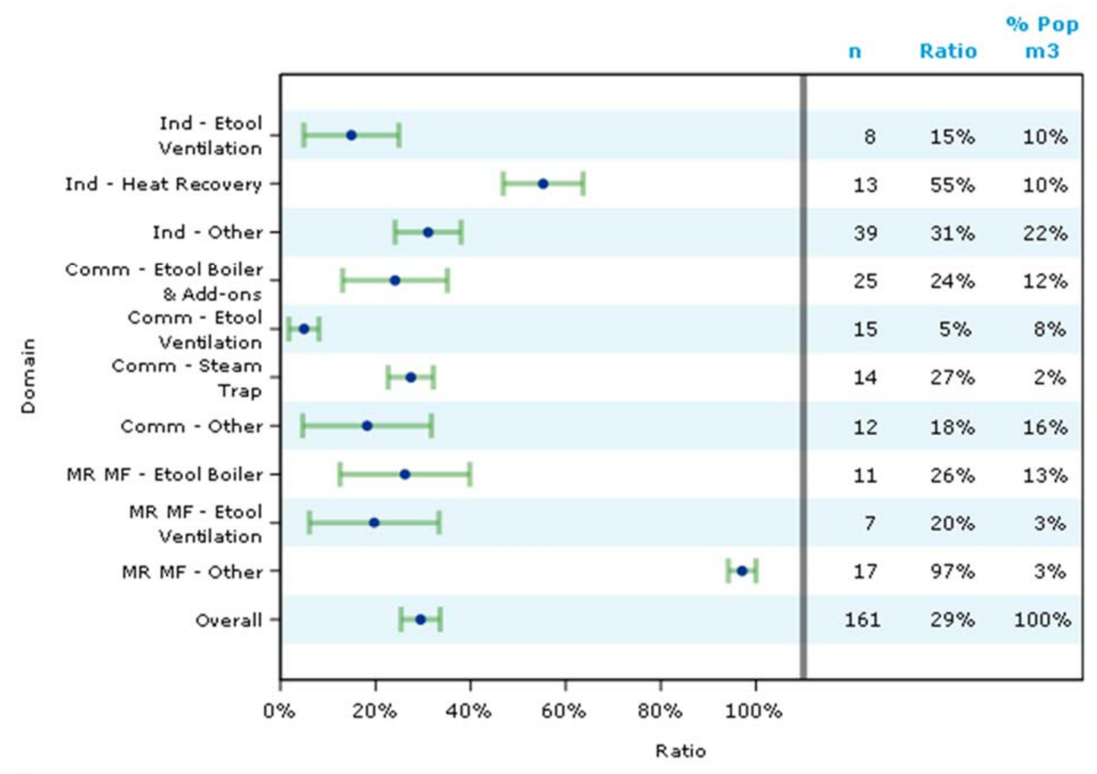
Table 5-4: NTG ratio for Enbridge Custom C&I programs

Sector	Domain	n		NTG Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Meas.	Custs.		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Etools Ventilation	8	7	15%	10%	5%	25%	70%	0.95	10%
	Heat Recovery	13	10	55%	9%	46%	64%	16%	0.27	10%
	Other	39	34	31%	7%	24%	38%	24%	0.81	22%
Custom Commercial	Etools Boiler and Boiler Add-on	25	20	24%	11%	13%	35%	47%	1.22	12%
	Etools Ventilation	15	15	5%	4%	1%	8%	72%	1.58	8%
	Steam Trap	14	6	27%	5%	22%	33%	19%	0.23	2%
	Other	12	8	18%	14%	4%	32%	76%	1.14	16%
Custom Multi-Residential	Etools Boiler	11	8	26%	14%	12%	40%	54%	0.80	13%
	Etools Ventilation	7	7	20%	14%	6%	34%	71%	0.97	3%
	Other	17	7	97%	3%	94%	100%	3%	0.05	3%
Overall*		**161**	**112**	**29%**	**4%**	**25%**	**34%**	**15%**	**0.97**	**100%**

Other Industrial: Controls, Etools boiler, Etools boiler add-on, Etools insulation, steam trap, other (increase mechanical dewatering, VFD, infrared heater and programmable thermostat, low temp catalytic oxidizer, air curtain, industrial roll-up doors, evaporator system, water heater, reduce powder paint curing oven exhaust, dock seal, aquathermat heating system, insulated panels, greenhouse double polyethylene walls)
Other Commercial: Etools insulation, controls, other (dock seal, building shell, steam chiller, high speed door, boiler – hydronic high-efficiency)
Other Multi-res: Etools boiler add-on, Etools insulation, heat reflector panels
APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.
*Overall ratio in this table is the sample weighted average and is not used in calculating net savings for the programs.

Figure 5-7 also shows the NTG ratio by domain. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, the numeric ratio, and the percent of program savings represented by each domain are shown to the right of the plot.

Figure 5-7: NTG ratio for Enbridge Custom C&I programs



5.4.3 Sources of attribution

As outlined in APPENDIX K, the NTG ratio is an estimate of a program's influence on the timing, quantity, and efficiency of the measure installed. This section details the program's effect on each of those sources of attribution and indicates where the program is creating the greatest transformation.

Table 5-5 represents the possible combinations of timing, efficiency, and quantity attribution. A "yes" in the timing, efficiency, or quantity column indicates partial or full attribution for that source. A "no" indicates no attribution for that source. For example, the row that has Yes for timing, efficiency, and quantity reports the portion of the program that indicated that the program had at least partial influence on the timing, efficiency, and quantity for that measure. For some measures, efficiency or quantity may not be applicable questions; for the purposes of this table, the not applicable measures are included as "no" on the non-applicable dimension.

The table also shows the portion of the program that falls into each combination of timing, efficiency, and quantity attribution represented by the number of responses and the percent of cumulative savings represented by that category.

The table shows that approximately two-thirds (63%) of program savings were at least partially influenced by the program. Of the three aspects relating to savings that the program can influence, timing is the most common, affecting approximately 57% of the program savings. Quantity affects approximately 20% of the program savings, and the program influenced efficiency levels of equipment accounting for approximately 13% of program savings.

Table 5-5. Overview of the sources of attribution for Enbridge Custom C&I programs

Attribution						
Timing	Efficiency	Quantity	Customers*	Units of Analysis	Measures	Percent Savings
Yes	Yes	Yes	0	0	0	0%
Yes	Yes	No	7	8	8	8%
Yes	No	Yes	18	27	33	20%
Yes	No	No	28	34	49	30%
No	Yes	Yes	*	*	*	<1%
No	Yes	No	*	5	5	6%
No	No	Yes	5	5	5	<1%
No	No	No	42	54	60	36%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

5.4.3.1 Timing component

Respondents answered a sequence of questions that addresses the timing of the equipment installation. First, respondents answered the likelihood of installing the same type of equipment at the same time without the program (DAT1a). Respondents who answered "Later" specified the number of months later in the next question (DAT1b). [20]

Timing was the component most strongly affected by the program. The program affected the timing of measures that account for more than half of program savings. Forty-eight out of 100 surveyed customers accounting for 43% of program savings said they would have installed their measure(s) at the same time. The rest indicated some amount of program acceleration, mostly between 1 and 48 months (Table 5-6).

Table 5-6. Determining the Acceleration period, Enbridge Custom C&I programs

DAT1a. Without the utility, how different would the timing have been? DAT1b. Approximately how many months later?						
DAT1a	DAT1b	Customers*	Units of Analysis	Measures	Percent Savings	Timing Attribution
Same Time	N/A	48	66	72	43%	0%
Earlier	N/A	0	0	0	0%	0%
Later	Months < 48	33	44	59	35%	ER baseline credit** for months accelerated
	Months ≥ 48	*	*	*	1%	100%+ ER baseline credit
	Don't Know/ Refused	5	5	5	2%	ER baseline credit for avg. of DAT1b
Never	N/A	9	15	21	14%	100%
Don't Know/ Refused	N/A	*	*	*	0%	ER baseline credit for avg. of DAT1a

[20] See APPENDIX K for the detailed scoring algorithm.

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.
**ER baseline credit reflects credit for a vs. in situ equipment baseline savings during the acceleration period.

5.4.3.2 Efficiency Component

Respondents answered a sequence of questions that addresses the program's effects on the efficiency level of the installed equipment. First, respondents indicated the likelihood of installing the same level of efficiency without the program (DAT2a). Respondents who answered that they would have installed a less efficient option answered a follow-up question (DAT2b) to specify the level of efficiency they would have installed.

The program had limited effect on efficiency (Table 5-7). Most (54%) of program savings were from measures for which efficiency levels is not applicable such as operational improvements, leak repairs or steam trap replacements. Most of the remaining survey respondents said the program had no effect on the efficiency level of the equipment installed. Respondents who indicated the program increased the efficiency level of their measures accounted for approximately 13% of program savings. Most of these indicated that the program moved them from an efficiency level already above standard efficiency to an even higher level of efficiency. The relatively low program influence on efficiency can be an indicator that measures included in the program, though above current code requirements, are standard on the market.

Table 5-7. Determining Efficiency Attribution, Enbridge Custom C&I programs

DAT2a. Without the utility, would you have installed the same, higher, or lower efficiency? DAT2b. Without the utility, what efficiency would you have installed?						
DAT2a	**DAT2b**	**Customers ***	**Units of Analysis**	**Measures**	**Percent Savings**	**Efficiency Attribution**
Same	N/A/Skipped	31	37	41	33%	0%
Lower	Standard Efficiency	*	*	*	<1%	100%
	Between Standard and High	6	6	6	10%	50%
	Don't Know/Refused	5	6	6	3%	Average of DAT2b
Higher	N/A/Skipped	0	0	0	0%	0%
Don't Know/Refused	N/A Skipped	*	*	*	<1%	Average of DAT2a
Not Applicable	N/A	57	83	106	54%	Not Asked

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

5.4.3.3 Quantity Component

Respondents answered a sequence of questions that addresses the program's effects on the amount of equipment installed. First, respondents indicated the likelihood of installing the same amount of equipment (or capacity for measures for which number is not relevant, such as heat exchangers) without the program (DAT3a). Respondents who answered that they would have installed less or more equipment answered a follow-up question (DAT3b) to specify how the program changed the amount that they installed.

The program had limited effect on the quantity of measures installed. Sixty-five of the 96 customers, who accounted for 82% of program savings, said they would have purchased the same amount of equipment without the program (Table 5-8). Most of the remaining customers (12% of savings) received full attribution because they indicated they would not have installed any measures without the program.

Table 5-8. Determining quantity/size attribution, Enbridge Custom C&I programs

DAT3a. Without the utility, how different would the quantity/size have been?						
DAT3b. By what percentage did you change the amount installed because of utility?						
DAT3a	DAT3b	Customers*	Units of Analysis	Measures	Percent Savings	Quantity Attribution
Same	N/A	65	94	117	82%	0%
Less	Value < 100%	9	11	11	4%	Value < 50%
	Value ≥ 100%	*	*	*	<1%	Value > 50%
	Don't Know/Refused	*	*	*	<1%	Average of DAT3a
More	Value < 100%	0	0	0	0%	Value < 100%
	Value ≥ 100%	0	0	0	0%	Value = 100%
	Don't Know/ Refused	0	0	0	0%	Average of DAT3a
None	N/A	10	16	19	11%	100%
Don't Know/ Refused	N/A	*	*	*	<1%	Average of DAT3
Not Applicable	N/A	7	9	10	2%	Not Asked

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

5.5 Gross and net savings

This section reports the evaluation-verified gross savings in section 5.5.1 and the net savings (including only free-ridership) in section 5.5.2.

5.5.1 Verified gross savings

Program-level gross savings are determined by multiplying the tracking savings by the gross realization rate within each primary reporting domain. Table 5-9 shows the primary domains, the tracking savings for that domain, the gross realization rate, and the final verified gross savings for that domain. Dividing the overall verified gross savings by the overall tracking savings results in a program-level gross realization rate of 92%.

Table 5-9: Verified gross savings for Enbridge Custom C&I and LIMF programs

Sector	Applied Domain	Cumulative Tracked Savings (m3)	Gross RR	Verified Cumulative Gross Savings (m3)
Custom Industrial	Heat Recovery	82,143,555	97.86%	80,385,683
	Steam Trap	20,222,930	127.62%	25,808,503
	Other	241,990,817	98.78%	239,038,529
	Total	**344,357,302**	**100.25%**	**345,232,715**
Custom Commercial and Multi-Residential		466,248,648	91.48%	426,524,263
Low Income Multi-Residential		63,801,575	91.48%	58,365,681

5.5.2 Net savings

Program-level net savings are determined by multiplying the verified gross savings by the NTG ratio within each primary reporting domain. Table 5-10 shows the primary domains, tracking savings, verified savings, NTG ratio, and the final net savings for that domain.

Table 5-10: Net savings for Enbridge Custom C&I programs

Sector	Applied Domain	Verified Cumulative Gross Savings (m3)	NTG	Net Cumulative Savings (m3)
Custom Industrial	Etool Ventilation	83,670,201	14.90%	12,466,860
	Heat Recovery	80,385,683	55.25%	44,413,090
	Other	181,176,831	31.04%	56,237,288
	Total	**345,232,715**	**32.77%**	**113,117,238**
Custom Commercial	Etool Boiler and Boiler Add-on	90,295,668	24.09%	21,752,226
	Etool Ventilation	61,235,559	4.93%	3,018,913
	Steam Trap	13,597,779	27.42%	3,728,511
	Other	121,290,363	18.22%	22,099,104
	Total	**286,419,369**	**17.67%**	**50,598,755**
Market Rate Multi-Residential	Etool Boiler	98,725,211	26.18%	25,846,260
	Etool Ventilation	21,825,719	19.70%	4,299,667
	Other	19,553,964	97.10%	18,986,899
	Total	**140,104,894**	**35.07%**	**49,132,826**
Low Income Multi-Residential*		58,365,681	100.00%	58,365,681

The Other Industrial category includes: Controls, Etools boiler, Etools boiler add-on, Etools insulation, steam trap, other (increase mechanical dewatering, VFD, infrared heater and programmable thermostat, low temp catalytic oxidizer, air curtain, industrial roll-up doors, evaporator system, water heater, reduce powder paint curing oven exhaust, dock seal, aquathermal heating system, insulated panels, and greenhouse double polyethylene walls)
The Other Commercial category includes: Etools insulation, controls, other (dock seal, building shell, steam chiller, high speed door, boiler – hydronic high-efficiency)
The Other Multi-residential category includes: Etools boiler add-on, Etools insulation, and heat reflector panels.
*The Enbridge Low Income Multi-Residential NTG ratio is deemed at 100%.

6 Enbridge RunitRight

Through its program RunitRight, Enbridge provides customers with an energy assessment, technical and implementation assistance and performance monitoring. RiR participation starts with EGD working with the customer utilizing investigation agents to identify low cost/no cost re-commissioning measures that could be implemented to achieve a minimum of 5% gas savings followed with energy monitoring to monitor impact of operational improvement and facilitate improved energy management. The FR portion will evaluate measures implemented in 2014 and claimed in 2015. Run it Right is not part of the CPSV scope for the verification of 2015 measures and is the only program with non-custom measures included in the scope of the evaluation.

6.1 CPSV results

The gross savings for the RunitRight program were not verified as part of this study.

6.2 NTG ratio

This section summarizes the free ridership results for the Enbridge RunitRight program. Section 6.2.1 summarizes the data collection efforts, section 6.2.2 presents the net savings realization rate, and section 6.2.3 describes the sources of program attribution.

6.2.1 Summary of participant data collected

Table 6-1 summarizes the net-to-gross ratio data collection efforts for the Enbridge RunitRight program. The table shows the portion of the program that:

- Completed an in-depth interview through the NTG battery
- Did not respond to an evaluation attempt at contact
- Was not contacted by the evaluation team.[21]

The data collected is represented as the cumulative ex ante natural gas savings, the number of measures, the units of analysis, and number of sites. The portion of the program in each category is also represented in Figure 6-1. See section 6.3.1 for more detail. The full sample design and achievement by strata can be found in APPENDIX A.

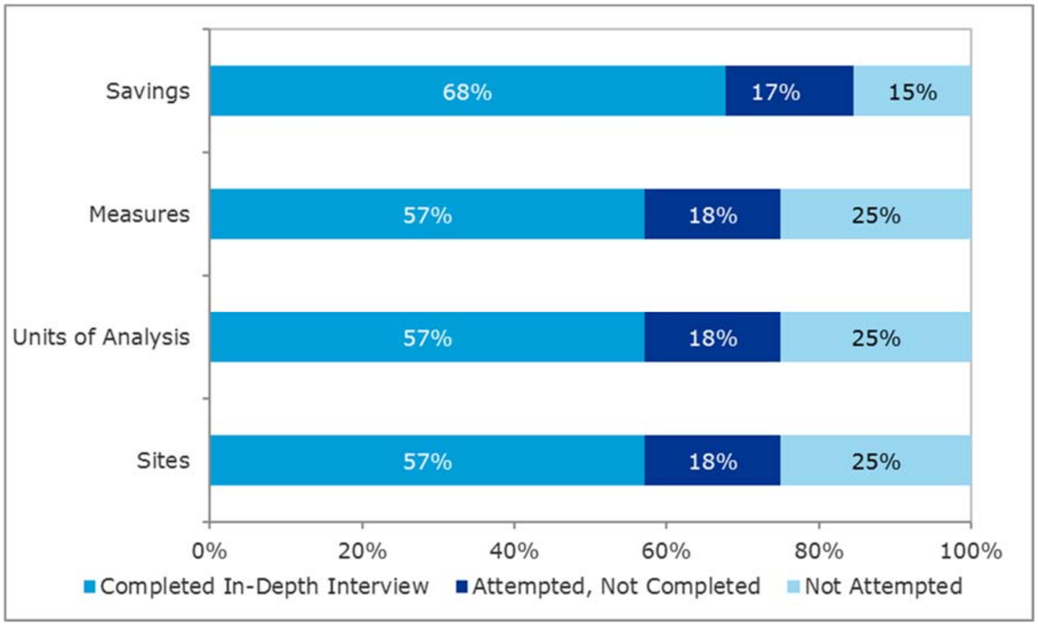
The study had a 58% customer response rate, reached the sample targets in two of three strata, and achieved a NTG ratio with absolute precision of +/-14% and relative precision of 27% at 90% confidence (shown in Table 6-2).

[21] Sites, measures, or units of analysis where contact was not attempted were either not selected for contact in sampling or in the backup sample and were not contacted due to strata quotas being met.

Table 6-1: Summary of NTG data collection for Enbridge RunitRight

Data Collection Category	Targeted	Completed			
	# Units of Analysis	# Sites	# Measures	# Units of Analysis	Ex Ante CCM
Completed In-Depth Interview	16	16	16	16	2,508,665
Attempted Contact, Not Completed		5	5	5	627,615
Not Attempted		7	7	7	569,850
Total		**28**	**28**	**28**	**3,706,130**

Figure 6-1: Summary of NTG data collection for Enbridge RunitRight



6.2.2 Free-ridership

Free-ridership is the sole contributor to the NTG ratio. The evaluation team is also conducting a study of the spillover savings attributable to the program; those results will be presented in a later report. The free-ridership is calculated from self-reported responses to survey questions as outlined in APPENDIX K**.**

Table 6-2 shows the NTG ratio by domain for the Enbridge RunitRight program. The table shows the number of units of analysis (n), NTG ratio, precision at the 90% confidence interval, error ratio, and percent of program savings. The percent of program savings represents the relative contribution that each domain makes to the overall result.

Enbridge's RunitRight program overall had 50% attribution, or 50% free-ridership.

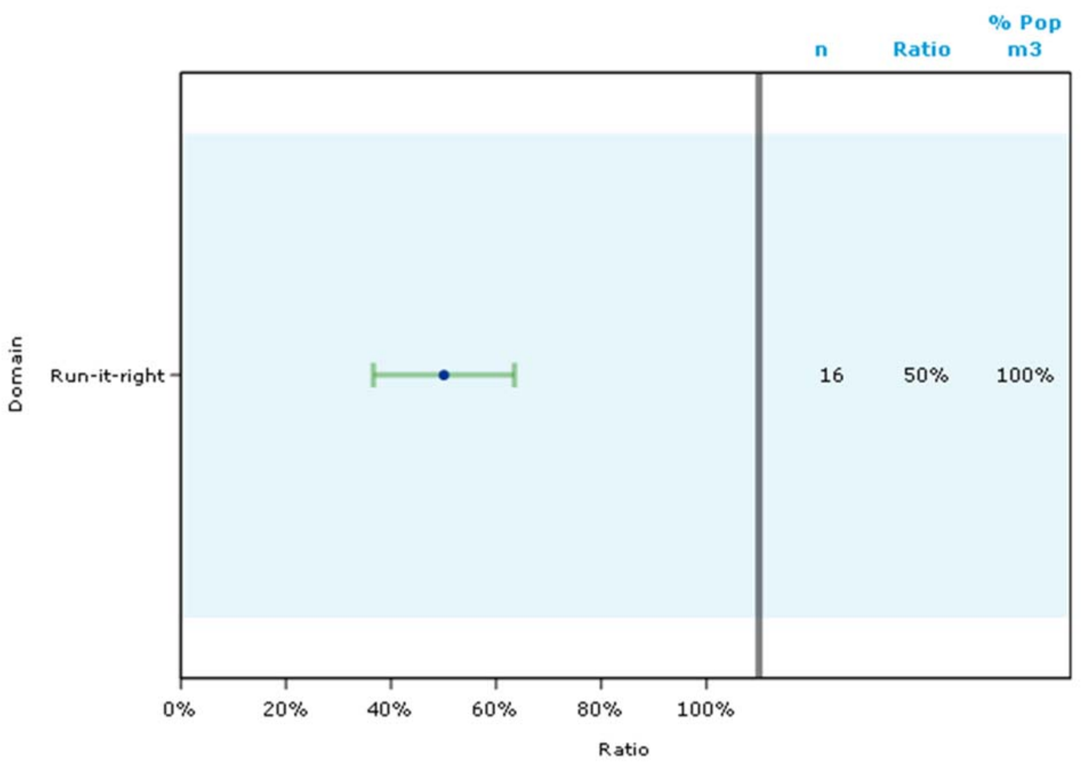
Table 6-2: NTG ratio for Enbridge RunitRight

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
RunitRight	16	10	50%	14%	36%	64%	27%	0.47	100%

APPENDIX M describes the criteria used for determining the domains used for ratio application and reporting.
Clusters reported in this table are unique customers per stratum: one customer may be in multiple strata, so the count of clusters is greater than the number of customers contacted.

Figure 6-2 also shows the NTG ratio for this program. The figure shows the ratio point estimate as a blue dot on the horizontal axis and the confidence interval as hashmarks connected by a green line. The number of units of analysis, numeric ratio, and percent of program savings represented by each domain are shown to the right of the plot. Attribution for the RunitRight program is higher than most of Enbridge's custom offerings, with the exceptions of Heat Recovery and Multi-Residential Other.

Figure 6-2: NTG ratio for Enbridge RunitRight



6.2.3 Sources of attribution

As outlined in APPENDIX K, the NTG ratio is a combination of responses regarding the program's influence on the timing, quantity, and efficiency of the measure implemented. Since most measures in the RunitRight program are a result of low cost/no cost operational improvements and re-commissioning which does not have its own inherent efficiency, the efficiency question was not asked for the participants of this program.

This section details the program's effect on each of those sources of attribution and indicates where the program is creating the greatest transformation.

Table 6-3 represents the possible combinations of timing and quantity attribution. A "yes" in the timing or quantity column indicates partial or full attribution for that source. A "no" indicates no attribution for that source. For example, the row that has Yes for timing and quantity reports the portion of the program that indicated that the program had at least partial influence on the timing and quantity for that measure.

The table also shows the number of customers, measures, and savings that fall into each combination. The portion of the program that falls into each combination of timing and quantity attribution is represented by the number of responses and the percent of cumulative savings represented by that category.

The table shows that all program participation was at least partially influenced by the program. The program affected the timing of all measures. It had a limited effect on quantity, influencing measures that accounted for approximately 7% of program savings.

Table 6-3. Overview of the sources of attribution for Enbridge RunitRight

Attribution					
Timing	Quantity	Customers*	Units of Analysis	Measures	Percent Savings
Yes	Yes	*	*	*	7%
Yes	No	6	15	15	93%
No	Yes	0	0	0	0%
No	No	0	0	0	0%

A * refers to a category with fewer than 5 participants. These are not shown for customer privacy reasons.
A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

6.2.3.1 Timing component

Respondents answered a sequence of questions that addresses the timing of the energy saving activities. First, respondents answered the likelihood of performing the energy saving activities at the same time without the program (DAT1a). Respondents who answered "Later" specified the number of months later in the next question (DAT1b). [22]

Timing was the component most strongly affected by the program. No customers indicated they would have completed the energy saving activities at the same time. Customers indicated that measures accounting for over a quarter of savings would not have been completed for four or more years and measures accounting for nearly an additional 59% of savings would have been completed within four years. The rest indicated that they didn't know when the measure would have been completed or refused to answer the question (Table 6-4).

Table 6-4. Determining the Acceleration period, Enbridge RunitRight

DAT1a. Without the utility, how different would the timing have been? DAT1b. Approximately how many months later?						
DAT1a	**DAT1b**	**Customers***	**Units of Analysis**	**Measures**	**Percent Savings**	**Timing Attribution**
Same Time	N/A	0	0	0	0%	0%
Earlier	N/A	0	0	0	0%	0%
Later	Months < 48	*	7	7	59%	ER baseline** credit for months accelerated
	Months ≥ 48	*	6	6	26%	100%+ ER baseline credit
	Don't Know/ Refused	*	*	*	7%	ER baseline credit for avg. of DAT1b
Never	N/A	0	0	0	0%	100%
Don't Know/ Refused	N/A	*	*	*	9%	ER baseline credit for avg. of DAT1a

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.
**ER baseline credit reflects credit for a vs. in situ equipment baseline savings during the acceleration period.

6.2.3.2 Quantity Component

Respondents answered a sequence of questions that addresses the program's effects on the extent of energy savings activities taken. First, respondents answered the likelihood of performing the same amount of energy saving activities without the program (DAT3a). Respondents who answered that they would have done more answered a follow-up question (DAT3b) to specify how the program changed the amount of activity that they performed.

The program had a small effect on quantity. Respondents indicated that they would have performed the same amount of activity in measures that accounted for almost all (93%) of the program savings. For confidentiality reasons this table is not provided.

[22] See APPENDIX K for the detailed scoring algorithm.

6.3 Gross and net savings

The RunitRight program was not included in the CPSV portion of the study. This section reports the net savings (including only free-ridership) in section 6.3.1.

6.3.1 Net savings

The program-level net savings are determined by multiplying the verified savings by the NTG ratio within each primary reporting domain. Table 6-5 shows the tracking savings, NTG ratio, and final net savings. Dividing the overall net savings by the overall verified savings results in a program-level NTG ratio of 50%.

Table 6-5: Net savings for Enbridge RunitRight

Domain	Cumulative Tracking Savings (m^3)	NTG	Net Cumulative Savings (m^3)
RunitRight	2,712,210	50.06%	1,357,732

7 Findings and recommendations

In the tables the primary outcomes of the recommendation are classified into four categories: reduce costs, increase savings, increase (or maintain) customer satisfaction and decrease risk (multiple types of risk are in this category including risk of adjusted savings, risk to budgets or project schedules, and others). Details of the findings, recommendations and outcomes follow the tables.

Table 7-1: Energy savings and program performance recommendations

#	Energy Savings and Program Performance Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
ES1	The utilities should continue in their commitment to accuracy.	✓	✓				✓	✓
ES2	Evaluate free-ridership for the programs annually and couple the free-ridership evaluation with process evaluation			✓		✓		
ES3	Error ratios from this report inform sample design for future evaluation.			✓	✓			✓
ES4	Align the program design with cumulative net goals	✓	✓			✓		
ES5	Do not pay incentives until after installation is complete.	✓	✓					✓
ES6	Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.	✓	✓					✓
ES7	Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.	✓	✓	✓				✓
ES8	Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.	✓	✓			✓		✓
ES9	Consider establishing an official definition for EUL and implementing a study to define EULs for program measures	✓	✓	✓				✓

#	Energy Savings and Program Performance Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
ES10	Track metrics for how long it takes from the final installation verification to the posting of incentive payments.	✓	✓				✓	
ES11	Increase transparency of "influence adjustments" and do not include in gross savings	✓				✓	✓	✓
ES12	Conduct a process evaluation to improve Large Volume influence on customer projects	✓				✓	✓	
ES13	Consider approaches to market that leverage third-party vendors.	✓	✓		✓	✓		

Table 7-2: Verification process recommendations

#	Verification Process Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
VP1	Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.	✓	✓		✓			✓
VP2	The verification and utility staff should agree to a code of conduct for each role during onsite visits.	✓	✓	✓			✓	

Table 7-3: Documentation and Support recommendations

#	Documentation and Support Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DS1	Take steps to improve documentation: • Include explicit sources for all inputs and assumptions in the project documentation. • Store background studies and information sources with the project files and make them available to evaluators. • Provide evaluators full access to customer data. • Provide pre- and post-installation photos, where available. • Document and provide internal M&V documents where available. • Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification	✓	✓			✓		✓
DS2	Ensure that incremental costs are supported by invoices or other documentation	✓	✓					✓
DS3	Increase the amount of documentation and source material for projects that have greater energy savings.	✓	✓					✓
DS4 A	Digitize and file project documentation for all projects as they are completed and paid during project closeout.	✓	✓		✓			✓
DS4 B	Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.			✓	✓			✓

#	Documentation and Support Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DS5	Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner.	✓			✓			✓
DS6	Use a consistent summary workbook.		✓		✓			✓

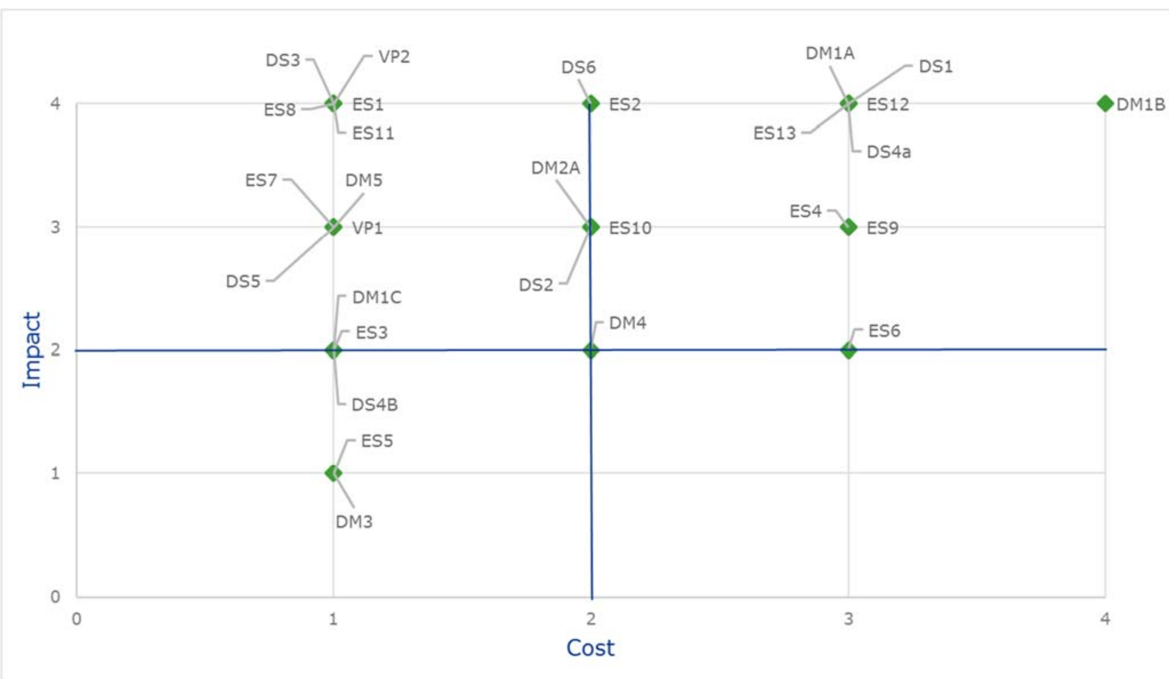
Table 7-4: Data management recommendations

#	Data Management Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DM1 A	Track contacts associated with projects in the program tracking database.	✓	✓		✓			✓
DM1 B	Strongly consider investing in relational program tracking databases.	✓	✓		✓			✓
DM1 C	Include structure for improved data integrity in the evaluator request for contact information for the 2016 and 2017 savings verification and evaluation.			✓	✓		✓	
DM2 A	Consider offering bonus incentives early in the year to combat the "hockey stick" phenomenon where a large percent of projects get closed in the fourth quarter of the year (which results in rushed QC for data).	✓	✓		✓			✓
DM3	Track and provide to evaluators dates for key milestones in the project.	✓	✓		✓			✓
DM4	Maintain a customer identifier in the database to clearly identify related sites.	✓	✓		✓		✓	

#	Data Management Recommendation	Applies to			Primary Outcome			
		Union	Enbridge	Evaluation	Reduce Costs	Increase Savings	Increase Customer Satisfaction	Decrease Risk
DM5	Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking extracts provided to evaluators.	✓	✓			✓		✓

Figure 1-1 shows an approximate cost vs. impact relation ship for each of the recommendations on a 4-point scale. The upper left quadrant of the figure shows the recommendations that are relatively low cost that would have a high impact. Those in the upper right are recommendations where both cost and impact are high.

Figure 7-1: Approximate Cost vs. Impact of each recommendation



7.1 Energy savings and program performance

ES1. Finding: Both utilities exhibit a strong commitment to accurate energy savings estimates. Both utilities have made significant investments in developing calculation tools which model savings accurately. For example, Union's dock door seal calculator is well considered and designed, and Enbridge's Etools calculator is very thorough in attempting to model savings for key measures.

Both utilities chose to retain engineers with strong understandings of their customers' building and process systems. We had numerous opportunities to interact with these engineers on phone calls and site visits, and have grown to respect their knowledge and engagement with the types of systems that matter to their customers.

Both utilities showed a commitment to finding accurate savings. On several occasions, both on the phone and in writing, the evaluation team suggested a value that would have increased savings in a way that the program engineer did not think was valid. When this happened, neither utility was shy in suggesting that we may want to make a more conservative choice.

Recommendation: The utilities should continue in their commitment to accuracy.

Outcome: Accurate energy savings.

ES2. Finding: Free-ridership in the utilities' programs is high

Recommendation: With high free-ridership and rapidly changing programs, consistent evaluation of free-ridership annually and free-ridership evaluation coupled with process evaluation will help identify specific ways for each program to manage and reduce free-ridership.

Outcome: Effective free-ridership management will allow the programs to increase their net savings significantly in future years.

ES3. Finding: Relative precision targets were exceeded for some programs and not met for others.

Recommendation: Error ratios from the results provided in this report should be used to inform sample design for future evaluation years.

Outcome: Better defined error ratios for the measures in the programs will allow more efficient sample design for future evaluations, improving precisions and reducing costs.

ES4. Finding: Attribution for the programs came primarily through acceleration rather than changes in efficiency or quantity/size. This is partly due to the measures that dominate the programs: controls, maintenance, and optimisation. These measures do not have varying efficiencies, so the programs are either affecting the number of units implemented or accelerating the measure. Acceleration is less valuable to programs that are seeking to meet cumulative net goals. Acceleration periods tend to be considerably shorter than the estimated useful life (EUL) of a measure and thus the partial attribution that results is low relative to cumulative gross savings.

Recommendation: To align the programs with cumulative net goals, the utilities should seek to:

- continue promoting long life measures and consider discontinuing promotion of short lived measures
- proactively upsell equipment purchases from standard to efficient products
- target hard to reach customers who have not participated in the past
- promote EE measures with low market penetration (such as heat reflector panels)

- motivate customers to increase the scope of their projects, some options include multi-measure bonuses or escalating incentive structures that pay more for doing more

Outcome 1: Focusing on proactive sales rather than reactive will help the net-to-gross (NTG) ratio.

Outcome 2: Effective free-ridership management will allow the program to increase net savings significantly in future years.

ES5. Finding: A handful (<5) of respondents indicated that all or part of their incentivized project had not yet been installed over a year after the incentive was paid.

Recommendation: Do not pay incentives until after installation is complete.

Outcome: Cost-effectiveness of the program will increase as it avoids paying for savings that do not materialize.

ES6. Finding: Some customers receive incentives from their electric provider and natural gas utility to complete the same EE measure. Both providers may claim the same changes in energy use, resulting in overlap when aggregated across fuels at the provincial level.

Recommendation: Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.

Outcome: More accurate energy and carbon savings estimates across the province.

ES7. Finding: Some measures (e.g., geothermal heat pumps, combined heat and power, and those that save district heating energy) have difficult-to-define baseline technologies.

Recommendation: Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.

Outcome: Less evaluation risk and a better alignment between province energy efficiency goals and program implementation.

ES8. Finding: Projects with very long and very short simple payback periods often have low NTG ratios. However, from a customer service standpoint, it may be difficult for utilities to deny incentives to customers unless they have pre-established rules to point to.

Recommendation: Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.

Outcome: The rule will give utilities a guideline to restrict the program to projects that are more likely to result in net savings. It will also allow the utilities to reject potentially poor projects without a large effect on customer satisfaction.

ES9. Finding: Members of the EAC and evaluation team have different understandings of the definition of some evaluation inputs.

Recommendation: Consider establishing an official definition for EUL and implementing a study to define EUL for all measures, especially steam traps, pipe leaks, steam leaks, condensate leaks, and pipe insulation.

Outcome: The study will improve the accuracy of lifetime savings estimates.

ES10. Finding: A handful (<5) of sites reported unhappiness with delays in receiving their incentive payment (5 months).

Recommendation: Track metrics for how long it takes from the final installation verification to the posting of incentive payments. Consider holding program managers accountable to these metrics by considering them during performance reviews, building in performance bonuses if all payments are posted within one month, and/or implementing a penalty if it takes greater than three months to post any payments.

Outcome: Improved customer satisfaction.

ES11. Finding: Influence adjustments were made to projects that adjusted the gross savings for "net" or program influence reasons. Accounting of which projects had these adjustments was not maintained by the program and the adjustments were included in different places in project calculation workbooks, making their identification challenging. In addition, the program NTG was also applied to these projects, effectively double discounting savings in scorecards.

Recommendation: If the utility chooses to continue making influence adjustments to the savings upon which it calculates savings, these adjustments should be made more transparent and not included in the reported gross savings for the program in scorecards. Instead the specific project influence adjustment should be included in the scorecard in place of the general program or domain level NTG factor.

Outcome: Reduced risk of double adjustments.

ES12. Finding: Union's Large Volume program has a very high amount of free-ridership.

Recommendation: This evaluation did not include a process evaluation. Union should consider conducting a process evaluation focused on how to reduce the rate of free-ridership. Three options that the Union might consider are:

- Eliminate measure types with high free-ridership (Union indicated that most maintenance type measures were eliminated in 2016).
- Use an application process that includes a committee review that can reject free riders. This option is hard for utilities to manage as it can affect customer satisfaction negatively
- Clear payback criteria such as initial payback must be longer that X years and the incentive paid must reduce payback below Y years. This has the advantage of being a rule that account representatives can explain when talking to customers.
- Non-energy benefits of projects that large industrial customers gravitate to are often large compared to energy saving benefits, so simple payback criteria will not eliminate all free rider projects. Awareness of this issue should be promoted among the implementation team.

Outcome: Effective free-ridership management may allow the program to increase its net savings significantly in future years.

ES13. Finding: Vendor attribution did not increase overall program attribution significantly. Of the vendors that customers cited as influences, few indicated that either program had much effect on the projects.

Recommendation: The utilities should consider approaches to market that leverage third-party vendors. A process evaluation that includes vendor interviews might uncover opportunities.

Outcome: Effective leveraging of vendors could both increase NTG ratios and increase program uptake.

7.2 Verification processes

VP1. Finding: DNV GL was unable to obtain access to all the equipment at all the sites selected for verification. Both Enbridge and Union have several large projects with industrial companies, including food processing, refineries, and other industries. In many cases, the customer refused to provide SCADA data or similar trend data to allow a reasonable verification of the project. This means we were unable to do more than a reasonableness check on the savings.

A review of the Enbridge contract shows that the customer is not required to provide the information that is necessary for EM&V. The most relevant sections are:

- Item 6 states: Payment of the Incentive Payment is subject to the completion of a satisfactory site inspection of the improvements, including the installed equipment by an authorized representative of Enbridge.
- Item 9 states: Upon request within eighteen months of the commissioning date of the Project, and with reasonable notice, the Customer agrees to provide authorized representatives of Enbridge with access to the Project, and with required information or data relating to the project for the purposes of the Application and these General Terms and Conditions.

Neither of these are sufficient for EM&V.

Recommendation: Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.

Outcome: Reduced evaluation costs and risks. Participant non-compliance requires evaluators to request documentation for a large backup sample, and to survey and/or visit additional sites to obtain sufficient data for the evaluation. The process of contacting a site and getting a refusal costs time and money, as does the substitution of an additional site to make up for the unobtained data. In some cases, there might not be additional sites to sample, in which case the evaluation estimates will have lower precision than they would with full compliance.

VP2. Finding: Verification engineers and verification forms caused confusion with site contacts and the length of visits also led to a handful of customer complaints. Utility staff at a handful of sites responded to questions in place of participating customers and in one case interfered with data collection.

Recommendation: The verification and utility staff should agree to a code of conduct for each role. The teams should receive clear direction as to the dos and don’ts of all parties involved in site visits, including both verification engineers and utility staff should they attend the visit. Open lines of communication between the site team and utility staff should be maintained to reduce misunderstandings and ensure that the teams are on the same page as to each other’s role.

In general, the following should be part of standard verification practices:

- Ensure site engineer reviews final site report for accuracy post-audit.
- Align data collection forms with site report structure to reduce communication and transcription errors.
- Ensure data appropriate to determining EUL is collected while on-site (i.e., make EUL determination a primary, rather than secondary focus).
- Request specific documentation or data from systems prior to site visit (allowing for adequate time for site contact to obtain).

Outcome: Improved data collection and customer satisfaction.

7.3 Documentation and support

DS1. **Finding:** Project documentation for some projects lacked sufficient details to allow evaluators to reproduce the calculations made by program staff or third-party vendors. Specific issues included:

- Project data or details missing
- Insufficient measure-level details to fully describe what was installed
- Descriptions that were difficult to understand
- Use of black box tools
- Hardcoded information in calculation spreadsheets
- Energy intensity changes presented without providing the data to justify it
- Undocumented assumptions
- Sources referenced but not included or available, such as feasibility studies and historical analysis of energy use that was left out of the project documentation
- Scanned documents that were unreadable
- Input adjustments that approximate other effects, but are not explained
- Insufficient access to customer data (by customers) for confidentiality reasons.
- Modelling files that could not be opened
- Adjustments to savings estimates for safety or influence that were not clearly marked, sourced, or carried out in a consistent fashion
- Etools files not provided for many industrial boiler & boiler add-on projects

Recommendation: Several steps could be taken to improve data quality:

- Include explicit sources for all inputs and assumptions in the project documentation.
- Store background studies and information sources with the project files and make them available to evaluators.
- Provide evaluators full access to customer data.
- Provide pre- and post-installation photos, where available.
- Document and provide internal M&V documents where available.
- Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification

Outcome: Properly explaining and sourcing the savings calculation method and assumptions allows the evaluating engineer to more easily identify what needs to be verified. It also makes it easier to determine whether the methods and assumptions are reasonable and use ex ante assumptions rather than seek documented values elsewhere.

DS2. **Finding:** Invoices were not always included with documentation, and we saw a handful (<5) of cases where utility program staff were overclaiming incremental costs. This did not appear to be systemic, but higher incremental costs enable payment of a larger incentive.

Recommendation: Ensure that incremental costs are supported by invoices or other documentation, especially for add-on and optimization measures where the total cost and incremental cost are likely to be the same. Equipment replacement measures may require an additional standard efficiency quote to produce incremental cost.

Outcome: Incremental cost is an important component of simple payback, which is often used to judge the economic benefit of energy efficiency projects. It is also an input to some benefit-cost tests.

DS3. Finding: Larger projects appeared to fall under the same documentation standards as smaller projects.

Recommendation: Increase the amount of documentation and source material for projects that have greater energy savings.

Outcome: Projects that are better documented tend to have more accurate savings estimates and receive fewer evaluation adjustments than those that are less documented. Large projects have a greater effect on overall savings adjustment factors. Therefore, large projects with better documentation are more likely to result in adjustment factors closer to 100%.

DS4. Finding: Enbridge did not maintain complete digital project files prior to the evaluation request. Union appeared to have digital documentation that was not completely assembled prior to evaluation.

Recommendation A: Digitize and file project documentation for all projects as they are completed and paid during project closeout. PDF and Excel files associated with a project should be stored in a way that allows them to be easily found and associated with a specific project and/or customer. The best practice is to include a document repository as part of the program tracking system with a separate folder for each project.

Recommendation B: Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.

Outcome: In our experience, DSM programs that store complete and well-organized digital records experience less evaluation risk. In other words, their gross savings adjustments are closer to 100%. This happens for three reasons:

- Digitization facilitates internal review of project documentation, providing additional opportunities to identify missing information and errors
- Assembly during project closeout improves the comprehensiveness of the documentation because less time has elapsed than if it was assembled for evaluation, so less information is lost or forgotten

Easy retrieval makes it more likely that the complete file is sent to the evaluation team, reducing the information gap between implementation and evaluation.

DS5. Finding: Union custom projects utilized a project application summary workbook that summarizes the key project inputs, calculations, and most details. In general, this is a good approach that facilitates internal review and evaluation. One challenge was that different projects used the workbook in different ways:

- The notes section was sometimes used to identify and highlight specific unique approaches and features in projects, but not always.
- Calculations internal to the summary page were consistent for most projects, but not all (additional factors were sometimes added).
- Sub-methods critical to the calculation were contained in hidden sheets.
- Safety and influence adjustments were inserted in different locations and not always explained.

Recommendation: Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner. Identify a common approach for common measures and, if necessary, document deviations and the reasons for the deviations in a clearly labelled field on the summary sheet.

Outcome: A consistent summary workbook aids both internal and external quality assurance, quality control, and measurement and verification.

DS6. Finding: The Enbridge Etools is used as both a calculation tool and as a communication tool with customers. While it appears to serve the needs of the program, this form of communication is difficult for the evaluation efforts.

- Etools does not easily allow for assumptions to be sourced within the record.
- Some Etools selections may be site-specific and some may be defaults; the calculator does not distinguish.
- Energy savings that are calculated outside of Etools are hard-entered in Etools but not always sourced.

Recommendation: Use a consistent summary workbook.

Outcome: A consistent summary workbook aids both internal and external quality assurance, quality control, and measurement and verification.

7.4 Data management

DM1. Finding: Neither Union nor Enbridge currently track participating customer or participating vendor contact information in their program tracking database. Providing the information to the evaluation put significant burden on utility staff. When contact information was provided, there were significant data integrity issues including contacts listed in the wrong places, partial addresses, and incorrect or missing phone numbers and email addresses.

Recommendation A: Track contacts associated with projects in the program tracking database. At a minimum, the program tracking database should include:

- Project site address
- Customer mailing address
- Primary customer contact name
- Primary customer contact phone
- Primary customer contact email
- Primary customer contact mailing address
- Addresses are best tracked as multiple fields including:
    - Street address line 1
    - Street address line 2
    - City
    - Province
    - Postal code

Phone number fields should include data validation to enforce a consistent format and avoid missing or extra digit errors. Phone extensions should be tracked in a field separate from the ten-digit phone number and be restricted to numeric data only.

The best practice is to maintain contacts in a table separate from specific project or customer data. This allows for a single contact to be connected to multiple accounts and/or projects as necessary without creating duplication. This structure also makes it easier to associate multiple contacts with a single project.

Vendor contact information should also be tracked in the database, in the same table as the participating customer contact information. With a relational database, the contact ID from the table can be added to a project record in the role consistent with the contact's participation (such as vendor, decision maker, or technical expert) with a separate table that allows a single vendor contact to be associated with multiple projects.

Outcome A: Reduced burden on utility staff to seek contact information for projects, whether for internal or evaluation use. Reduced evaluation costs and improved sample design expectations.

Recommendation B: The utilities should strongly consider investing in relational program tracking databases. Relational program tracking databases and customer relationship management (CRM) systems allow for multiple contacts to be associated with a single account and/or project. This allows programs to easily clarify aspects of projects during implementation and to provide accurate, timely, and usable contact information to evaluators and verifiers. The incremental cost of implementation is low if it is part of the initial database design, populated as projects are started, and updated once they are complete.

Outcome B: Reduced burden on utility staff and reduced evaluation costs. A relational database would streamline aggregation of program data for scorecards and make providing data simpler for annual savings evaluation and verification.

Recommendation C: For 2016 (and perhaps 2017), we do not anticipate that contact information will have been entered into the program tracking databases. When the evaluation requests contact information for the 2016 and 2017 savings verification and evaluation, the contact request spreadsheet will be updated to provide additional fields to enforce data integrity (e.g., specific fields for a parsed address and company name for the technical and decision-making contacts).

Outcome C: Reduced evaluation costs due to less data cleaning and research to fill missing information. Improved data collection with less returned advance letters and more accurate connection between projects and contacts.

DM2. **Finding:** Both utilities have indicated that inputting and/or extracting data necessary for annual reporting and evaluation requires significant effort.

Recommendation A: Consider offering bonus incentives early in the year to combat the "hockey stick" phenomenon where a large percent of projects get closed in the fourth quarter of the year.

Outcome: Reduced burden on program staff, more consistency in meeting annual filing deadlines.

Recommendation B: See recommendation DM1B. The utilities should consider investing in a new database.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

DM3. Finding: The extracts from the utility program tracking database do not include dates for key project milestones. Enbridge's data did not include any dates and Union's included only the "installation date."

Recommendation: Track and provide to evaluators dates for key milestones in the project. Dates for project start, installation, and those that define the program year provide useful context for interviewers that is not always easy to find in project documentation

Outcome: Improved data collection through more informed interviewers and reduced evaluation costs through less need to search for dates in documentation.

DM4. Finding: Customers with multiple sites are not tracked in the program tracking database. A few property management groups had many sites selected in the sample, but it was not clear from project tracking or the provided contact information that the sites were related. Property management firms were the most significant but not the only customer type where this was true.

Recommendation: Maintain a customer identifier in the database to clearly identify related sites. This is easiest to deploy in a relational database see recommendation DM1B.

Outcome: Reduced evaluation costs and reduced customer burden. In some cases, a failure to identify related sites can result in multiple calls to the same customer, which a customer identifier would avoid. In addition, tracking related sites could improve program implementation by increasing awareness of connected opportunities.

DM5. Finding: EUL and cumulative gross savings were not provided in the standard program tracking database extracts. The evaluation team backed out the missing information from the fields provided.

Recommendation: Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking database.

Outcome: Improved data integrity results in less evaluation risk and more accurate savings totals. Providing each of the key savings types and their components allows evaluation to confirm that the savings provided are internally consistent.

8 APPENDICES

APPENDIX A. FINAL SAMPLE ACHIEVEMENT

The tables below (Table 8-1 to Table 8-7) show the achieved sample for each stratum in the sample designs. The tables are specific to a program group and show the categorical stratification (grouping) and size strata (larger numbers are bigger projects). Sampling was done at the unit of analysis level which was a slight aggregation of the measures in the data base. The target column shows the number of units we attempted to complete. "Normal completes" were randomly selected and received a full sample weight, while "extra completes" were non-random measures that we collected data on while collecting data for a selected unit. "Extra completes" were unit weighted (given a weight of 1) so that they only represent themselves in the sample expansion. The strata status indicates whether additional units were not attempted in a strata (open) or we attempted to contact all units (closed). Percent of frame cumulative savings is the percent of total savings in the sample frame (population studied) in each category.

Table 8-1: CPSV Sample Achievement for Union Custom C&I and LIMF programs

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
					Complete			Frame Total	Strata %	% Complete			
				Target	Total	Normal	Extra			Total	Normal	Extra	
Commercial	Action	On-site	19,910,861	3	3	3	0	7	3%	<1%	<1%	0%	Closed
			31,595,400	1	1	1	0	1	2%	2%	2%	0%	Closed
		TSER	6,237,000	3	4	4	0	13	1%	<1%	<1%	0%	Open
	Equipment	On-site	2,419,140	3	7	4	3	104	1%	<1%	<1%	<1%	Open
			20,369,040	3	3	3	0	4	3%	2%	2%	0%	Closed
			76,886,900	1	1	1	0	1	5%	5%	5%	0%	Closed
		TSER	2,453,080	3	5	4	1	42	1%	<1%	<1%	<1%	Open
	Multi-family	On-site	1,008,360	1	0	0	0	5	<1%	0%	0%	0%	Open
			5,093,140	1	1	1	0	1	<1%	<1%	<1%	0%	Closed
		TSER	44,260	1	0	0	0	1	<1%	0%	0%	0%	Closed
Industrial	Action	On-site	14,670,829	6	8	8	0	21	5%	2%	2%	0%	Open
		TSER	20,817,671	3	5	4	1	44	7%	1%	1%	<1%	Open
	Equipment	On-site	6,027,660	6	21	6	15	104	12%	3%	<1%	3%	Open
			20,887,330	5	9	6	3	22	16%	6%	4%	2%	Open
			67,233,620	5	5	4	1	9	23%	12%	9%	3%	Open
			88,336,980	1	1	1	0	1	6%	6%	6%	0%	Closed
		TSER	2,082,190	4	7	2	5	91	3%	<1%	<1%	<1%	Open
			11,662,800	4	5	4	1	19	5%	2%	1%	<1%	Open
			41,029,840	1	1	1	0	1	3%	3%	3%	0%	Closed
Low Income	Multi-family	On-site	20,865	1	1	1	0	1	<1%	<1%	<1%	0%	Closed
			1,433,430	1	1	1	0	1	<1%	<1%	<1%	0%	Closed
		TSER	621,180	3	3	3	0	35	<1%	<1%	<1%	0%	Open

Table 8-2: CPSV Sample Achievement for Union Large Volume

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
					Complete			Frame	Strata	% Complete			
				Target	Total	Normal	Extra	Total	%	Total	Normal	Extra	
Large Volume	Action	On-site	13,696,893	4	17	17	0	28	10%	7%	7%	0%	Closed
			60,858,260	3	6	6	0	6	17%	17%	17%	0%	Closed
			63,059,180	1	1	1	0	1	5%	5%	5%	0%	Closed
	Equipment	On-site	19,498,030	4	13	10	3	25	9%	6%	4%	2%	Open
			36,699,320	3	3	3	0	5	11%	7%	7%	0%	Closed
			63,342,400	3	2	2	0	4	16%	9%	9%	0%	Closed
			179,561,960	3	2	2	0	3	31%	17%	17%	0%	Closed

Table 8-3: CPSV Sample Achievement for Enbridge Custom C&I and LIMF programs

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
				Target	Complete			Frame Total	Strata %	% Complete			
					Total	Normal	Extra			Total	Normal	Extra	
Commercial	Action	On-site	568,750	2	2	2	0	2	<1%	<1%	<1%	0%	Closed
			10,213,885	1	1	1	0	1	1%	1%	1%	0%	Closed
		TSER	531,630	4	2	2	0	24	<1%	<1%	<1%	0%	Open
	Equipment	On-site	2,231,300	4	8	4	4	50	2%	<1%	<1%	<1%	Open
			7,735,530	4	7	7	0	8	4%	3%	3%	0%	Closed
			9,501,060	1	0	0	0	1	1%	0%	0%	0%	Closed
		TSER	1,594,225	5	3	3	0	265	10%	<1%	<1%	0%	Open
			11,081,850	5	3	3	0	28	17%	3%	3%	0%	Open
	Multi-Residential	On-site	2,702,600	5	7	4	3	53	3%	<1%	<1%	<1%	Open
		TSER	1,032,930	4	5	2	3	139	6%	<1%	<1%	<1%	Open
			4,357,525	4	7	5	2	36	9%	2%	1%	<1%	Open
Industrial	Action	On-site	424,835	3	3	3	0	8	<1%	<1%	<1%	0%	Open
			1,059,870	3	3	3	0	4	<1%	<1%	<1%	0%	Closed
			12,988,135	1	1	1	0	1	1%	1%	1%	0%	Closed
		TSER	799,210	3	3	3	0	7	<1%	<1%	<1%	0%	Open
			2,935,575	1	1	1	0	1	<1%	<1%	<1%	0%	Closed
	Equipment	On-site	2,716,060	4	12	4	8	47	5%	1%	<1%	1%	Open
			6,197,900	4	7	6	1	13	6%	3%	3%	<1%	Open
			19,604,220	4	6	6	0	7	9%	8%	8%	0%	Closed
			49,314,000	3	2	2	0	3	12%	8%	8%	0%	Closed
		TSER	3,332,925	5	5	4	1	24	3%	<1%	<1%	<1%	Open
			20,592,275	1	1	1	0	1	2%	2%	2%	0%	Closed
Low Income	Multi-Residential	On-site	1,922,580	2	2	2	0	6	<1%	<1%	<1%	0%	Open
		TSER	3,548,480	6	7	5	2	104	7%	<1%	<1%	<1%	Open

Table 8-4: NTG Sample Achievement for Union Custom C&I programs

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
				Target	Complete			Frame Total	Strata %	% Complete			
					Total	Normal	Extra			Total	Normal	Extra	
Commercial	Action	On-site	19,910,861	4	6	6	0	7	3%	3%	3%	0%	Closed
			31,595,400	1	1	1	0	1	2%	2%	2%	0%	Closed
		TSER	6,237,000	6	4	4	0	13	1%	<1%	<1%	0%	Open
	Equipment	On-site	2,419,140	9	20	14	6	104	1%	<1%	<1%	<1%	Open
			20,369,040	4	4	4	0	4	3%	3%	3%	0%	Closed
			76,886,900	1	1	1	0	1	5%	5%	5%	0%	Closed
		TSER	2,453,080	5	7	6	1	42	1%	<1%	<1%	<1%	Open
	Multi-family	On-site	1,008,360	2	1	1	0	5	<1%	<1%	<1%	0%	Open
			5,093,140	1	1	1	0	1	<1%	<1%	<1%	0%	Closed
		TSER	44,260	1	0	0	0	1	<1%	0%	0%	0%	Closed
Industrial	Action	On-site	14,670,829	7	12	12	0	21	5%	4%	4%	0%	Open
		TSER	20,817,671	4	6	5	1	44	7%	1%	1%	<1%	Open
	Equipment	On-site	6,027,660	13	45	20	25	104	12%	6%	3%	3%	Open
			20,887,330	12	17	17	0	22	16%	14%	14%	0%	Closed
			67,233,620	9	7	7	0	9	24%	16%	16%	0%	Closed
			88,336,980	1	1	1	0	1	6%	6%	6%	0%	Closed
		TSER	2,082,190	5	10	4	6	91	3%	<1%	<1%	<1%	Open
			11,662,800	4	6	5	1	19	5%	2%	1%	<1%	Open
			41,029,840	1	1	1	0	1	3%	3%	3%	0%	Closed

Table 8-5: NTG Sample Achievement for Union Large Volume

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
				Target	Complete			Frame Total	Strata %	% Complete			
					Total	Normal	Extra			Total	Normal	Extra	
Large Volume	Action	On-site	13,696,893	5	22	22	0	28	10%	9%	9%	0%	Closed
			60,858,260	4	5	5	0	6	17%	16%	16%	0%	Closed
			63,059,180	1	1	1	0	1	5%	5%	5%	0%	Closed
	Equipment	On-site	19,498,030	10	15	14	1	25	9%	6%	6%	<1%	Open
			36,699,320	5	4	4	0	5	11%	9%	9%	0%	Closed
			63,342,400	4	4	4	0	4	16%	16%	16%	0%	Closed
			179,561,960	3	2	2	0	3	31%	17%	17%	0%	Closed

Table 8-6: NTG Sample Achievement for Enbridge Custom C&I programs

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
				Target	Complete			Frame Total	Strata %	% Complete			
					Total	Normal	Extra			Total	Normal	Extra	
Commercial	Action	On-site	568,750	2	2	2	0	2	<1%	<1%	<1%	0%	Closed
			10,213,885	1	1	1	0	1	1%	1%	1%	0%	Closed
		TSER	531,630	4	3	2	1	24	<1%	<1%	<1%	<1%	Open
	Equipment	On-site	2,231,300	13	18	17	1	50	2%	1%	1%	<1%	Open
			7,735,530	8	8	8	0	8	4%	4%	4%	0%	Closed
			9,501,060	1	1	1	0	1	1%	1%	1%	0%	Closed
		TSER	1,594,225	17	14	11	3	265	11%	<1%	<1%	<1%	Open
			11,081,850	17	9	9	0	28	18%	5%	5%	0%	Open
	Multi-Residential	On-site	2,702,600	8	13	9	4	53	3%	<1%	<1%	<1%	Open
		TSER	1,032,930	10	7	6	1	139	7%	<1%	<1%	<1%	Open
			4,357,525	9	7	6	1	36	9%	2%	2%	<1%	Open
Industrial	Action	On-site	424,835	4	3	3	0	8	<1%	<1%	<1%	0%	Closed
			1,059,870	3	1	1	0	4	<1%	<1%	<1%	0%	Closed
			12,988,135	1	1	1	0	1	2%	2%	2%	0%	Closed
		TSER	799,210	3	4	4	0	7	<1%	<1%	<1%	0%	Open
			2,935,575	1	1	1	0	1	<1%	<1%	<1%	0%	Closed
	Equipment	On-site	2,716,060	7	15	9	6	47	6%	2%	1%	1%	Open
			6,197,900	7	9	9	0	13	6%	4%	4%	0%	Closed
			19,604,220	7	6	6	0	7	9%	8%	8%	0%	Closed
			49,314,000	3	3	3	0	3	13%	13%	13%	0%	Closed
		TSER	3,332,925	5	8	6	2	24	3%	1%	<1%	<1%	Open
			20,592,275	1	1	1	0	1	3%	3%	3%	0%	Closed

Table 8-7: NTG Sample Achievement for Enbridge RunitRight

Grouping			Max CCM Savings	Units of Analysis					Percent of Frame CCM Savings				Strata Status
				Target	Complete			Frame Total	Strata %	% Complete			
					Total	Normal	Extra			Total	Normal	Extra	
Run-it-right	Action	IDI	170,060	8	9	9	0	19	14%	20%	20%	0%	Open
			208,725	5	3	3	0	5	34%	21%	21%	0%	Closed
			700,715	4	4	4	0	4	52%	52%	52%	0%	Closed

APPENDIX B. SPECIFIC TOPIC METHODS

General topics

Multiple topics came up during the evaluation that required methodological decisions. These included:

- Codifying and clarifying standard or best practices for:
- Baselines
- EULs
- Determination of industry standard practice for measures and sectors that lack a known, researched standard and code requirements for key equipment (e.g.: greenhouses)
- Whether to use a dual baseline for early replacement measures.

This appendix memorializes some of the more noteworthy topics that arose during the evaluation as part of Evaluation Advisory Committee (EAC) review of CPSV site reports.

Measure categories and baseline selection

Table 8-8shows the CPSV team's definitions of which baseline is appropriate for various situations. These are guidelines that apply to almost all projects. Some situations may require an exception, in which case the reasoning was described in the site report.

Table 8-8 General Baseline Appropriateness Guidelines

Measure Type	Gross Savings, based on remaining useful life from facility contact and documentation		Examples	Net Savings, based on acceleration period identified in the NTG surveys.	
	Early Replacement Baseline	Normal Replacement Baseline		Net: Acceleration Period Baseline	Net: Post Acceleration-Period Baseline
Replace on Burnout (ROB) and Existing Equipment More Efficient than Code	NA	In-Situ (must use the original specified rating as brand new non-degraded equipment, or a comparable brand with new theoretical baseline)	Unique measures where no code/Industry Standard Practice (ISP) exists; Drum Dryers	NA	In-Situ (must use the original specified rating as brand new non-degraded equipment, or a comparable brand with new theoretical baseline)
Replace on Burnout (ROB) and Existing Equipment Less Efficient than Code	NA	Code/Standard Market Efficiency	Replacing a 40-year-old boiler; Replacing anything beyond its EUL	NA	Code/Standard Market Efficiency
New Construction/Load (NC)/ Capacity Expansion (CE)	NA	Code/Standard Market Efficiency	New boiler for new space or system (80 commercial or 82% Industrial/Agricultural; specify the minimum). Any new construction or natural gas load adding/increasing.	NA	Code/Standard Market Efficiency
Retrofit Add On (REA)	In-Situ	In-Situ (unless the retrofit triggers code[23])	Boiler controls; HVAC controls; Flue gas controls; VFDs; Heat recovery; Addition of boiler economizer (such new HX, not replaced HX); Insulation (where truly no prior insulation existed, or the insulation is added on new pipes/tanks/equipment less than 1 year old; for the latter, ISP/code for NC would be valid measure type and not REA.	In-Situ (unless the retrofit triggers code)	In-Situ (unless the retrofit triggers code)
Normal Replacement (NR) and Existing Equipment **More** Efficient than Code	In-Situ	In-Situ (must use the original specified rating as brand new non-degraded equipment, or a comparable brand with new theoretical baseline)	Similar examples as ROB, except the equipment was past EUL but in good operating condition; Greenhouse components –Example: A site originally had double-layer polyethylene walls (that degraded) and installs triple layer but uses single layer poly walls as the baseline (this is a regressive baseline) to estimate savings. Must use double layer (new not degraded) as the baseline	In-Situ	In-Situ (must use the original specified rating as brand new non-degraded equipment, or a comparable brand with new theoretical baseline)
Normal Replacement (NR) and Existing Equipment **Less** Efficient than Code	In-Situ	Code/Standard Market Eff.	Similar to ROB, except the equipment was past EUL but in good operating condition; Regenerative Thermal Oxidizer (RTO) – required to meet local air quality emissions requirements, that a recuperative or direct-fired oxidizer cannot achieve. Greenhouse components such as single layer heat curtains, which might be ISP, but ex ante is using no heat curtain as the baseline.	In-Situ	Code/Standard Market Eff.

[23] Larger retrofits often require related systems or spaces to be brought up to code as part of the project

Measure Type	Gross Savings, based on remaining useful life from facility contact and documentation		Examples	Net Savings, based on acceleration period identified in the NTG surveys.	
	Early Replacement Baseline	Normal Replacement Baseline		Net: Acceleration Period Baseline	Net: Post Acceleration-Period Baseline
Maintenance (Including Repair or Maintain to Code or Restoration to Prior Efficiency Level)	In-Situ	In-Situ	Maintenance allowed in the 2015 program: pipe insulation of existing pipes. Re-tube boilers to rated efficiency levels; Repair heat exchanger; Replace heat exchanger oil; Rewind motors; Repair or Replace faulty/leaking valves, pipes, ductwork, etc.; Descale or clean boiler tubes; Clean gas burners; Re-pipe condensate return lines. Typically allowed maintenance: steam trap repairs, boiler tune-ups.	In-Situ	In-Situ
System Optimization (OPT)	In-Situ	In-Situ	VALID SYSTEM OPTIMIZATION: Revamp Process Control Strategy; De-bottlenecking to increase production and m^3/widget; Modifying the sequence of processes.	In-Situ	In-Situ

Estimated useful life

The EUL of the new measure applied to the following categories of measures:

- Replace on Burnout
- New Construction (NC)/Capacity Expansion (CE)
- Normal Replacement (NR)
- Early Replacement (ER)

We based EULs on those found in the OEB Measure Life Guide,[24] when present and reasonable. When EULs were not present in the OEB Measure Life Guide, we EULs on those used in other North American jurisdictions. In rare cases, manufacturer information may have been used to determine the applicable EUL for measures that were not found in a survey of EUL guides and TRMs.

The RUL of the existing equipment limited the EUL of the implemented measure for the following categories of measures:

- Retrofit Add-on (REA)
- System Optimization (OPT)
- Maintenance

RUL was determined based on the best available evidence. In some cases, the preponderance of evidence suggested that a REA measure was likely to be re-used with new equipment when the existing equipment was replaced. Evidence to support using an EUL rather than RUL for REA measures required that the re-use was both feasible (REA measure must be compatible with a wide range of substitute equipment) and likely (ISP was re-use for the application and/or site contact indicates that re-use was planned).

[24] Union Gas Limited, Enbridge Gas Distribution Inc. (2016, December 21). EB-2016-0246 Joint Summary Table of Measures Assumptions. Toronto.

There are situations where the RUL of the existing measure is more than likely longer than the EUL of the REA measure. Pipe insulation is an example: in almost all cases we would expect existing pipes to outlast the insulation installed on them.

Site engineers and interviewers used a list of questions to help determine the RUL of existing equipment. Due to time constraints, project specifics and the site contact's willingness/ability to respond, not all questions were asked of all sites.

The list of questions included:

1. What was the age of the pre-existing equipment? (In years)
2. Was the pre-existing equipment fully functional, fully functioning but with significant problems, or non-functional?

   At the time the pre-existing equipment was replaced,

3. How often was maintenance required and of what type? How often was major non-scheduled maintenance required and of what type?
4. Can you provide recent/historical maintenance records?
5. How often did the old equipment fail (downtime for the past year), and how was this (downtime) compared to previous years?
6. How satisfactory was the performance of the old equipment?
7. How long would the old equipment have met the technical and performance needs of the facility?
8. How many years do you think the old equipment would have lasted (without major repairs which may have led to replacement)?

In a limited number of cases RUL of existing equipment could not be determined based on site contact provided information or project documentation. In these cases, a default RUL was required. The default RUL for existing equipment was one-third the EUL for new equipment of the same type (consistent with the CA DEER approach). The default applied if:

- the existing equipment was older than the EUL of new equipment of the same type as existing, AND
- existing equipment was fully functional AND
- the information provided by the site contact was insufficient to make a reasonable RUL determination

Greenhouse baselines

For this round of CPSV, the evaluation team accepted most of the baseline assumptions used by the utilities, as applicable codes for commercial greenhouses do not provide specific guidance toward defining minimum efficiency levels for any of the equipment included in the utility programs. Further, Industry Standard Practice (ISP) for Ontario has not been studied. The baseline assumptions used by the utilities are generally closer to a "minimum available on the market" baseline rather than ISP.

In accepting the program baseline for gross savings, the CPSV adjustment was likely to be small. However, a larger number of participants would likely say that they would have installed something significantly more efficient than the program baseline in the absence of the program, resulting in a NTG adjustment farther from 100%. If the evaluation team had used our experience of ISP in other jurisdictions as the baseline for gross savings, the CPSV adjustment was likely to be larger. However, more participants would be likely to say that they would have installed something that was the same as the ISP baseline, resulting in a NTG adjustment closer to 100%. Either way, the net savings would be similar.

Due to the number and size of these projects and the anticipated continued growth in greenhouse construction, we recommend scoping and undertaking a greenhouse baseline study in the future.

Union topics

Union specific topics that required significant decisions during the verification included evaluation approach to "influence factors," and steam traps.

Influence factors

Previous CPSV efforts identified that Union was risking high free ridership on some project types including steam traps and steam leak repairs. The auditor recommended that Union discount savings to only claim the portion that they believe the program had influence on. Union implemented this recommendation by applying influence factors (the evaluation teams term) to projects that reduced ex ante savings to account for anticipated partial free ridership. This reduced the incentives paid to customers as well. Union's approach was conservative in that by reducing gross savings for these projects, a separate program-level NTG factor was also applied further reducing the claimed net savings.

The approach taken by Union demonstrated the utilities concern with free ridership and represented a proactive way of addressing it.

Inclusion of the influence factors created a dilemma for the evaluation team. Gross savings are not discounted for program influence and are meant to represent the savings that are happening at customer sites relative to those sites not installing efficient measures or taking efficient actions. Inclusion of an influence factor in gross savings muddies this interpretation. Further the inclusion of the influence factor in gross savings complicates the analysis of evaluated net savings and the NTG ratio. When asking customers about their projects, customers will not be thinking of the portion the program claimed, they will instead be considering the project as a whole. To correctly estimate net savings for the project the evaluation needed to adjust gross savings to remove the influence factors.

Steam traps

The CPSV team used a six (6) year EUL for these measures. In previous project documentation, Union typically used seven (7) year EULs and Enbridge usually used six (6) year EULs. The CPSV team used a single EUL for both utilities, adopting a six (6) year EUL. The six-year value was based on a 2015 Massachusetts study and is also consistent with the California DEER database, Massachusetts evaluations and the Wisconsin Focus on Energy TRM. The Michigan MEMD (Michigan Efficient Measure Database) uses a five (5) year EUL.

Project documentation provided by Union to support a longer EUL for Union projects consisted of three reports from customers documenting their practices and survey results. Each of the three sites provided was a petrochemical plant.

The reports showed failure rates that could be consistent with 7, 11 and 13 years respectively.

Methodologically, 1/”failure rate” is a way to estimate the EUL, but it assumes that all traps fail randomly. Many factors affect the life to the steam trap: temperature, pressure, flowrate, operating hours, quality of the installation of the steam trap, location of the steam trap in the system (e.g., near elbows and constrictions, or in a straight line of pipe, or somewhere where near forklift traffic), presence of low concentrations of chemicals in the steam and more. The steam traps replaced as part of a program are going to be more likely to be those with a higher rate of failure than those of the facility as a whole.

DNV GL also reviewed the project files sent for the 2015 CSPV sample. While most of the project files do not report the number of traps surveyed, the evaluation team found two others in the 2015 project files that did (the two largest, one petrochemical and one other manufacturing). The failure rates in those sites were consistent with 4.3 and 8.1 years, but it was not clear how often they conduct surveys, so these could have been multi-year failures (longer implied EUL with a 1/”failure rate” method).

Five large customers are not necessarily representative of the program population, and the steam traps replaced by the program are likely to fail at a rate greater than those not replaced. The evaluation team does not have enough evidence to support a longer steam trap EUL for Union and used 6 years as the EUL, consistent with the current best available research (the Massachusetts study).[25]

Union uses three general approaches to calculating savings from steam traps. Most of the projects fall into approaches 1 and 2, with only a few projects using approach 3.

1. Standard: A calculation tool takes inputs provided by vendors and applies them to a simplified version of the Spirax Sarco equation, then applying a derating factor. Similar to the approach used by many vendors.
2. Chemical and Refinery: A calculation tool which uses four different equations depending on pressure and steam trap type, including choked and non-choked versions of both the Napier equation and ANSI standard equation. Generally applied to large chemical and refinery plants with thermodynamic traps.
3. Ad-Hoc: This approach represents a variety of methods which take different outputs which are likely to have been based on different assumptions from simple vendor calculations without specifically stating assumptions and converts steam loss to natural gas savings.

For this round of evaluation, we accepted Union’s methodology for Approaches 1 and 2, retaining their savings estimates unless we learned something from the site contact about the pressure, leak rate, or other condition that differed from the ex ante assumption/documentation. Where site information differed from the documentation, the methodology used to estimate ex post savings was determined on a case-by-case basis. For Approach 3, we planned to recalculate savings using a formula from the Illinois TRM, which generally produces savings estimates similar to the results from the Enbridge and Union Approach 1 methods. Approach 3 was in the end not used.

In the future, we propose that Union document and provide the orifice sizes used to check the vendor calculations. We also propose that Union provide all documentation, including charts, tables, and vendor documentation where needed, to evaluate Approach 2 sites. Union should also provide Excel calculators with live formulas rather than hardcoded values when the values were determined based on a formula or table as

[25] Massachusetts 2013 Prescriptive Gas impact Evaluation. Prepared by DNVGL for Massachusetts Gas Program Administrators and Massachusetts Energy Advisory Council, June 2015.

opposed to a chart or curve. If the chart or curve was the source, Union should provide a copy of the source material.

Some options for to increasing the evaluation rigour for steam traps, might entail one or more of the following options:

- attempting to independently gather orifice sizes and maximum flow capacity charts by reaching out to vendors ourselves to develop a database which would allow us to independently verify calculations,
- purchasing a license for steam trap auditing software allowing for independent verification, or
- developing an assessment of measure life using DNV GL's ultrasonic leak detector to assess failure rate at participating sites.

Enbridge topics

Enbridge specific topics that required significant decisions during the verification included evaluation approach to boilers and steam traps.

Boilers

For the 2015 evaluation of the Enbridge programs, the DNV GL team accepted the Etools calculation method along with the inputs used by Enbridge, except in cases where we were able to verify with site contacts a different condition than what was shown in the documentation.

For the future evaluations, the evaluation team will:

- look for more existing evidence from Enbridge (including emails from the customers, photographs, inspection reports, cut sheets, invoices, and conversation notes) to explain why site-specific inputs were used.
- request that Enbridge explicitly state for DHW boiler replacements in buildings with storage tanks whether the existing tank was replaced as part of the boiler replacement, and whether the existing tank was insulated.
- recommend that the DHW tank insulation be included as a separate measure from boiler replacement.
- consider additional research and reporting that includes:
    - pursuing a detailed review of the ASRAE 155P research,
    - pursuing a review of the Etools calculator which digs into the underlying assumptions and formulas, and
    - writing a detailed memo which summarizes the results of these reviews.

  One benefit would be greater clarity around the remaining calculation uncertainties and a better understanding of their effect. Another would be the identification of areas where the calculation rigor can be cost-effectively increased through further research.

During the evaluation, we noted that Enbridge's approach to boiler implementation appeared to take more of the boiler system into account than prescriptive and custom programs implemented elsewhere. This may be motivated by the savings estimation approach that Etools takes and provides justification for on average higher savings estimates from Etools than prescriptive boiler savings estimates elsewhere.

Due to the unique approach to market and calculation that Enbridge takes, future CPSV efforts should consider using an empirical measurement approach to directly estimate usage and/or savings for boilers. Empirical measurement could take the form of billing analysis or an on-site metering study which either measures natural gas directly or measures proxy values (such as flue gas temperature, water flow, or combustion fan electrical usage). On-site metering studies are becoming more cost effective as end-use natural gas metering expertise and the accuracy of meters to measure proxy variables continue to increase. An empirical sample-based study would not prevent Enbridge from using a custom calculation approach, but would help to calibrate the custom calculation and may provide value to the ASHRAE committee attempting to quantify seasonal efficiency. A billing analysis approach to estimate savings for multifamily and/or commercial boiler replacements may yield reasonable statistical significance due to the large numbers of boilers installed by Enbridge and the fact that boiler usage represents the large majority of gas usage in most buildings.

Steam traps

For this round of evaluation, the evaluation team accepted Enbridge's approach and savings estimates for steam trap evaluations unless we learned something from the site contact about the pressure, leak rate, or other condition that differed from the ex ante assumption/documentation. Where site contacts provided different information to the verifier than that included in the ex ante documentation, the approach used to estimate ex post savings was determined on a case by case basis (depending on what was different).

For their steam trap savings estimates, Enbridge uses an internal database of vendor-provided orifice sizes to check the calculations done by vendors. Based on a review of the formulas used by each vendor, calculations with a sample of pressures and leak rates used by each vendor, and a comparison to Spirax Sarco (whose calculation approach is generally recognized as superior by independent industry experts), Enbridge determines an vendor-specific average derating factor which is applied to the steam losses reported by each vendor. These derating factors are used to convert vendor savings estimates to ex ante program estimates.

The estimates that each contractor's approach produces can vary widely depending on orifice size, leak rate, pressure, and whether condensate is returned or not, so we deviated from Enbridge's method where applicable based on site-specific information.

The Enbridge estimates appear accurate for a group of projects averaged together. The evaluation checked these estimates using an alternative calculation method (based on the Illinois TRM approach) and achieved a similar total savings, though site specific estimates varied widely.

In the future, we will consider requesting that Enbridge document the orifice sizes they used to check the calculations done by vendor for the evaluated site and independently confirm the calculated savings. We will also consider increasing the rigour for steam traps which could entail one or more of the following options: attempting to independently gather orifice sizes by reaching out to vendors ourselves to develop a database, purchasing a license for steam trap auditing software, or assessing the measure life using DNV GL's ultrasonic leak detector to assess failure rate at participating sites.

APPENDIX C. FREE-RIDERSHIP SURVEY RESPONSES

Union Commercial, Industrial and Multi-Family Programs

This section presents the Union Commercial and Industrial self-reported responses from the timing, efficiency, and quantity attribution battery where customers were asked "Why do you say that?". Table 8-9, Table 8-10, and Table 8-11.

A "yes" in the timing, efficiency, or quantity column indicates partial or full attribution for that source based on the scored questions (not the responses here). A "no" indicates no attribution for that source. For example, in the first table a "yes" in the timing column indicates that the respondent answered the question DAT1a and DAT1b with responses that credited the program with accelerating the project. A "no" in the timing column indicates that the respondent did not credit the program with accelerating the project. A "no" for timing does not preclude the same respondent indicating the program affected the efficiency or quantity/size of the same project.

Additionally, following the specific timing, efficiency and quantity questions, customers were asked to summarize the program's effect on the timing, efficiency and amount of the project installed (Dat4). These responses are presented in Table 8-12 with the scored level of attribution: full, partial, or none.

None of the responses provided below were used in the direct scoring of surveys. For respondent confidentiality these responses are isolated from other responses from the interview and do not reflect the full story the respondent conveyed. The responses are provided here to provide insight into how customers describe their decision making on the project relative to the program. See APPENDIX J and APPENDIX K for details on how attribution was scored.

Table 8-9: Timing Verbatim Responses Union Custom C&I programs

Timing	Dat1a_O. Why do you say that?
Yes	***** would've happened more piecemeal but would've happened; ***** had to be done immediately
Yes	2 more years.
Yes	At some point in time we would have learned the value of this and done it.
Yes	Because without the incentive other projects would have become a higher priority.
Yes	Didn't know about the associated energy savings, but once the Union Gas rep showed us savings calculations we did it right away. Hope we would have done this anyways down the road.
Yes	Everything boils down to economics, what it costs us to do, what the paybacks are.
Yes	Funding.
Yes	Funding was tight.
Yes	He never thought of this before.
Yes	He wouldn't have known about it. They would have kept going through the plant a piece at the time.
Yes	Highly likely that there was a 0% chance that we would have done anything.
Yes	If we didn't have incentives, we would only do this work every 2 years (instead of every year).
Yes	Incentive helps us make the decisions faster and invest in new tech sooner with more confidence.
Yes	Incentives allowed for us to complete the project sooner than if we had to wait for the budget.
Yes	It depends on how energy costs go. It was 3 years pushing it.
Yes	It depends on what portion of the production process run as to whether it would have been viable to do.
Yes	It's one of those things that you put on a list and OK, we'll do it sometime, but it might be 5 years or 3 years. Hard to say.
Yes	May have done it the next year without incentives. Hard to say if upper management would have approved.
Yes	Once you commit to this infrastructure, you're committed. So it’s a conversation about rate of return for shareholder purposes; if we said we wanted to do this and didn’t incorporate a potential grant then the IRR isn’t there.
Yes	The payback was too long.
Yes	The program did affect it a little bit, and made me do it a little sooner.
Yes	Realized inefficiency due to existing seals, but utilities encouraged us to do the work right away.
Yes	Some sections would have been done later due to cost.
Yes	They do things that save money.
Yes	They weren't going to be making the ROI at that point in time. Would have had a harder time selling to the board.
Yes	Utilities encouraged us to do the work, otherwise would not have identified the opportunity.
Yes	We were not aware of the steam traps.
Yes	We would have gone ahead with the less efficient design we already had in place.
Yes	Without the program we would have likely only fixed large leaks. Small leaks would have been fixed later.
Yes	Would have done some at the same time, but would have taken longer to complete the remainder.
Yes	It all depends on the payback.
Yes	Their assistance enabled us to get the calculations and get that info to the production department and would’ve been much harder to get numbers to justify the project.
Yes	We would have broken it up into smaller projects without the program. On as-needed basis.
Yes	Finances would've been harder to come by.
Yes	If payback was more than 2 years they wouldn't have done it.
Yes	It went with the same project as *****, but might have been even longer maybe a couple of years.
Yes	It would take us forever; we will always be *****, would never get them all done.
Yes	Payback wouldn't have worked out.
Yes	Probably would never have done it; if so, maybe a couple of years.
Yes	The program prompted us to think about things that we wouldn’t have thought about otherwise.
Yes	It would have taken longer to get approval.
Yes	The program educated them about the opportunity for savings; so they did this sooner than they would've otherwise.
Yes	The rebates help the ROI and increases the chances the ***** will approve; they would've done this eventually.
Yes	They will wait to replace something until they really have to unless it's a health and safety issue.
Yes	They would've had to do these eventually.
Yes	Tough question - It's possible that we just would have done nothing at all. Maybe fewer if we did.

Timing	Dat1a_O. Why do you say that?
Yes	Without the incentive same time, without the program never because they told us to do it.
Yes	Without the incentive the payback would've been longer, so it would've take a longer time.
Yes	We would have done it anyway, but taken thru 2020; some of it was insulated with insulation ***** years old.
Yes	We would have gone with standard *****.
Yes	We would have had to replace anyway.
Yes	We would have taken 2 years instead of 1, so it would double the time.
Yes	We wouldn't have even done it; been working 5 years with issues and still had no plans to replace it. Reviews of steam losses with Union gas helped us push it forward.
Yes	No comment.
No	***** were overdue for replacement - needed to be done regardless.
No	All of the overlap from the rest of construction.
No	As a company, they're looking at energy efficiency. They seek these opportunities. The incentive was not high enough to drive this.
No	At the beginning, it was more important as we got more of an incentive, but now it's as important because people already understand the value of this type of project. By 2015 we were already set, so it didn't affect time frame; in 2008-11 it was important.
No	Because of the window of opportunity (seasonal availability and had to do it then).
No	Because the project was going ahead. We needed the building built. It might have impacted what equipment was being installed in the building.
No	Cheaper, easier decision, still easy to pursue in absence of incentive and program support.
No	Company felt this was a necessary project, so incentive had little influence.
No	Decision driven by equipment failure. Also I'm an energy guy, so we were motivated irrespective of Union Gas program. Incentive helps a bit to convince CFO but would have happened anyway.
No	Dictated by size of project.
No	Did this work before we knew it qualified for incentives.
No	Driven by the need *****.
No	He needed the boiler.
No	High ROI (under 1 year).
No	High maintenance and I had to change the unit.
No	I don't run my business based on a rebate program that is peanuts to my business.
No	I don't think it would have made a difference.
No	If we would have known about the program, we probably would have done it earlier.
No	Incentives were mostly an afterthought and icing on the cake financially.
No	It neither sped up nor hindered the progress. That's a positive comment. Some programs do hold us up like when you need pre-approval and it drags on. That impedes the speed of the project.
No	It was needed.
No	It's just the way things fell into place, step by step, when we were installing.
No	Large energy waste if we didn't recover the heat from new larger ***** unit.
No	No significant factor on timing.
No	Only because there was the ability to get that ***** down. We knew there was big savings in gas for us.
No	Projects were already on the radar and needed done.
No	Safety hazard that needed to be resolved.
No	That's what was happening with our construction schedule.
No	We needed to do those changes anyways. But, it was good that we had incentives on the side. But, when you've got to do it, you've got to do it.
No	We planned to do this work regardless (need for expansion).
No	We planned to do this work regardless (need for insulation).
No	We were moving forward before learning of the rebate.
No	We would have still installed it, but most likely gone with a somewhat cheaper option that would have saved less energy. For example, we decided to go with the ***** versus the *****.
No	The incentive wasn't a game changer, it had to be done.
No	It was the right time of the year to do this and the business needed it, they've been growing a bit.
No	The project was small enough that rebate didn't impact timing.
No	Replacing failed equipment so it needed to be done quickly.
No	The earlier *measure* was broken.
No	The owner wanted it done quickly.

Timing	Dat1a_O. Why do you say that?
No	The project had its own merits, so if it was to move forward it probably wouldn't affect timing.
No	We can only shutdown the plant during 2 specific times a year.
No	We had to address the leaks immediately; ***** so they're just wasting money if they left it leaking.
No	We needed to do this during the summer, a very short window.
No	We were at a point between ***** and the manpower was available to do these projects; already had the budget approved to address the equipment failure because they had been thinking of doing this for some time.
No	This was an installation that helped the plant, *****, so it would've happened regardless.
No	Very attractive on own merits.
No	Very likely, the time frame the same; would have done the project anyway; it wasn't - we get a rebate if we upgrade, but we need to upgrade, and hey- we can get a rebate.
No	Very likely; same timing.
No	You need the program to prompt us to think about EE; we have an enormous utility bill.
No	No comment.

Table 8-10: Efficiency Verbatim Responses for Union Custom C&I programs

Efficiency	Dat2a_O. Why do you say that?
Yes	***** would have dropped out. ***** may have been harder to justify.
Yes	Cost reasons.
Yes	I would have put up the same amount of *measure*, but would have chosen a less efficient product.
Yes	If there were not incentives, than we likely would have not been able to afford the more efficient options.
Yes	We had a less efficient design in place.
Yes	Standard efficiency for the industry that would still support our overall budget.
Yes	The program recommended the highest R-value insulation available and rebates are tied to energy savings so greater efficiency leads to a higher rebate.
Yes	We didn't know of the insulation opportunity and savings.
Yes	We wouldn't have had the knowledge about available higher efficiency options.
Yes	It could have easily affected the technology. We were *****, so may have gone for *****.
Yes	We just would have went with a cheaper, less efficient version, like we did years ago.
Yes	Possibly less but just as likely that we would have done nothing at all.
Yes	The program incentives allowed us to install more measures, greater efficiency.
Yes	The rebates allow us to purchase better equipment.
Yes	We would do ***** just to code.
Yes	Would have been a less efficient *measure*; the old *measure* was 40 years old.
No	Because I don't think we could have gone any higher with the efficiency. It's pretty efficient.
No	After analyzing different options, it seemed like the best option for our operation.
No	We would not have been able to do *****, but we checked them every couple of years.
No	Considered going with more efficient option, but savings did not appear to be worth the extra money.
No	Decision driven by equipment failure. Also I'm an energy guy, so we were motivated irrespective of Union Gas program. Incentive helps a bit to convince CFO but would have happened anyway.
No	I would have kept fixing the leaks for the next 18 months then would have to replace it.
No	High ROI (under 1 year).
No	I'm looking at the long term on my bill.
No	If we are doing the work, we try to replace with best technology available because we've found it often saves us money in the long run and is better ***** (i.e. ***** is clearer and provides *****).
No	Incentives were mostly an afterthought and icing on the cake.
No	It all comes back to I need to do what I think I need to do to give me the best ROI. If I rely on some government program then we are all in trouble.
No	It is the highest. If I decided to go with doing the insulation of the pipe it would have been the same efficiency.
No	It was either install it or not. We wouldn't have considered different efficiencies.
No	It's a guess. It's possible.
No	The program did not affect our planning or decisions whatsoever. They were driven by ***** requirements.
No	There's not that many choices.
No	We decided that's what we wanted to do, and they ok'ed it.
No	We liked what we did, because we saw it at other *****.
No	We had a set ***** in mind.
No	We try to get the most energy efficient options available anyways - if incentive is only 1% of project cost we are going with the same equipment regardless.
No	We were going for ***** anyways. The incentive just helped us along.
No	We would have gotten the same boiler.
No	You don't know what you don't know.
No	The efficiency of ***** was part of the engineering design so they wouldn't have changed it.
No	It's based on the programming, so nothing different.
No	The payback would've worked out without rebates.
No	Same efficiency - we have standards that we have to follow.
No	Same efficiency as it was the best available at that time.
No	We needed the efficiency that we installed.
No	We prioritize energy savings.
No	We would've gone with the same ***** from the same manufacturer - they've been buying from the same manufacturer for years.

Efficiency	Dat2a_O. Why do you say that?
No	The vendor ***** recommends an insulation value, after a certain amount adding more insulation doesn't get more savings.
No	We would have still picked the most efficient option.

Table 8-11: Quantity Verbatim Responses for Union Custom C&I programs

Quantity	Dat3a_O. Why do you say that?
Yes	Because without the incentive other projects would have become a higher priority.
Yes	We didn't know of the opportunity and savings.
Yes	We had another plan in place.
Yes	If a steam trap was on the border of needing to be replaced, we may have not completed it without the incentive.
Yes	It was such a minor project.
Yes	It would have been none.
Yes	We may have done less of the dock seals without the incentives.
Yes	We may have not replaced all the steam traps at the same time.
Yes	We only had a few large leaks and lots of small leaks. We would have only fixed large leaks without incentives.
Yes	We were not aware of the steam traps.
Yes	We may not have done as much testing as we did. But, it would have been close.
Yes	We needed to do it with utility incentive support or not at all.
Yes	We wouldn't have *****. With the additional savings. It led to the next project *****.
Yes	It would have been spread over numerous years.
Yes	We would not have identified the opportunity without help from Union Gas.
Yes	Because the project is not scalable.
Yes	It comes down to spending (the incentives).
Yes	We definitely would not have done everything we did without the rebates.
Yes	If it was a proactive replacement, maybe half.
Yes	The original design was no insulation.
Yes	Out of the *****, we would have done half.
Yes	Possibly less, but just as likely that we would have done nothing at all.
Yes	The rebates allow us to do more.
Yes	The rebates allowed us to install more measures.
Yes	The incentive improved the payback and allowed us to replace more valves.
Yes	There were areas with no doors and garage doors that would have been just left open.
Yes	There would have been nothing.
Yes	We wouldn't have installed energy saving *****; there was a lot that went into the construction of the ***** so hard to say what wouldn't have been done.
Yes	We would have done 20% less; incentive helps us get more $ for this year.
Yes	We would have done 25% of what we did.
Yes	We would have done fewer building. We do 2 or 3 per year, so we would have done half. Maybe 1 to code and 1 with insulation.
Yes	We would have had no ***** without the program; *****.
Yes	We would have only done 25% of what we did; would not have targeted the most important ones; *****, just the ones we could visually locate, the others no.
Yes	No comment.
No	***** had enough justification on their own. Auxiliary equipment would have changed.
No	*****, same scale.
No	The amount of work was need based.
No	Cheaper, easier decision, still easy to pursue in absence of incentive and program support.
No	The current condition was a safety hazard. We needed to complete this amount to fix it.
No	The decision was driven by equipment failure. Also, I'm an energy guy, so we were motivated irrespective of the Union Gas program. Incentive helps a bit to convince CFO but would have happened anyway.
No	We did this work before we knew it qualified for incentives.
No	Didn't present management with smaller options.
No	He would have kept going through the plant piecemeal, eventually getting to the whole thing. This is accounted for in timing.
No	High ROI (under 1 year).
No	I don't rely on rebates to make these decisions. I base the decision on the return on investment.
No	I would use the source I used to calculate what I needed and install it.
No	If we did the work, we would have done it the same way.
No	The incentive doesn't make any difference.

Quantity	Dat3a_O. Why do you say that?
No	The incentives were mostly an afterthought and icing on the cake.
No	It was a ***** replacement.
No	It would be very difficult to do anything else. It's all or nothing. You can't do part.
No	It's a very large building. We had to install the proper equipment in it.
No	It's just a matter of the size of the *****. There's nothing that I could change.
No	Just based on this project requirements. There was only one way to do it. There weren't options.
No	We knew what we wanted.
No	NA for this project, set amount required for this application regardless
No	No difference.
No	Same - Energy savings were large enough to make it worth it, even without incentives.
No	Scope of projects already determined years prior.
No	The program did not influence our decisions.
No	The size of the ***** was decided based on the needs of the process.
No	The incentive did not affect the amount of equipment that would have been installed.
No	There is a certain amount needed *****. That can't change.
No	We had a specific size that we needed. The new one has more throughput.
No	We had an engineering study completed in order to identify exactly the size of the unit we needed.
No	To leave some pipe uninsulated would not have made sense.
No	We didn't want to leave any pipe exposed.
No	We just replaced what needed to be replaced.
No	We needed a certain size *****.
No	We needed to conduct this amount of work, regardless of the incentives.
No	We upgrade a whole suite of controls; so we needed to do all for it to function properly.
No	We were moving forward before learning of the rebate.
No	We would have done it. We had to do it. The incentive is a great thing. We welcome that. But, the incentive is not going to change the scope of the work.
No	It would have been spread over numerous years.
No	We would have still done the same amount, just may have taken a little longer to get completed.
No	The amount of the incentive didn't drive the quantity, it was marginal, so they would've installed the same amount.
No	The capacity wouldn't have changed.
No	It doesn't make sense to do a portion.
No	We might've chosen not to do as many steam traps right away, some were just leaking as opposed to failing outright.
No	We need the same size to keep up with customer demands for our product.
No	The quantity was not an issue here; we didn't have an ***** and we wanted one to increase efficiency.
No	The quantity was not relevant; we needed to replace the fans.
No	The quantity wasn't the issue here.
No	We replaced one washer.
No	It was required.
No	The same amount but we would have done it less frequently.
No	The same scale.
No	The option with the most savings was to go with the ***** smaller *****; incentives made no difference here.
No	We have all sorts of other systems that fit with the ***** - heating/cooling, irrigation, etc. - that we had to get the amount of ***** we did.
No	We needed the quantity that we went with.
No	We needed to address all of the leaks with or without the rebate.
No	We needed to replace the failed insulation, no more no less.
No	Ultimately the same amount, but it would have taken us much longer to get through the queue.
No	We would have installed a lower quality.
No	It wouldn’t really have an effect.
No	No comment.

Table 8-12: Dat4 Verbatim Responses for Union Custom C&I programs

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
Full	We had to do it right away; it was designed to incorporate a lot of ee tools.
Full	I'd say it definitely would have impacted whether we did it. And, the quality of product that went into it.
Full	It had a positive impact on the end result. / It allowed us to select a higher efficiency unit that is cheaper to run.
Full	It had a large effect, probably wouldn't have done this work without program/incentives.
Full	Nothing at all.
Full	The program affected the timing; the grant was coming, so we could do the project right away; otherwise it would have been delayed. would have gone standard efficiency; lots of planning and design went into maximizing efficiency and product quality.
Full	The rebate influenced the timing of the project. We likely wouldn't have done it otherwise.
Full	The only reason I did it was because of the program, so I wouldn't have done it.
Full	The program affected the timing, size, and materials selection of the project because they are involved in the annual planning phases.
Full	The program made it all work. It's a lot easier to put together a big project all at once than small little ones over time. The money savings allowed it to be a larger up front project.
Full	The program provided technical support and incentives that helped the project move forward.
Full	The program provided technical support and incentives that were essential to the project moving forward.
Full	The program slowed down the process due to the length of the process (i.e. application), but allowed us to install more efficient equipment. It did not have an effect on the amount of equipment installed.
Full	They were very polite and very easy to deal with. In going forward, we are going to bring them in right at the forefront. Union Gas's program wasn't the reason for doing the project. We didn't do the project just because we saved the gas. That was a very nice spin-off of the project.
Full	Very helpful. Audit helped us to recognize steam traps and fix them.
Full	We wouldn't have done this without the program.
Full	Without the program this project would have likely not been implemented.
Full	The program was a large influence in helping to coordinate moving forward with the project.
Full	Union Gas was highly influential in the project because their visit and suggestion led to the initiation of the project. Once discovered, the project would have proceeded at the same time with or without the incentive but not at all without their involvement.
Full	We would have built a standard *****, with no upgrades; we would not have ventured down this path without the program. We used engineering services to see if it was going to work; we did trials up front; we stepped forward in increments.
Full	We would have done nothing at all.
Full	Without the rebates, we would have done it, just would have went with a cheaper, less efficient version.
Full	We would have installed roofing just to meet code, not beyond.
Full	We need the program to even prompt us to think about energy efficiency.
Full	No comment.
Partial	Definitely with Union it made the decision easier. Sometimes financially it's not doable at the time. It makes it easier, but in this case it was already in the plan.
Partial	We didn't know about the energy savings from this project, but we would have been doing it for years if we had known (with or without the incentives since it has such a high ROI).
Partial	Due to the incentive, it moved the program forward for us; re controls and other equipment, it assisted us in upgrading those controllers.
Partial	We would have kept going through the plant a piece at a time.
Partial	I would have put up the same amount of ***** area, but would have chosen a less efficient product; Program did affect it a little bit, and made me do it a little sooner, maybe a year later without the program.
Partial	Incentives are nice, but we would do this work anyways due to the energy savings and safety. It does help us get the work done more quickly.
Partial	It had a payback involved in it. So, it was a deciding factor in deciding whether to proceed or not and the timing of when to proceed. And, if it saved on capital funds. Because if we were able to get a grant then that would speed up implantation.
Partial	It made it sooner and more. No effect on energy efficiency level per se.
Partial	It was a lot easier to do the project when they did it when they offered the rebate. Otherwise, it would have been another 6 months or a year.

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
Partial	Medium to large effect, we probably wouldn't have done this work or done less dock seals without program.
Partial	Program had an effect on timing since incentives helped get the project approved quickly by upper management. The program had little effect on efficiency or quantity (for this project - larger projects like a boiler this would likely have a greater effect).
Partial	The program impacted the timing of the project but not the quantity or efficiency.
Partial	The program impacted the timing, efficiency, and quantity.
Partial	The program impacted timing, quantity, and efficiency; their projects are entirely dependent on payback.
Partial	The program incentives influenced timing, efficiency, and quantity of what was installed.
Partial	Program is not as important is it used to be in 2008-2011.
Partial	The project would have been delayed 12 months and absence of program could have easily affected the technology. We were *****, so we may have gone for plain *****
Partial	We would have installed the same amount of square meters (or linear meters) or I just wouldn't have done it at all.
Partial	The program had little effect on the timing. No impact on efficiency for this project, but helped us get more efficient boilers in the past. Incentives helped us do more steam traps than we likely would have been able to do at one time.
Partial	The program helped us complete the work sooner/more frequently than otherwise possible and also helped us afford to complete more. Little effect on efficiency.
Partial	The program made it all work. It's a lot easier to put together a big project all at once than small little ones over time. The money savings allowed it to be a larger up front project.
Partial	They were part of bringing the awareness of that project to us, it helped us with cost justification and calculations and made us aware of the technology.
Partial	Union Gas incentives probably helped upper management approve this work, otherwise would have tried to get it approved the next year.
Partial	What we did was just identified if we could get an increase in productivity with our ***** then we could take our other ***** off line.
Partial	We would have kept repairing the cracked *****, removing sections, etc… and then would have replaced it in 1-2 years.
Partial	We would have only fixed large leaks without incentives.
Partial	Lower efficiency is not an option, but would not have been able to do it with the level of frequency and intensity.
Partial	The program did not influence timing or efficiency, but it did influence the quantity of valves installed.
Partial	The program had an influence on the timing of the project and the quantity (for steam traps), but no impact on the efficiency level.
Partial	The program impacted the timing, not quantity or efficiency.
Partial	The program influenced the timing but not the efficiency or the amount.
Partial	The program prompted us to think about it; maybe would have done half over several years.
Partial	The same amount but we would have done it less frequently; with the program we were doing it annually, without the program, we would have done it every 2-3 years instead.
Partial	The same time, same size/scale, some components such as ***** and ***** would have dropped out.
Partial	The incentives were a nice bonus; had no impact on timing, quantity, or efficiency.
Partial	The program's largest effect was the assistance in assessing the situation. As far as the rebate program goes, it made it easier to convince the project going forward. Incentive wise it’s a moderate effect.
Partial	The Union incentive had a significant effect on size and effectiveness. Without the incentive, it may have proceeded but it would've been harder to justify and smaller in scope.
Partial	We would have done half as many *****
Partial	We would have done it anyway, but would have done less than half of what we did and it would have taken through 2020; audits helped identify what we needed.
Partial	We would have only done 25% of the quantity, only the ones that we could see.
None	We could have done it later, but it would have been awkward, looked bad, and potentially damaged the building.
None	Essentially, Union makes us aware that the incentive programs are available. They haven't really pushed them in any one direction WRT any specific projects.
None	Everything was in line and turned out very well for us and for Union Gas. Because I had to change the unit, I would do it anyway. Since I had the incentive it was faster for us to go ahead and purchase the unit.
None	Everything went smooth. I am thankful for the incentive. There was nothing else we could have done to better the efficiency.

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
None	Had to do it. Original controls were 11 years old and had reached the end of the equipment life. Were wasting a lot of energy. No effect by program on timing, efficiency, size/scope.
None	I think it was a bonus for the overall project that this incentive was available. It probably influenced the decisions on some of the smaller, gas-fired equipment that we use in the building. It might have contributed to *****.
None	Incentives didn't have large impact. Main goal was to reduce heat output. ROI was high enough that we would have done anyways.
None	Incentives were nice but didn't have a huge impact since we realized the potential savings from this project.
None	It made no difference.
None	It would have been a very similar project. But, the incentive helps our decision to go forward and install the components. The timing wouldn't have changed.
None	It's great. It didn't effect the timing, efficiency, or amount.
None	Made it easier to make the case to my CFO but would have happened anyway.
None	No effect on timing, efficiency, or quantity, since we did this work before learning about incentives.
None	No effect.
None	No influence on timing, quantity, or efficiency.
None	Not much influence.
None	Nothing in particular.
None	The program had no impact on timing, efficiency, or quantity.
None	Safety was the main driver, not the program, although the incentives were appreciated.
None	The fact that there's an incentive program provides incentives for doing the project, but it's not the major factor. It helps push this project along.
None	The program didn't really effect the timing, efficiency, or amount, but incentives did help.
None	The program had little effect on the timing, efficiency, and amount of work conducted for this project since it was all need based. Other projects they have influence quantity though (i.e. when installing insulation).
None	The project was designed. Went on time. We got good results from the project. And we are thankful that we got the incentive from Union Gas for the project.
None	The timing was good because everything got completed on time. We didn't know the savings until about 7 months later, when we hit winter. The incentive was a great help.
None	There was no effect.
None	There was some effect. There are a few things we might not have done, or the utility support sped the decision. E.g. the ***** and the *****. Would have likely done anyway but taken longer to analyze and decide.
None	Utility helped define the minimum efficiency for project and helped improve ROI to get easy approvals from corporate
None	We were moving forward before learning of the rebate.
None	While the incentives were appreciated, they were not large enough to have much effect on what we installed (timing, efficiency, or amount).
None	While we appreciated the incentive, we would have installed the energy curtain anyways to save on natural gas so the program didn't really influence our decision.
None	Incentives were a bonus that fit in with their maintenance schedule; program had no influence on timing, quantity, or efficiency
None	No impact on the timing and efficiency. The incentives were a nice bonus; always looking for way to get energy savings.
None	No impact on timing, quantity, or efficiency.
None	No program attribution. The program did not impact timing, quantity or efficiency.
None	The program didn't have an influence on anything.
None	The program had no influence on timing, quantity, or efficiency.
None	The program impacted efficiency of equipment; no impact on timing or quantity.
None	We would have done the same exact thing that we did. You could get a less efficient deck design but we wouldn’t have picked that.
None	We would have done exactly what we did; the rebate is a bonus on the end; we're making decision based on best payback and most EE; if there’s a rebate, great. If not, we wouldn't do something less efficient because it doesn’t make business sense.
None	No comment.

Union Large Volume

This section presents the Union Large Volume self-reported responses from the timing, efficiency, and quantity attribution battery where customers were asked "Why do you say that?". These responses along with whether a response received some timing, efficiency, or quantity credit are presented inTable 8-13, Table 8-14, and Table 8-15.

A "yes" in the timing, efficiency, or quantity column indicates partial or full attribution for that source based on the scored questions (not the responses here). A "no" indicates no attribution for that source. For example in the first table a "yes" in the timing column indicates that the respondent answered the question DAT1a and DAT1b with responses that credited the program with accelerating the project. A "no" in the timing column indicates that the respondend did not credit the program with accelerating the project. A "no" for timing does not preclude the same respondant indicating the program affected the efficiency or quantity/size of the same project.

Additionally, following the specific timing, efficiency and quantity questions, customers were asked to summarize the program's effect on the timing, efficiency and amount of the project installed (Dat4). These responses are presented in Table 8-16 with the scored level of attribution: full, partial, or none.

None of the responses provided below were used in the direct scoring of surveys. For respondent confidentiality these responses are isolated from other responses from the interview and do not reflect the full story the respondent conveyed. The responses are provided here to provide insight into how customers describe their decision making on the project relative to the program. See APPENDIX J and APPENDIX K for details on how attribution was scored.

Table 8-13: Timing Verbatim Responses for Union Large Volume

Timing	Dat1a_O. Why do you say that?
Yes	By being aware of everything it helped to speed things up.
Yes	Do a yearly steam trap analysis and would have discovered the failed traps then.
Yes	I think because the effective cost of the work was less with the incentive from Union Gas.
Yes	It helped to move it ahead faster, with the funding.
Yes	It was creating a *****, one was very fouled, so it had to be done regardless, the 2nd was borderline, and would have been cleaned the next year if it hadn't been last year.
Yes	Survey by Union Gas identified the issues, but this would've happened eventually anyway.
Yes	It was a good project & made sense to do at some point in time. ***** would have given it more priority.
Yes	No comment.
No	Already identified and approved as part of infrastructure maintenance - incentives were a bonus.
No	Company has recognized the need for this due to potential energy savings/ ROI.
No	Decision driven by needs at the site, not incentives.
No	Installation was staggered as it was. They chipped away at it. Had to stagger anyway due to their production schedule and constraints.
No	It would have had no impact. We would have implemented the project with or without the program rebate.
No	It's a larger project. So, the relative effect of the rebate is not as great.
No	Needed to be replaced. Incentives were too small to have an effect (incentive less than 1% of project cost).
No	Only the one window of time for spring maintenance projects.
No	The incentive is appreciated. But, I can't delay such a large maintenance item.
No	The project was feasible on its own merits and management expected them to implement it.
No	These issues are important to the continuing operation of the plant and they are addressed as quickly as they can be.
No	Timing determined by turnaround cycle.
No	We planned to do it regardless of the program.
No	Because of equipment age (turnaround). incentive helpful to engineering group, but small compared to whole project. Incentive less than 1% of project cost.
No	Because of equipment age. incentive helpful to engineering group, but small compared to whole project. Incentive less than 5% of project cost.
No	Because won't have another ***** until ****, so take advantage of that opportunity or lose out on it.
No	It needed to be replaced.
No	The program had no influence on these projects. These were maintenance issues that needed to be done regardless and met payback requirements without incentives.
No	Repairs, so they had to happen.
No	It was part of a larger project.
No	We had to do the one as it was failing, the 2nd would have been done in the next couple of years if we didn't do it at this time, it would have failed in 2-3 years.
No	No comment.

Table 8-14: Efficiency Verbatim Responses for Union Large Volume

Efficiency	Dat2a_O. Why do you say that?
Yes	Because they made us aware of the potential energy savings of going with what we did. And, they actively lobbied us for it.
Yes	No comment.
No	As a ***** manufacturer, we understand going with higher efficiency product will save us money in the long run. Plus already had scope approved by president/director.
No	Energy savings justify on its own.
No	Engineering standards.
No	More efficient units like the one we got would pay for themselves, even without the incentive.
No	It needed to be replaced. Incentives were too small to have an effect in this case (for other projects incentives have helped us afford more efficient equipment, but depends on ROI).
No	We picked this ***** because it was the best operational decision. It's just good business practice to install the highest efficiency that we could install.
No	We would have selected same product.
No	We needed the amount of insulation and the type that we installed.
No	We had to do the one, the 2nd would have been done in the next couple of years if we didn't do it at this time, it would have failed in 2-3 years.
No	Would have gone ahead with same ***** project anyway.
No	No comment.

Table 8-15: Quantity Verbatim Responses for Union Large Volume

Quantity	Dat3a_O. Why do you say that?
Yes	We would have gone with an option that did not increase the efficiency of the system.
Yes	One ***** needed to be replaced due to corrosion, but the rebate allowed us to do the 2nd one at the same time.
Yes	Would be influenced.
Yes	No comment.
No	*Measure* needed to be replaced anyway. Maintenance ***** needed to be done anyway, and was already scheduled.
No	Already identified and approved as part of infrastructure maintenance - incentives were a bonus.
No	Certain constraints in terms of safety standards.
No	Decision driven by needs at the site, not incentives.
No	Maintenance standards.
No	NA - only 1 was needed.
No	Needed to be replaced anyway.
No	Needed to be replaced. Incentives were too small to have an effect (incentives less than 1% of project cost).
No	The program is beneficial; it puts money back into their pocket. Like sprinkles on cake (extra $).
No	The simplicity of the project. What we were implementing was just standard practice. There was nothing we would have done that was out of the ordinary.
No	There wasn't really an option to do only part of it.
No	It was based on engineering standards, not on program incentives.
No	We had a pretty good idea of what we were going to do. We spent a lot of time determining the scope of the work. At the time we are thinking, it is not guaranteed that we will get the rebates. So, it is a bit of an educated guess.
No	We had to install the amount we did. The incentive contribution was not material.
No	We needed the insulation they installed, and we wouldn't have changed this.
No	We needed to replace ***** failed steam traps anyway, would just have been delayed.
No	Only one choice.
No	Repairs are necessary.
No	Same amount but this would've had to happen over a period of time / piecemeal.
No	This was what we needed, and we incorporate the program in our planning process.
No	It was new construction/***** project, one window of opportunity.
No	We would have been installed anyway on own merits.
No	No comment.

Table 8-16: Dat4 Verbatim Responses for Union Large Volume

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
Full	The program provides commitment to the project. Gets it done.
Full	They were instrumental in helping us to identify the potential energy savings, which expanded the project's scope. But, resulted in a long-term cost benefit to our organization. The program was very helpful in convincing the powers that be that the more expensive option was the best one to pursue.
Full	Would not have installed absent the program. Would have kept as-is.
Full	No comment.
Partial	Incentives helped motivate staff to get going. The project was done slightly earlier and on a larger scale than it would have been absent the program.
Partial	It improved the timing because of the availability of the rebate. The efficiency and the scope would have remained the same. We couldn't have done less work than we did.
Partial	Program provides commitment to project. Gets it done.
Partial	The timing, the program made it happen sooner. So, we gained the savings sooner.
Partial	Very likely to install same equipment, 36 months later, same efficiency, same quantity.
Partial	Very likely to install same equipment, would have been delayed 18 months.
Partial	We would have done less and less frequently. We would have likely done it, but 6 months later when we have downtime, on a smaller scale. We would do 75% and not replace ***** until they were closer to end of life because of program education we understand ***** efficiency.
Partial	Its hard to say, would have done half as many 2 years later. We would have wasted more fuel, traps are something we observe; years of patching up equipment. Now it's maintenance annually due to program ed.
Partial	One ***** needed to be replaced due to corrosion, but we did the 2nd one at the same time because of the rebate, but it had some RUL.
Partial	The program influenced timing and quantity.
Partial	The program accelerated the installation by 12 months and caused a larger amount of steam traps (half of those that were incented) to be replaced.
Partial	The program accelerated the installation some, and caused a larger amount of pipe insulation to be replaced but the respondent didn't know by how much for either.
Partial	We would have been somewhat likely to do it, because we knew what we were doing. It wasn't a good thing to do, but would have been 6 months later because we didn't know how much fuel we were wasting, but in keeping with same scale/efficiency.
Partial	We would have done the same thing; rebate was influential in getting us to do the *****; incentive pushed the 2nd project to this year, instead of the next year; utility rebate makes the payback better.
None	As mentioned before, the utility mainly just provided the incentive quote/estimate, but did not have much effect on anything else.
None	Honestly, we were set on doing this as an infrastructure improvement and would have done it all the same without the incentives.
None	Incentives can help for certain projects, but when they are relatively small they don't impact our timing, efficiency, or amount. Still helps, but doesn't sway us.
None	It had no effect. It's a good program that helps people make better business decisions in terms of installing the best, efficient materials and equipment and, therefore, making better business decisions.
None	It triggered an awareness that there were many more projects that we could implement. It put us in that frame of thought and helped encourage us.
None	It would have affected if and how soon the project got approved.
None	No effect on timing, efficiency or size/scope of what they installed. Would have done anyway.
None	No effect. Decision driven by needs at the site, not incentives
None	No effect. Would have been same timing, efficiency level and size/scope.
None	Program had little effect on the decision to do this work, because it was necessary for the safety/continuing operation of the facility. Also little effect on efficiency and quantity, due to engineering and maintenance standards respectively.
None	Project was very likely to be implemented without the Union Gas program, at the same time, efficiency level and size/scope.
None	The program had essentially no effect on this work at all (timing, efficiency, or amount). This was work we planned to do regardless.
None	The project would have been done at the same time, efficiency level and size absent the program.
None	Very likely to install same equipment, same time, same efficiency, same quantity.

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
None	No effect on the timing, efficiency level, or size/scope.
None	No influence.
None	The program is always there, so you look for ways to recoup your money. But without the program we would still do these repairs.
None	It wouldn't have affected it. Would have happened anyways.
None	No comment.

Enbridge Commercial, Industrial and Multi-Residential Programs

This section presents the Enbridge Commercial, Industrial and Multi-Residential self-reported responses from the timing, efficiency, and quantity attribution battery where customers were asked "Why do you say that?". These responses along with whether a response received some timing, efficiency, or quantity credit are presented in None of the responses provided below were used in the direct scoring of surveys. For respondent confidentiality these responses are isolated from other responses from the interview and do not reflect the full story the respondent conveyed. The responses are provided here to provide insight into how customers describe their decision making on the project relative to the program. See APPENDIX J and APPENDIX K for details on how attribution was scored.

Table 8-17, Table 8-18, and Table 8-19.

A "yes" in the timing, efficiency, or quantity column indicates partial or full attribution for that source based on the scored questions (not the responses here). A "no" indicates no attribution for that source. For example in the first table a "yes" in the timing column indicates that the respondent answered the question DAT1a and DAT1b with responses that credited the program with accelerating the project. A "no" in the timing column indicates that the respondend did not credit the program with accelerating the project. A "no" for timing does not preclude the same respondant indicating the program affected the efficiency or quantity/size of the same project.

Additionally, following the specific timing, efficiency and quantity questions, customers were asked to summarize the program's effect on the timing, efficiency and amount of the project installed (Dat4). These responses are presented in Table 8-20 with the scored level of attribution: full, partial, or none.

None of the responses provided below were used in the direct scoring of surveys. For respondent confidentiality these responses are isolated from other responses from the interview and do not reflect the full story the respondent conveyed. The responses are provided here to provide insight into how customers describe their decision making on the project relative to the program. See APPENDIX J and APPENDIX K for details on how attribution was scored.

Table 8-17: Timing Verbatim Responses for Enbridge Custom C&I programs

Timing	Dat1a_O. Why do you say that?
Yes	*****: delayed a year w/o rebate – it still would have gone, but maybe 60%chance it was done that year/40% chance next year; *****: would have to do something at some point...maybe delayed, it would not go to ruin but it could be neglected longer.
Yes	Because having a stronger business case will give us better payback and the project will become more viable and more likely to get approved and funded.
Yes	I don't know for this specific project - but incentives frequently expedite getting projects approved.
Yes	It is easy to justify in the project budget.
Yes	Enbridge's program created the business case for us.
Yes	Eventually we would have gotten to it, such a large saver.
Yes	I would have added ***** instead of doing the *****. But, I would still have had to add *****.
Yes	The incentive matters.
Yes	Incentives are included in our budget forecasting.
Yes	Incentives helped the director approve the project. We may have been delayed it without incentives.
Yes	Incentives made it easy to get approved (brought it within 2.5 yr ROI). May have got pushed back without incentives because more convincing would have been necessary.
Yes	It would have been much later if not never.
Yes	It wouldn't have had the payback. It would have been beyond our guideline.
Yes	It's the business case. The incentives shore it up. Without that funding, it throws off the numbers, we need to secure more internal funding.
Yes	Just because of the ROI. The incentives made it happen. They put it over the edge.
Yes	Likely would not have done it without incentives due to maintenance costs/hassle to keep them clean.
Yes	Money.
Yes	Our location is closing, so it would never have happened.
Yes	Probably a little bit later because general awareness of incentive was lower. Enbridge turned them on to other incentives.
Yes	The *process* for ***** relatively expensive for the expected ROI. As a result, upper management would not likely see value without the incentive.
Yes	The incentive helps focus people's attention in terms of getting the job done. They help us in highlighting these measures as opportunities.
Yes	The incentive raised the profile of the project in comparison to its size.
Yes	The math showed them the savings to get the ***** installed. Enbridge helped with the math.
Yes	The program is not just an incentive thing. The thing for me that is equally important is the parternship in terms of identifying and vetting different project ideas.
Yes	They incentivized the steam trap audit as well.
Yes	They now do this every year. This is an odd question.
Yes	They were still considering energy savings and wanted to be proactive. They like the incentive. If there weren't an incentive, they would do another project first.
Yes	They would do it every three years, but not every year.
Yes	They would have done them piecemeal over time.
Yes	Upper management would have likely not approved a project like this that is not viewed as an immediate priority.
Yes	We had to do it. But, the incentive helped us to do it faster.
Yes	We wouldn't have been able to justify the payback without the incentive.
Yes	Without incentives the project would not have been approved/ we wouldn't have done the project.
Yes	It would have been pushed off.
Yes	We would have had to wait until next summer to get it in the budget.
Yes	We would have likely still replaced one at the same time, and then the second one at a later date.
Yes	We would have replaced on equipment burnout.
Yes	We would have taken longer to be aware of the savings opportunity. Plus the incentive was relatively large and a significant motivator.
Yes	We would have taken longer to get appropriate resources and funding in place.
Yes	We wouldn't have had technical or financial support.
Yes	It's not a small project *****, so it takes time, lots of operations, keep the plant running all the time, started 2011, ended 2015, rebate accelerated the project by one year.
Yes	The rebate helped the payback work out.
Yes	The rebate reduced payback so they could install measures sooner.

Timing	Dat1a_O. Why do you say that?
Yes	The rebate helped the payback allowing them to do the project sooner.
Yes	Tough to say; they have tight ROI metrics.
Yes	It would have taken longer to convince them to do.
Yes	It would've been replaced eventually, but they don't typically become aware until an audit or something breaks down.
Yes	No comment.
No	***** replacement was due
No	***** was a regular maintenance item. ***** were something they wanted for growing reasons.
No	Aiming to meet internal efficiency goals.
No	Because of our business model. We work in *****. We only have a short window to ***** because of the weather.
No	The incentive is a very small percentage from the project cost.
No	The unit was old and needed to be replaced.
No	Because we were going to change the boilers whether there was any incentive or not.
No	The Enbridge program was not a factor.
No	End of useful life, savings with gas when replaced.
No	The equipment had failed and we needed a replacement. The decision was driven largely by the larger Toronto Hydro incentive. The small Enbridge incentive relative to the large total project cost wasn't a big motivator.
No	The equipment needed replacement.
No	I think that moment when you are trying to decide, knowing that there is some extra funding pushes you to do it. Enbridge's involvement had more to do with whether we would do it or not do it than the with timing of doing it.
No	I would still implement it. It's more of an operational savings. We are going to get savings with the Enbridge program or not.
No	The idea came from us and our president.
No	It's the business case. The incentives shore it up. Without that funding, it throws off the numbers, we need to secure more internal funding.
No	Leaks needed to be fixed, it's very expensive for the company to continue operating "as is/was".
No	Motive was for improved plant conditions, only found out about incentives after we were set on doing project.
No	It needed doing.
No	We needed to get this work done for energy efficiency purposes.
No	Once we discovered the need we like to move on them, given the circumstances.
No	Refused.
No	Similar time because we have a 5 year plan on spending on this type of project.
No	Simply because the payback was justifiable.
No	That was the time when we were able to identify it. The program being in place just helped us move along.
No	The Hydro Incentive was bigger. The Enbridge incentive was great. It made the ROI that much better. It was a bonus. But, it was the Hydro one that made the case for this project.
No	The boilers were falling apart. Try to submit early in the year when people aren't busy, timing for tender is very important.
No	The drivers for the projects didn't have much overlap with the Enbridge reps; they provide only a very small portion of total funding; they're not at the table.
No	The incentive makes it a real no brainer, but it's a decent business case without it. The decision is weather driven, so we do it every year but could do it every other year without the incentives.
No	They needed to be done.
No	They were a pile of rust.
No	This one would probably have happened at this time, though in a smaller way.
No	This was a construction project which was scheduled for other reasons.
No	Timing was coordinated by the energy office.
No	We had planned to do this replacement per our schedule.
No	We had to change the equipment. Enbridge just helped us with installing energy efficient equipment.
No	We had to have the ***** shut down at the time we made the installation. Those shutdowns aren't very frequent. We had a scheduled outage. And, the equipment was here. So, that's when we installed it.
No	We had to replace the *****.
No	The maintenance had to be done.
No	It didn’t affect timing.

Timing	Dat1a_O. Why do you say that?
No	We had to address safety issues.
No	It had to be done during shutdown.
No	it was a quick, small project; no capital investment involved.
No	leverage *****
No	One of the boilers was failing critically.
No	The project was under the 1-year ROI, but the rebate made the ROI lower.
No	The rebates were not a factor in the timing. We were going to do these projects with or without the incentives.
No	The rebates were not a factor in the timing; We were going to do this project with or without the incentives.
No	The system was broken. We had to replace.
No	We planned these projects well before they knew the rebates existed.
No	To improve process efficiency.
No	No comment.

Table 8-18: Efficiency Verbatim Responses for Enbridge Custom C&I programs

Efficiency	Dat2a_O. Why do you say that?
Yes	Incentive changed the cost/benefit calculation.
Yes	Incentives helped get a more efficient unit approved. *****, so may have gone with unit of a similar efficiency - hard to say.
Yes	Might have gone less efficient. Hard to know.
Yes	The program incentive helps improve PP.
Yes	The incentive helps to install a higher efficiency equipment.
Yes	We would have gone with a lower efficiency.
Yes	We would have replaced like for like without the rebates.
Yes	I don’t know for this specific project, but possibly less efficient equipment if that was the only way they could get it approved.
Yes	We would have installed more than standard but not quite high-efficiency.
Yes	The rebates allowed them to pursue more efficient equipment.
No	Again, the decision wasn't driven by the Enbridge incentive.
No	Consultant recommendation.
No	Enbridge is just a small player in the financing and decision making for these projects.
No	Enbridge's involvement is mainly to do with verifying what they did. No influence on efficiency.
No	Energy savings is important to us
No	If we are going to do it, we'll do it right. The goal was to increase efficiency.
No	If we were to do the *****, we would have done it in the most efficient way possible.
No	We installed the equipment suggested by our vendor. Incentives did not influence the choice.
No	Just energy savings after the fact. I am very conscious of the environmental energy cost, its just second nature to my training, how are we going to be better.
No	***** driven
No	The ***** requirements were the driver for getting the *****.
No	The big ***** was supposed to be more efficient.
No	The equipment we selected meets our own internal high standard and yields payback over time.
No	We don't care about the rebates.
No	We wanted to install the best and latest technology.
No	We bought a used unit that became available. We did not custom buy it.
No	We needed a ***** that would be faster because of the increased usage.
No	We put the best possible solution at the time in place.
No	We try to install the most EE boiler money can buy, we know that in the long run you save on operating cost.
No	We try to update our equipment with like for like, efficient alternatives regardless (this is why we consult energy experts first).
No	We wanted to use the equipment we used.
No	Without incentives the project would not have been approved/ we wouldn't have done the project.
No	We would have replaced it with the same efficiency levels.
No	It wouldn't make sense to spend the money without getting the savings.
No	Just ***** installation and some ***** to control it.
No	There was only one option other than *****, which is ***** and that's what we did.
No	We had a good idea of what we wanted based on previous experience. We wanted to save money by increasing energy efficiency.
No	We knew what we needed.
No	No comment.

Table 8-19: Quantity Verbatim Responses for Enbridge Custom C&I programs

Quantity	Dat3a_O. Why do you say that?
Yes	Because the program helps offset the difference in the price cost.
Yes	Because we would have less incentive. So, the payback would have been less. So, there would have been less money to be spent.
Yes	Enbridge made us aware of the type of equipment that was available.
Yes	Enbridge's incentives and assistance in annual planning is critical for the implementation of most non-mission critical projects.
Yes	If there is no incentive, then we might go for less.
Yes	If you can get incentives to do something, then you will do a better job just because of the cost reduction.
Yes	It all come backs to it being one system. You are either installing it or not.
Yes	May have only installed 1 or 2 *****.
Yes	Not immediate priority due to lower ROI.
Yes	Only one *action* was necessary to recover heat.
Yes	Same reason, budget would have had a smaller scope. We may not have adjusted the dampers.
Yes	The cost savings with the program.
Yes	The incentive made it cost effective enough that we could get approval from our finance team.
Yes	They might do however many steam traps they could afford, which is often not much.
Yes	They would have done one of the ***** boilers.
Yes	They would not have done this project otherwise.
Yes	We needed it.
Yes	We would have gone with like-for-like replacement of the old system, which was smaller.
Yes	We wouldn't have been focused on identifying the traps that needed replacing.
Yes	Without the proper ROI we would have had to come up with some other design or something to get it approved. But, I don't know what that would be.
Yes	Without incentives, the project would not have been approved/ we wouldn't have done the project.
Yes	We would have likely replaced the seal/bumper on one door, then another later on.
Yes	We would have probably not done any without incentives.
Yes	We would have still done both since we were focusing on renovating non-critical office area.
Yes	We wouldn't have been aware of the value and need.
Yes	We would have just done one *measure* instead of two.
Yes	No comment.
No	All units were at the end of the useful life.
No	Amount was needed for significant improvement.
No	The audit service provided by the utility was very helpful. But the incentives did not impact the choice.
No	Basically, we don't get to see incentive money, it goes back to ***** and might be used somewhere else.
No	Enbridge is just a small player in the financing and decision making for these projects.
No	Engineer and vendor recommendation.
No	The equipment needed replacement.
No	Every site needed a new *****
No	The extent would have been the same.
No	It had to be compatible, but increased efficiency was part of 5 year goal.
No	I don't think the incentive had any bearing on whether we were going to do this project.
No	It all come backs to it's one system. You are either installing it or not.
No	It had merits on it own. It had its own justification, even without Enbridge's rebate.
No	It was a comprehensive project for all mechanicals by design.
No	It's because of the financials.
No	It's just a maintenance thing they had to fix.
No	It's was the option we needed to save money.
No	Just have 1 heater.
No	Leaks needed to be fixed. It would be expensive for the company to not repair.
No	Likely would have done less, and only completed a few of the ***** one year and more the next.
No	We might have gone with a smaller system.
No	We needed to replace them all at once to get a better price from the vendor.
No	There was no influence on size or quantity of boilers installed.
No	I'm not certain, but I believe only one needed to be replaced.

Quantity	Dat3a_O. Why do you say that?
No	No influence on sizing.
No	Not scalable; had to control all ***** fans.
No	We only need one unit.
No	We only needed to replace the one.
No	The project needed to be done together because of co-location of *****.
No	The quantity was based on ***** advice based on square feet. We would install as many as they advised since they had most experience with them. Not dependent upon the incentive.
No	The repair had to be done to address safety concerns.
No	The ***** was more influential.
No	The ***** requirements was the driver for getting the EE points.
No	The equipment was sized based on the amount of *process*.
No	The equipment we selected to meet our own internal high standard and yields payback over time.
No	The incentive was just a bonus. We had to do this.
No	The size we went with fills the need.
No	They go based on the building size.
No	They sized it for the building.
No	They wanted to try it, which is what they did.
No	They were a system. Replace all at once.
No	They were sized for the building.
No	They would do the audit and replacement the same, just less often.
No	Vendor.
No	We needed it.
No	You can't do less because of the type of work we do. You can't do a portion and not do the other portion.
No	Because the units that were being replaced all work well together hand-in-hand so it was advantageous to do a whole replacement instead of partial. More practical and cost efficient.
No	The decision wasn't driven by the Enbridge incentive.
No	Just a longer period of time.
No	We needed the size for health and safety.
No	Not scalable.
No	The same process, both buildings.
No	The same size either way.
No	The same, with controls, you can't say do more/less, you have to do it.
No	Still gone after at the same time because of internal drivers, good business case.
No	The failing boilers needed to be replaced.
No	The project would have been the same without Enbridge support as the old system was broken.
No	We needed to redo the ductwork system, so nothing would've changed without rebates.
No	We needed what we got; the rebate had no impact on this.
No	We were only looking to install one VFD.
No	It would've gotten replaced but later, as they failed.
No	No comment.

Table 8-20: Dat4 Verbatim Responses for Enbridge Custom C&I programs

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
Full	Enbridge's incentives and assistance in annual planning is critical for the implementation of most non-mission critical projects.
Full	It helps with the timing. Some of the projects would never happen at all if it wasn't for the analysis. The efficiency is improved as well. The analysis helps determine how to make the project a better option. They help with the overall outcome by providing the technical support and some of the fi.
Full	The program had large impact on timing and amount. Very likely this work would have not been approved without incentives.
Full	Program had little effect on timing or efficiency for ***** project (because it was a HUGE energy waste and had a very high ROI = needed to be done), but had large impact on ***** - made this project feasible.
Full	The funding made the project viable. Without the funding we wouldn't have been able to do it.
Full	The incentive and the program through Enbridge allowed us to get a program completed that we probably wouldn't have without their help. They helped us simplify the project and implement it in a timely manner.
Full	The incentives had a very large effect. If we didn't have them, the ROI would have been over 3 years and the project would have never been approved.
Full	They originated the project, the business case. They helped with the assessment which helped accelerate the process of approval with the incentives and a faster ROI.
Full	They provided evidence that this was a good thing to do, and they put their money where their mouth is.
Full	We would have installed a standard efficiency boiler otherwise.
Full	When I give them the number of exhaust fans that I have. And, I give them the ***** units that I have, they did the calculations to balance the system. / When I learned that there is an incentive then I can spend a little more money than what I planned to. With the incentives, we could install a *****.
Full	With the incentives and the individual help from Enbridge it helped us reach the proper ROI and make the project a reality.
Full	Without incentives, we would most likely not have done this work, so large effect on timing and amount.
Full	Without the timing, it would have been delayed indefinitely.
Full	We would have installed all ***** boilers at the same efficiency.
Full	No comment.
Partial	Absent the program and incentive, the controls projects would have been implemented eventually, about 12 months later. The program had no impact on the efficiency level or size dimension.
Partial	Big influence. The incentive is a great help to the corp. Without the incentive, they would not move the project forward that soon.
Partial	By having the incentive, it does increase our ability to save money sooner rather than later. And, it increases our ability to get it done sooner.
Partial	I suspect this work would have taken longer to get approved and we may have had to settle for a less efficient unit without incentives.
Partial	Certainly, a relevant bonus to us, we got 5% back, but again, overall, project would have proceeded regardless
Partial	Enbridge's incentives and assistance in annual planning is critical for the implementation of most non-mission critical projects.
Partial	Hard to say for a lot of these (since hypothetical), but incentives helped get this work approved. Without incentives, we may have done it later, or only 1 maybe 2 of the economizers at this time.
Partial	I think Enbridge's program for subsidizing steam trap studies and replacement of faulty traps ensures that we do it on a regular basis and a higher frequency than we otherwise would.
Partial	If we didn't have the assistance the project would not have been completed to the extent that it was. And, it would have been much later that we got the job done. We would have not experienced the improvements in production.
Partial	Incentives helped bring down ROI which made it easier to get approved. We would have likely done a less thorough job and later without incentives, since the bottom line is critical here.
Partial	It helped us install it a year early.
Partial	It improved the business case and made the decision process easier. Also, it invites more rigor for measurement and verification which makes it easier for us.
Partial	Program incentives helped us afford a more efficient option, but didn't impact timing/quantity since all units were overdue for replacements.
Partial	Program incentives helped us complete both ***** at the same time. Otherwise would have done work in two stages.

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
Partial	Sped up installation, improved efficiency, and had no effect on quantity for this one site.
Partial	The Enbridge rep made them aware of the incentive for the VFD measure and got the process started. The VFDs were installed 24 months before they would have been absent the program. No effect on the efficiency level or size/scope.
Partial	The incentive and help with calculations of paybacks were important. Easier to make the business case and sell it to VP level to get funded. It clarifies the driving factors and provides outside proof that it will save money.
Partial	The incentive program helps in specifying energy efficient equipment. Also, the coordinator helped in answering questions for optimum energy equipment. Also, to help in reducing the cost of the project.
Partial	The incentives helped them to implement the project in 2015. Else they would have replaced it on burnout, perhaps a few years later.
Partial	The key was our Enbridge contact making us aware of the incentives. Then our consultant ***** identified the failed traps and the quantitative savings opportunity. We would have done fewer traps and significantly later without the program's role.
Partial	The program definitely helped us to create the business case. Without Enbridge's help we would not have looked in depth at the ***** project. They helped during the assessment which helped create the business case for the payback. And, they helped direct us to manufacturers to help replace the equipment. The incentives helped us move forward faster on the process of approval. And, the money helped us to do more. And, giving us the incentives gives us a lot of visibility.
Partial	The program has very significant influence on the timing and efficiency of the projects but it promotes the selection of the smaller or easier projects as opposed to larger or more complicated projects.
Partial	The program helps in specifying the equipment. So, the program helps in offsetting some costs for us.
Partial	The program incentives helped us increase the project scope and improve overall ***** efficiency, but did not have much effect on the timing.
Partial	The program was the main driver in the maintenance manager initially becoming a steam trap champion.
Partial	The timing was okay. We got our incentive as soon as we finished the project. So, it gave us incentive to finish it quicker rather than later. We are satisfied with it. We are happy with the program.
Partial	There was a small effect by the program on the timing of installation. The measure would still have been installed, but about 12 months later.
Partial	They had key inputs in helping ***** upsize to bigger more efficient equipment.
Partial	They helped us do the audit every year rather than every three years.
Partial	They raised the profile of the project as they have done for other projects like boilers.
Partial	We would have done one boiler to see how it went otherwise.
Partial	Without the incentive, we would have had to wait until the next year at least.
Partial	Without the program incentives, we may have not done this work as soon or as thorough.
Partial	We would have installed them two years later at a lower efficiency level.
Partial	We would probably have done these piecemeal over time.
Partial	We would still have gone after the same projects because of internal drivers, good business case.
Partial	All or nothing, same upfront costs, let’s not waste time doing half and half again; it may have affected repairs if I didn’t have enough $.
Partial	It influenced the timing, but that's it.
Partial	The program had an influence on the timing due to incentive.
Partial	The program impacted timing and efficiency.
Partial	The program influenced timing, nothing else.
Partial	The program only influenced timing.
Partial	The program rebates influenced the timing, nothing else.
Partial	The insulation before was deteriorating so we had to put it back; with the rebate we could put in something more efficient to capture everything; controls would have done the same efficiency/quantity.
Partial	We would have replaced *measure* with the same *measure* instead of spending $ modifying the piping to install *measure*, but that would only be good for 2-3 years.
None	It was nice to have that money, it wasn’t what pushed it to do it. Aged equipment needed replacement.
None	We were already set on doing this project before we became aware of incentives, so the program did not have an impact on timing or efficiency. Quantity only based on advice of product specialist.
None	Audit service provided by the utility was very helpful. But the incentives did not impact the choice, size, efficiency or timing of the project.
None	Enbridge did not have influence. Rebates were nice to have but not the driving force.

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
None	Enbridge didn't have as much impact on this project as the Toronto Hydro incentive. Enbridge's was an additional incentive that we could go for. But, it was just a bonus. We received a larger incentive from Toronto Hydro. Don't get me wrong. We love the Enbridge program. But, the Toronto Hydro incentive was more influential.
None	Enbridge incentives were good but did not impact the scope or timing of the project.
None	Enbridge reps; they're not at the table; we remember there's money there and we always apply for it because we want to apply it forward; but you’re not even a 5% share; 100% goes back into other projects.
None	Enbridge's incentive on the project didn't have much effect on the timing. It was an expensive project. So, the incentive was a smaller portion of the total cost than with other projects. So , it was nice. But, the project was going to go ahead with or without incentives.
None	Enbridge's support allowed us to make a decision to move ahead quickly. Their technical support helped us make the decision. And, the financial support also helped expedite the decision.
None	I just plan it the year before. I've got a budget. You get a rebate. But, because I have to tell them the year before, I have to tell them about the project. You tell them everything that is going to happen the year before. It makes it easier to do the project because there is an incentive.
None	Incentives helped, but we would have done the project the same without it.
None	Incentives were helpful to get work approved, but we would have done mostly the same since we had it on radar with our internal 5 year energy savings plan.
None	It didn't affect the timing. It didn't affect the scope. It stood on its own merits. So, it was a bonus that we got a rebate check at the end. But, we still would have pursued this anyways.
None	Makes the decision a no brainer i.e. much easier to do.
None	Minimal effect on timing, efficiency, and amount installed for this project, since we had planned to replace this anyways since it was at the end of its expect life.
None	No effect.
None	No impact. We know that there's incentive money coming, but if we have to replace, we just go ahead and do it.
None	None.
None	Not a huge effect.
None	Not much effect, since it needed to happen right away due to failed equipment and since larger ***** Toronto Hydro incentive was the big driver. Still, every piece played a part in overall financing and decision making.
None	Program had no influence on timing, quantity, or efficiency.
None	Program incentives didn't effect timing, efficiency, and amount installed since the leaks needed to be repaired.
None	Rebates were nice but didn't make a difference.
None	Since we knew about the incentives before we started planning, the program might have increased the efficiency level of what we installed. Not sure, though. In terms of timing and what we did, we were doing the whole thing regardless.
None	The Enbridge program was icing on the cake for us. We would still have implemented the program regardless of the Enbridge program. The operational savings and the energy savings had more impact than the incentive and rebate.
None	The owners tend to take rebates into account.
None	The program had no effect on the project, and it would have gone forward at the same time, efficiency level and size absent the program.
None	The program had no effect on this project; it had to be done to address safety issues. No effect on timing, efficiency or size from the program.
None	The program just really didn't have an effect on whether we would do it or not. The timing was good and it made it get approved.
None	There was no impact on this boiler project. It was just another thing to go and get because it was available. The impact on Project 1 was more.
None	These projects were well on their way before they became aware of the rebates.
None	This project had to be done at the time that it was (during shutdown) and the program had no impact on the efficiency level or size dimension. The company would have installed the same technology regardless.
None	This project we would have done otherwise.
None	To get the incentive, audits and repairs have to follow a specified methodology, so it's high as well. The program's existence tightens up our process.

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
None	When we planned to replace the door we knew we had to replace the door. Our general manager said to contact Enbridge to see if there is an incentive that we could get. They came over and looked at our plan. They told us there is an incentive and this is what it is going to be. The Enbridge incentive gave us a boost to do it. It went through faster.
None	We would have done these anyhow.
None	Installation had to happen, rebate was a nice bonus.
None	No influence on timing, quantity, or efficiency.
None	No program influence on timing, quantity, or efficiency.
None	The program did not have any influence on the timing, efficiency or quantity.
None	The program really just was a bonus for us (a surprise because we didn't know Enbridge was going to supply a credit).
None	We would have done the same; it's a pure opportunity for savings; it's a mandate for every project we do, there has to be an energy component.
None	No comment.

RunitRight

This section presents the Enbridge RunitRight self-reported responses from the timing, efficiency and quantity attribution battery where customers were asked "Why do you say that?". These responses along with whether a response received some timing or quantity credit are presented in Table 8-21 and Table 8-22.

A "yes" in the timing or quantity column indicates partial or full attribution for that source based on the scored questions (not the responses here). A "no" indicates no attribution for that source. For example in the first table a "yes" in the timing column indicates that the respondent answered the question DAT1a and DAT1b with responses that credited the program with accelerating the project. A "no" in the timing column indicates that the respondend did not credit the program with accelerating the project. A "no" for timing does not preclude the same respondant indicating the program affected the efficiency or quantity/size of the same project.

Additionally, following the specific timing, efficiency and quantity questions, customers were asked to summarize the program's effect on the timing, efficiency and amount of the project installed (Dat4). These responses are presented in Table 8-23 with the scored level of attribution: full, partial, or none.

None of the responses provided below were used in the direct scoring of surveys. For respondent confidentiality these responses are isolated from other responses from the interview and do not reflect the full story the respondent conveyed. The responses are provided here to provide insight into how customers describe their decision making on the project relative to the program. See APPENDIX J and APPENDIX K for details on how attribution was scored.

Table 8-21: Timing Verbatim Responses for Enbridge RunitRight

Timing	Dat1a_O. Why do you say that?
Yes	We have a strong commitment to energy efficiency so the program's financial incentive helped accelerate the timeline of the gas projects by decreasing their cost and their payback periods.
Yes	Later or never. Some of the work we were aware needed to be done, but incentives allowed us to expedite work. Some things identified may have been overlooked/never done.
Yes	The rebate helped accelerate the project timeline.

Table 8-22: Quantity Verbatim Responses for Enbridge RunitRight

Quantity	Dat3a_O. Why do you say that?
Yes	Our internal efficiency audits are likely not as thorough as Enbridge's report.
Yes	No comment.
No	No comment.

Table 8-23: Dat4 Verbatim Responses for Enbridge RunitRight

Attribution	Dat4. Summarize the program's effect on the timing, efficiency, and amount that you installed.
Full	Helped identify the projects earlier and provided the motivation to act on them earlier.
Partial	Only affected the timing of the projects by helping to make them happen sooner.
Partial	The program helped expedite work and helped us complete a more extensive project overall. Also helped us identify/plan for future capital projects.
Partial	The ***** program accelerated the timeline for the gas projects.
Partial	The program has very significant influence on the timing and efficiency of the projects but it promotes the selection of the smaller or easier projects as opposed to larger or more complicated projects.
Partial	Unsure how program would have affected timing but it didn't affect the extensiveness or size of the projects.

APPENDIX D. GROSS RR RESULTS FOR ADDITIONAL DOMAINS

These results are not applied to calculate savings totals. The results in this section are different aggregations of the data that provide additional information to the programs and stakeholders. In the tables, results with less than 5 completes or absolute precision (+/-) greater than 20% are not shown, but the categories remain in the table to provide context for the results that can be reported.

The final table in each section has the application domain (same domain as in the body of the report) with non-finite population (non-FPC) corrected errors. Non-FPC errors provide a more appropriate estimate of error for projecting future program performance.

Overall ratios in these tables are the sample weighted average and not used in calculating verified gross savings for the programs.

Union Commercial, Industrial and Multi-Family Programs

Table 8-24: Targeted Sample Domain for Union Custom C&I and LIMF programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Overall	**114**	**74**	**98%**	**6%**	**92%**	**105%**	**6%**	**0.33**	**100%**

Table 8-25: Simple vs. Complex Engineering adjustment for Union Custom C&I and LIMF programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Complex	56	42	87%	7%	81%	94%	8%	0.29	67%
Simple	58	39	117%	12%	105%	129%	10%	0.38	33%
Overall	**114**	**74**	**98%**	**6%**	**92%**	**105%**	**6%**	**0.33**	**100%**

Table 8-26: Program and Simple vs. Complex Engineering adjustment for Union Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Complex	42	30	90%	7%	83%	97%	8%	0.26	54%
	Simple	38	25	116%	13%	103%	129%	11%	0.33	27%
Custom Commercial	Complex	11	9	68%	17%	51%	86%	26%	0.41	12%
	Simple	17	12	127%	35%	92%	163%	28%	0.53	5%
Multi-residential	Complex	3	3	124%	2%	122%	126%	2%	0.01	1%
	Simple	3	2	100%	0%	100%	100%	0%	0.00	0%
Overall		**114**	**114**	**98%**	**6%**	**92%**	**105%**	**6%**	**0.33**	**100%**

Table 8-27: Detailed Measures for Union Custom C&I and LIMF programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+ / -	Lower Bound	Upper Bound	Relative Precision		
Hydronic Insulation	9	9	116%	11%	105%	127%	9%	0.15	8%
Heat Recovery	13	10	106%	10%	96%	117%	10%	0.17	20%
Greenhouse	15	9	92%	4%	88%	95%	4%	0.06	29%
Operational Improvements	9	7	90%	10%	80%	99%	11%	0.15	4%
Leak Repair	7	4	130%	32%	98%	162%	25%	0.21	6%
HVAC	10	10	85%	41%	44%	125%	48%	0.83	11%
Steam Trap	9	8	85%	1%	84%	86%	1%	0.02	3%
Other Action	2	1	191%	0%	0%	0%	0%	0.00	3%
Controls	10	9	82%	9%	74%	91%	11%	0.17	5%
Building Shell	8	6	99%	12%	87%	112%	12%	0.15	2%
Other Equipment	16	12	83%	18%	65%	101%	22%	0.42	9%
Other Multi-family	6	5	121%	8%	114%	129%	6%	0.07	1%
Overall	**114**	**74**	**98%**	**6%**	**92%**	**105%**	**6%**	**0.33**	**100%**

Table 8-28: Program and Detailed Measures for Union Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Meas.	Clusts.		+ / -	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Building Shell	8	6	89%	8%	81%	97%	9%	0.11	2%
	Controls	4	4	88%	20%	68%	108%	23%	0.19	2%
	Greenhouse	15	9	97%	3%	94%	100%	3%	0.05	29%
	Heat Recovery	13	10	105%	10%	95%	114%	9%	0.16	20%
	HVAC	5	5	93%	12%	81%	106%	13%	0.14	2%
	Hydronic Insulation	9	9	116%	11%	105%	127%	9%	0.15	8%
	Leak Repair	7	4	121%	30%	92%	151%	24%	0.21	6%
	Operational Improvements	9	7	96%	8%	88%	105%	9%	0.12	4%
	Steam Trap	3	3	100%	1%	99%	101%	1%	0.00	2%
	Other Equipment	7	5	70%	25%	45%	95%	35%	0.37	6%
Custom Commercial	Controls	6	5	98%	4%	93%	102%	4%	0.05	3%
	HVAC	5	5	59%	25%	34%	84%	42%	0.44	9%
	Steam Trap	6	5	99%	3%	97%	102%	3%	0.03	1%
	Other Action	2	1	173%	0%	0%	0%	0%	0.00	3%
	Other Equipment	9	7	90%	11%	79%	101%	12%	0.17	2%
Multi-Family	Other	9	7	90%	11%	79%	101%	12%	0.17	2%
Overall		**114**	**114**	**98%**	**6%**	**92%**	**105%**	**6%**	**0.33**	**100%**

Table 8-29: Applied Domains with non-FPC Errors for Union Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse Equipment	15	9	92%	5%	87%	97%	6%	0.09	29%
	Action	20	12	108%	20%	88%	127%	18%	0.35	12%
	Hydronic Insulation	9	9	116%	15%	101%	131%	13%	0.21	8%
	Other Equipment	36	25	101%	20%	81%	120%	19%	0.57	33%
Custom Commercial and LIMF		34	24	89%	30%	59%	120%	34%	0.98	19%
Overall		**114**	**74**	**99%**	**9%**	**89%**	**108%**	**10%**	**0.49**	**100%**

Union Large Volume

Table 8-30: Simple vs. Complex Engineering adjustment for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Complex	55	24	102%	20%	82%	122%	20%	0.57	49%
Simple	22	15	57%	23%	33%	80%	41%	0.91	51%
Overall	**77**	**36**	**78%**	**20%**	**58%**	**98%**	**26%**	**0.91**	**100%**

Table 8-31: Detailed Measures for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Hydronic Insulation	6	5	99%	2%	97%	100%	2%	0.02	44%
Heat Recovery	13	10	140%	57%	83%	196%	41%	0.70	8%
Operational Improvements	15	10	56%	12%	45%	68%	21%	0.36	19%
Leak Repair	18	11	46%	24%	23%	70%	51%	0.93	7%
Steam Trap	14	9	62%	34%	28%	96%	54%	0.88	4%
Other Action	3	3	96%	28%	67%	124%	30%	0.18	5%
Other Equipment	8	7	122%	109%	13%	232%	89%	1.22	13%
Overall	**77**	**36**	**78%**	**20%**	**58%**	**98%**	**26%**	**0.91**	**100%**

Table 8-32: Applied Domains with non-FPC Errors for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	24	18	116%	36%	80%	152%	31%	0.76	68%
Action	53	18	175%	176%	-1%	350%	101%	2.45	32%
Overall	**77**	**36**	**135%**	**81%**	**54%**	**217%**	**60%**	**2.13**	**100%**

Enbridge Commercial, Industrial and Multi-Residential Programs

Table 8-33: Targeted Sampling Domains for Enbridge Custom C&I and LIMF programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	53	41	100%	3%	97%	103%	3%	0.12	39%
Custom Commercial and LIMF	74	41	91%	14%	78%	105%	15%	0.57	61%
Overall	**127**	**82**	**95%**	**9%**	**86%**	**103%**	**9%**	**0.51**	**100%**

Table 8-34: Simple vs. Complex Engineering adjustment for Enbridge Custom C&I and LIMF programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Complex	64	41	100%	3%	97%	103%	3%	0.12	41%
Simple	63	45	92%	14%	78%	106%	15%	0.61	59%
Overall	**127**	**82**	**95%**	**9%**	**86%**	**103%**	**9%**	**0.51**	**100%**

Table 8-35: Program and Simple vs. Complex Engineering adjustment for Enbridge Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Simple	37	26	100%	4%	96%	104%	4%	0.11	33%
	Complex	16	16	102%	2%	101%	104%	2%	0.04	7%
Custom Commercial	Simple	22	14	82%	27%	56%	109%	33%	0.69	30%
	Complex	14	9	100%	7%	93%	107%	7%	0.11	6%
Multi-residential	Simple	25	15	104%	4%	100%	108%	4%	0.09	22%
	Complex	13	6	99%	2%	97%	101%	2%	0.02	2%
Overall		**127**	**82**	**95%**	**9%**	**86%**	**103%**	**9%**	**0.51**	**100%**

Table 8-36: Detailed Measures for Enbridge Custom C&I and LIMF programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Heat Recovery	13	10	98%	5%	93%	103%	5%	0.09	9%
Etools Boiler	18	12	104%	3%	101%	107%	3%	0.06	25%
Etools Ventilation	16	15	100%	3%	96%	103%	4%	0.08	21%
Steam Trap	21	13	124%	2%	122%	126%	1%	0.03	4%
Etools Boiler Add-on	8	7	101%	15%	86%	116%	15%	0.20	3%
Other Equipment	29	23	74%	27%	47%	101%	37%	1.03	34%
Other Action	3	3	20%	16%	4%	36%	80%	0.47	0%
Other Multi-Residential	19	9	101%	2%	99%	103%	2%	0.03	4%
Overall	**127**	**82**	**95%**	**9%**	**86%**	**103%**	**9%**	**0.51**	**100%**

Table 8-37: Program and Detailed Measures for Enbridge Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Etools Ventilation	4	3	106%	8%	97%	114%	8%	0.05	10%
	Heat Recovery	12	9	99%	5%	94%	104%	5%	0.08	9%
	Steam Trap	8	8	106%	3%	104%	109%	2%	0.04	2%
	Other Action	3	3	32%	25%	8%	57%	76%	0.45	0%
	Other Equipment	25	19	94%	6%	88%	99%	6%	0.15	18%
Custom Commercial	Etools Boiler	3	3	100%	0%	100%	100%	0%	0.00	8%
	Etools Boiler Add-on	8	7	106%	13%	94%	119%	12%	0.16	3%
	Etools Ventilation	8	8	97%	7%	90%	104%	8%	0.11	8%
	Steam Trap	13	5	100%	0%	100%	100%	0%	0.00	2%
	Other Equipment	4	4	52%	70%	-18%	122%	135%	1.15	16%
Multi-residential	Etools Boiler	15	9	107%	4%	103%	110%	3%	0.06	17%
	Etools Ventilation	4	4	93%	11%	82%	104%	12%	0.10	4%
	Other Multi-Residential	19	9	100%	1%	99%	101%	1%	0.02	4%
Overall		**127**	**82**	**95%**	**9%**	**86%**	**103%**	**9%**	**0.51**	**100%**

Table 8-38: Applied Domains with non-FPC Errors for Enbridge Custom C&I and LIMF programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Heat Recovery	13	10	98%	8%	90%	106%	8%	0.14	9%
	Steam Trap	8	8	128%	5%	123%	132%	4%	0.05	2%
	Other	32	25	99%	7%	92%	106%	7%	0.20	28%
Custom Commercial and Multi-residential		74	41	91%	15%	77%	106%	16%	0.61	61%
Overall		**127**	**82**	**95%**	**10%**	**85%**	**104%**	**10%**	**0.55**	**100%**

APPENDIX E. NTG Results for Additional Domains

These results are not applied to calculate savings totals. The results in this section are different aggregations of the data that provide additional information to the programs and stakeholders. In the tables, results with less than 5 completes or absolute precision (+/-) greater than 20% are not shown, but the categories remain in the table to provide context for the results that can be reported.

The final table in each section has the application domain (same domain as in the body of the report) with non-finite population (non-FPC) corrected errors. Non-FPC errors provide a more appropriate estimate of error for projecting future program performance.

Overall ratios in these tables are the sample weighted average and not used in calculating net savings for the programs.

Union Commercial, Industrial and Multi-Family Programs

Table 8-39: Targeted Sample Domain for Union Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	136	84	38%	5%	33%	43%	13%	0.74	82%
Custom Commercial	62	28	43%	11%	32%	54%	26%	0.80	18%
Overall	**198**	**112**	**39%**	**5%**	**34%**	**44%**	**12%**	**0.76**	**100%**

Table 8-40: Net-to-Gross Category for Union Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	147	85	41%	5%	36%	46%	12%	0.67	80%
Action	49	26	35%	12%	22%	47%	35%	1.06	19%
Multi-family	*	*	*	0%	*	*	0%	0.00	1%
Overall	**198**	**112**	**39%**	**5%**	**34%**	**44%**	**12%**	**0.76**	**100%**

Table 8-41: Program and Net-to-Gross Category for Union Custom C&I programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Equipment	107	67	42%	5%	36%	47%	13%	0.64	70%
	Action	29	17	24%	12%	11%	36%	52%	1.23	12%
Custom Commercial	Equipment	40	18	33%	4%	29%	37%	11%	0.27	11%
	Action	*	*	*	21%	*	*	36%	0.58	7%
Multi-family	Multi-family	*	*	*	0%	*	*	0%	0.00	1%
Overall		**198**	**112**	**39%**	**5%**	**34%**	**44%**	**12%**	**0.76**	**100%**

Table 8-42: Detailed Measures for Union Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Hydronic Insulation	12	12	42%	13%	29%	55%	31%	0.60	8%
Heat Recovery	29	21	59%	7%	52%	66%	12%	0.32	20%
Greenhouse	26	17	40%	12%	28%	52%	30%	0.70	29%
Operational Improvements	9	7	10%	9%	1%	19%	85%	1.16	4%
Leak Repair	14	9	37%	16%	21%	52%	42%	0.68	6%
HVAC	21	17	33%	17%	16%	51%	52%	1.23	11%
Steam Trap	14	12	38%	11%	27%	48%	28%	0.55	3%
Other Action	*	*	*	23%	*	*	62%	0.52	3%
Controls	23	13	45%	9%	36%	54%	20%	0.40	5%
Building Shell	*	*	*	20%	*	*	38%	0.66	2%
Other Equipment	28	19	18%	9%	10%	27%	47%	1.17	9%
Other Multi-family	*	*	*	0%	*	*	0%	0.00	1%
Overall	**198**	**112**	**39%**	**5%**	**34%**	**44%**	**12%**	**0.76**	**100%**

Table 8-43: Program and Detailed Measures for Union Custom C&I programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Meas.	Clusts		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse	26	17	40%	12%	28%	52%	30%	0.70	29%
	Heat Recovery	29	21	59%	7%	52%	66%	12%	0.32	20%
	Hydronic Insulation	12	12	42%	13%	29%	55%	31%	0.60	8%
	Leak Repair	14	9	37%	16%	21%	52%	42%	0.68	6%
	Operational Improvements	9	7	10%	9%	1%	19%	85%	1.16	4%
	Building Shell	*	*	*	20%	*	*	38%	0.66	2%
	Controls	7	7	18%	4%	14%	22%	21%	0.29	2%
	Steam Trap	6	6	29%	12%	17%	41%	42%	0.52	2%
	HVAC	*	*	*	21%	*	*	95%	1.64	2%
	Other	10	8	7%	8%	-1%	15%	108%	1.61	6%
Custom Commercial	HVAC	10	7	46%	19%	27%	65%	41%	0.56	9%
	Controls	16	6	78%	5%	74%	83%	6%	0.07	3%
	Steam Trap	8	6	54%	16%	38%	69%	29%	0.35	1%
	Other Action	*	*	*	23%	*	*	62%	0.52	3%
	Other Equipment	18	11	38%	8%	30%	46%	20%	0.37	2%
Multi-Family	Other	*	*	*	0%	*	*	0%	0.00	1%
Overall		**198**	**112**	**39%**	**5%**	**34%**	**44%**	**12%**	**0.76**	**100%**

Table 8-44: Applied Domains with non-FPC Errors for Union Custom C&I programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Greenhouse	26	17	38%	27%	11%	65%	71%	1.68	29%
	Heat Recovery	29	21	58%	17%	41%	74%	29%	0.76	20%
	Leak Repair and Hydronic Insulation	26	21	35%	19%	17%	54%	53%	1.41	14%
	Operational Improvements	9	7	12%	15%	-3%	27%	123%	1.68	4%
	Controls	7	7	19%	8%	11%	26%	41%	0.56	2%
	Steam Trap	6	6	29%	21%	8%	50%	73%	0.89	2%
	Other	33	23	21%	19%	2%	40%	90%	2.51	10%
Custom Commercial	Controls	16	6	78%	39%	39%	117%	50%	0.61	3%
	Other	46	23	42%	32%	10%	75%	76%	2.13	16%
Overall		**198**	**112**	**38%**	**10%**	**28%**	**49%**	**27%**	**1.70**	**100%**

Union Large Volume

Table 8-45: Net-to-Gross Category for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	26	21	5%	2%	3%	7%	37%	0.98	68%
Action	57	20	12%	4%	8%	16%	34%	0.89	32%
Overall	**83**	**41**	**8%**	**2%**	**6%**	**10%**	**27%**	**1.02**	**100%**

Table 8-46: Detailed Measures for Union Large Volume

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Hydronic Insulation	10	7	6%	3%	3%	9%	51%	0.70	44%
Heat Recovery	13	10	7%	5%	2%	11%	70%	1.20	8%
Operational Improvements	20	12	13%	5%	7%	18%	41%	0.79	19%
Leak Repair	14	8	12%	6%	5%	18%	55%	0.82	7%
Steam Trap	17	11	21%	7%	13%	28%	35%	0.65	4%
Other Equipment	6	6	0%	0%	0%	0%	146%	1.77	13%
Other Action	*	*	*	0%	*	*	0%	0.00	5%
Overall	**83**	**41**	**8%**	**2%**	**6%**	**10%**	**27%**	**1.02**	**100%**

Table 8-47: Applied Domains with non-FPC Errors for Union Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Hydronic Insulation	10	7	6%	12%	-7%	18%	217%	2.95	44%
Operational Improvements	20	12	17%	11%	6%	29%	67%	1.28	19%
Heat Recovery	13	10	11%	15%	-5%	26%	144%	2.48	8%
Leak Repair and Other Actions	17	11	7%	9%	-2%	15%	127%	2.33	12%
Steam Trap	17	11	21%	17%	4%	38%	83%	1.52	4%
Other Equipment	6	6	0%	0%	0%	0%	235%	2.86	13%
Overall	**83**	**41**	**11%**	**6%**	**5%**	**17%**	**58%**	**2.21**	**100%**

Enbridge Commercial, Industrial and Multi-Residential Programs

Table 8-48: Targeted Sample Domain for Enbridge Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	60	50	32%	5%	27%	37%	15%	0.65	42%
Custom Commercial	101	62	27%	7%	20%	35%	26%	1.20	58%
Overall	**161**	**112**	**29%**	**4%**	**25%**	**34%**	**15%**	**0.97**	**100%**

Table 8-49: Net-to-Gross Category for Enbridge Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Equipment	102	79	26%	4%	21%	30%	16%	0.87	76%
Action	24	16	25%	13%	12%	37%	51%	1.17	5%
Multi-Residential	35	17	44%	14%	30%	58%	31%	0.74	19%
Overall	**161**	**112**	**29%**	**4%**	**25%**	**34%**	**15%**	**0.97**	**100%**

Table 8-50: Program and Net-to-Gross Category for Enbridge Custom C&I programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Equipment	50	40	33%	5%	28%	38%	15%	0.56	40%
	Action	10	10	*	22%	*	*	96%	1.65	3%
Custom Commercial	Equipment	52	39	17%	7%	10%	24%	40%	1.47	37%
	Action	14	6	27%	5%	22%	33%	19%	0.23	2%
Multi-Residential	Multi-Residential	35	17	44%	14%	30%	58%	31%	0.74	19%
Overall		**161**	**112**	**29%**	**4%**	**25%**	**34%**	**15%**	**0.97**	**100%**

Table 8-51: Detailed Measures for Enbridge Custom C&I programs

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Heat Recovery	13	10	55%	9%	46%	64%	16%	0.27	10%
Etools Ventilation	30	29	12%	5%	7%	17%	43%	1.36	22%
Etools Boiler	24	19	27%	10%	17%	36%	36%	0.90	21%
Steam Trap	24	16	25%	13%	12%	37%	51%	1.17	4%
Etools Boiler Add-on	11	9	14%	4%	10%	18%	29%	0.46	3%
Other Equipment	42	33	28%	7%	21%	35%	25%	0.83	36%
Other Multi-Residential	17	7	97%	3%	94%	100%	3%	0.05	3%
Overall	**161**	**112**	**29%**	**4%**	**25%**	**34%**	**15%**	**0.97**	**100%**

Table 8-52: Program and Detailed Measures for Enbridge Custom C&I programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Etools Ventilation	8	7	15%	10%	5%	25%	70%	0.95	10%
	Heat Recovery	13	10	55%	9%	46%	64%	16%	0.27	10%
	Steam Trap	*	*	*	22%	*	*	96%	1.65	2%
	Other Equipment	29	24	33%	7%	25%	40%	23%	0.65	19%
Custom Commercial	Etools Ventilation	15	15	5%	4%	1%	8%	72%	1.58	8%
	Etools Boiler	13	11	27%	15%	12%	41%	54%	0.99	8%
	Boiler Add-on	11	9	14%	4%	10%	18%	29%	0.46	3%
	Steam Trap	14	6	27%	5%	22%	33%	19%	0.23	2%
	Other	13	9	18%	12%	5%	30%	70%	1.13	17%
Multi-Residential	Etools Boiler	11	8	26%	14%	12%	40%	54%	0.80	13%
	Etools Ventilation	7	7	20%	14%	6%	34%	71%	0.97	3%
	Other	17	7	97%	3%	94%	100%	3%	0.05	3%
Overall		**161**	**112**	**29%**	**4%**	**25%**	**34%**	**15%**	**0.97**	**100%**

Table 8-53: Applied Domains with non-FPC Errors for Enbridge Custom C&I programs

Sector	Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
		Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	Etool Ventilation	8	7	15%	22%	-7%	37%	146%	1.98	10%
	Heat Recovery	13	10	55%	30%	25%	85%	54%	0.93	10%
	Other	39	34	31%	18%	14%	49%	56%	1.95	22%
Custom Commercial	Etool Ventilation	15	15	5%	5%	0%	9%	91%	2.01	8%
	Etool Boiler and Boiler Add-on	25	20	23%	14%	9%	37%	61%	1.57	12%
	Steam Trap	14	6	27%	14%	13%	42%	52%	0.63	2%
	Other	12	8	21%	20%	1%	42%	97%	1.45	16%
Multi-Residential	Etool Boiler	11	8	27%	16%	10%	43%	61%	0.90	13%
	Etool Ventilation	7	7	20%	21%	-2%	41%	108%	1.47	3%
	Other	17	7	97%	4%	93%	101%	4%	0.06	3%
Overall		**161**	**112**	**29%**	**9%**	**21%**	**38%**	**29%**	**1.87**	**100%**

RunitRight

Table 8-54: Net-to-Gross Category for Enbridge RunitRight

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Clusters		+/-	Lower Bound	Upper Bound	Relative Precision		
Action	16	10	50%	14%	36%	64%	27%	0.47	100%
Overall	**16**	**10**	**50%**	**14%**	**36%**	**64%**	**27%**	**0.47**	**100%**

Table 8-55: Applied Domains with non-FPC Errors for Enbridge RunitRight

Domain	n		Ratio	90% Confidence Interval				Error Ratio	% Program Savings
	Measures	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
RunitRight	16	10	50%	20%	30%	70%	39%	0.68	100%

APPENDIX F. SECONDARY ATTRIBUTION Results

These results are not applied to calculate savings totals. This secondary attribution approach is lower rigour than the primary approach and provides a sense of the incremental effect that historical program efforts have on projects today. This score is not intended for application in determining program net savings.

Union Commercial, Industrial and Multi-Family Programs

Table 8-56: Secondary Attribution for Union Custom C&I programs

Sector	Domain	n		Secondary Attr Ratio	Ratio	Ratio Difference	% Program Savings
		Measures	Clusters				
Custom Industrial	Greenhouse	26	17	46%	40%	6%	29%
	Heat Recovery	29	21	61%	59%	2%	20%
	Leak Repair and Hydronic Insulation	26	21	54%	40%	14%	14%
	Operational Improvements	9	7	10%	10%	0%	4%
	Controls	7	7	51%	18%	32%	2%
	Steam Trap	6	6	35%	29%	7%	2%
	Other	33	23	21%	21%	0%	10%
Custom Commercial	Controls	16	6	92%	78%	14%	3%
	Other	46	23	45%	38%	7%	16%
Overall		**198**	**112**	**45%**	**39%**	**6%**	**100%**

Union Large Volume

Table 8-57: Secondary Attribution for Union Large Volume

Domain	n		Secondary Attr Ratio	Ratio	Ratio Difference	% Program Savings
	Measures	Clusters				
Hydronic Insulation	10	7	6%	6%	0%	44%
Operational Improvements	20	12	21%	13%	8%	19%
Heat Recovery	13	10	15%	7%	9%	8%
Steam Trap	17	11	21%	21%	1%	4%
Other Equipment	6	6	1%	0%	1%	13%
Leak Repair and Other Actions	17	11	17%	9%	8%	12%
Overall	**83**	**41**	**12%**	**8%**	**4%**	**100%**

Enbridge Commercial, Industrial and Multi-Residential Programs

Table 8-58: Secondary Attribution for Enbridge Custom C&I programs

Sector	Domain	n		Secondary Attr Ratio	Ratio	Ratio Difference	% Program Savings
		Measures	Clusters				
Custom Industrial	Etools Ventilation	8	7	15%	15%	0%	10%
	Heat Recovery	13	10	61%	55%	6%	10%
	Other	39	34	39%	31%	8%	22%
Custom Commercial	Etools Ventilation	15	15	35%	5%	31%	8%
	Steam Trap	14	6	61%	27%	33%	2%
	Etools Boiler and Boiler Add-on	25	20	27%	24%	3%	12%
	Other	12	8	24%	18%	6%	16%
Multi-Residential	Etools Boiler	11	8	30%	26%	4%	13%
	Etools Ventilation	7	7	60%	20%	41%	3%
	Other	17	7	99%	97%	1%	3%
Overall		**161**	**112**	**39%**	**29%**	**9%**	**100%**

RunitRight

Table 8-59: Secondary Attribution for Enbridge RunitRight

Domain	n		Secondary Attr Ratio	Ratio	Ratio Difference	% Program Savings
	Measures	Clusters				
RunitRight	16	10	60%	50%	10%	100%
Overall	**16**	**10**	**60%**	**50%**	**10%**	**100%**

APPENDIX G. VENDOR ATTRIBUTION

The NTG ratio includes two components, a participant score and a vendor score. APPENDIX K provides details of how vendor interviews are triggered and how vendor scores are used.

Union Commercial, Industrial and Multi-Family Programs

Table 8-60 shows that of the 51 measures that we attempted to contact the vendor, we completed 24 via 14 vendor interviews.

Table 8-60: Vendor Interviews for Union Custom C&I programs

Vendor Involvement	Attribution	Customers		Measures		Percent Savings
		N	n	N	n	
Vendor not involved in decision		38	N/A	85	N/A	48%
Vendor not important		11		26		16%
Vendor important	100% Direct Attribution	18		36		14%
	<100% Direct Attribution	31	14	51	24	23%
Total		**98**	**14**	**198**	**24**	**100%**

Table 8-61 shows a comparison of attribution with and without vendors. The table shows that vendor scores increased attribution by 3% overall, with the greatest effect being a 12% increased for controls.

Table 8-61: Attribution with and without Vendors for Union Commercial, Industrial and Multi-Family Programs

Sector	Domain	n		Ratio with Vendor	Ratio without Vendor	Ratio Difference	% Program Savings
		Measures	Clusters				
Custom Industrial	Greenhouse	26	17	40%	40%	0%	29%
	Heat Recovery	29	21	59%	59%	0%	20%
	Leak Repair and Hydronic Insulation	26	21	40%	36%	4%	14%
	Operational Improvements	9	7	10%	6%	4%	4%
	Controls	7	7	18%	6%	12%	2%
	Steam Trap	6	6	29%	27%	2%	2%
	Other	33	23	21%	18%	3%	10%
Custom Commercial	Controls	16	6	78%	78%	0%	3%
	Other	46	23	38%	31%	7%	16%
Overall		**198**	**112**	**39%**	**36%**	**3%**	**100%**

Union Large Volume

Table 8-62 shows that we attempted to contact five vendors and were only able to complete one.

Table 8-62: Vendor Interviews for Union Large Volume

Vendor Involvement	Attribution	Customers	
		N	n
Vendor not involved in decision		16	N/A
Vendor not important		2	
Vendor important	100% Direct Attribution	11	
	<100% Direct Attribution	5	1
Total		**34**	**1**

For confidentiality reasons, the number of measures and percent of savings cannot be reported for this program.

Table 8-63 shows that vendor attribution did not increase overall attribution for this program.

Table 8-63: Attribution with and without Vendors for Union Large Volume

Domain	n		Ratio with Vendor	Ratio without Vendor	Ratio Difference	% Program Savings
	Measures	Clusters				
Hydronic Insulation	10	7	6%	6%	0%	44%
Operational Improvements	20	12	13%	13%	0%	19%
Leak Repair and Other Actions	17	11	9%	9%	0%	12%
Heat Recovery	13	10	7%	7%	0%	8%
Steam Trap	17	11	21%	21%	0%	4%
Other Equipment	6	6	0.1%	0.1%	0%	13%
Overall	**83**	**41**	**8%**	**8%**	**0%**	**100%**

Enbridge Commercial, Industrial and Multi-Residential Programs

Table 8-64 shows that of the 49 measures that we attempted to contact the vendor, we completed 23 via 19 vendor interviews.

Table 8-64: Vendor Interviews for Enbridge Custom C&I programs

Vendor Involvement	Attribution	Customers		Measures		Percent Savings
		N	n	N	n	
Vendor not involved in decision		27	N/A	50	N/A	31%
Vendor not important		6		9		9%
Vendor important	100% Direct Attribution	29		54		30%
	<100% Direct Attribution	37	19	49	23	30%
Total		**99**	**19**	**162**	**23**	**100%**

Table 8-65 shows that vendor attribution increased overall program attribution by 2%. The greatest increases were for Multi-residential boilers and ventilation.

Table 8-65: Attribution with and without Vendors for Enbridge Custom C&I programs

Sector	Domain	n		Ratio with Vendor	Ratio without Vendor	Ratio Difference	% Program Savings
		Measures	Clusters				
Custom Industrial	Etools Ventilation	8	7	15%	15%	0%	10%
	Heat Recovery	13	10	55%	55%	0%	10%
	Other	39	34	31%	30%	1%	22%
Custom Commercial	Etools Ventilation	15	15	5%	5%	0%	8%
	Steam Trap	14	6	27%	27%	0%	2%
	Etools Boiler and Boiler Add-on	25	20	24%	22%	2%	12%
	Other	12	8	18%	16%	2%	16%
Multi-Residential	Etools Boiler	11	8	26%	19%	7%	13%
	Etools Ventilation	7	7	20%	11%	8%	3%
	Other	17	7	97%	97%	0%	3%
Overall		**161**	**112**	**29%**	**28%**	**2%**	**100%**

RunitRight

Table 8-66 shows that we attempted to contact two vendors and were only able to complete one.

Table 8-66: Vendor Interviews for Enbridge RunitRight

Vendor Involvement	Attribution	Customers	
		N	n
Vendor not involved in decision		3	N/A
Vendor not important		1	
Vendor important	100% Direct Attribution	1	
	<100% Direct Attribution	2	1
Total		**7**	**1**

For confidentiality reasons, the number of measures and percent of savings cannot be reported for this program.

Table 8-67 shows that vendor attribution did not increase overall attribution for this program.

Table 8-67: Attribution with and without Vendors for Enbridge RunitRight

Domain	n		Ratio with Vendor	Ratio without Vendor	Ratio Difference	% Program Savings
	Measures	Clusters				
RunitRight	16	10	50%	50%	0%	100%
Overall	**16**	**10**	**50%**	**50%**	**0%**	**100%**

APPENDIX H. MAPPING OF REPORTING DOMAINS TO TRACKING CATEGORIES

A map of reporting domains to tracking database records and categorization will be provided to each utility in Excel format to facilitate adding the ratio results to their internal data.

APPENDIX I. SAMPLING PROCESS

This appendix provides detail on the:

- High-level process used in sampling
- exploration of tracking data
- definition of the unit of analysis
- stratification decisions
- 2015 FR and CPSV sample design
- 2013/14 Spillover Sample design
- Sample and backup sample selection

High-level process

A sample is a collection of data items such as those collected through surveys, metering or on-site observation. A sample design is required when a sample does not include the entire target population. Most sample designs are driven by cost constraints (including schedule constraints), desired precision or both. The sampling process described here ensures that all bases are covered, ensuring optimal precision around estimates of interest for the data collected. The process we followed is detailed below. All numbers and observations and goals described were operating assumptions used at the beginning of the process:

1. **Identify Goals, Methods and Constraints**: for sampling, the goals consist of identifying the primary and secondary estimates of interest: what quantitative results are most important. Defining the data collection methodology –the process used to gather the data for the analysis – and the estimation method – the approach used to calculate the primary estimate of interest – is critical for defining elements of the design. Cost and schedule constraints surrounding the data collection and analysis then determine an upper bound for the sample size.
   - **Goals**: For this study the primary estimate of interest is the NTG ratio for each program. The NTG ratio is the parameter that we are targeting for 90/10 precision for each program.

     As will be described later in the methodology memo, we calculate the NTG ratio as

     NTG = (1-FR)*(1+SO).

     Since spillover tends to be small, this formulation is mathematically very close to the simpler formula indicated in the recent Ontario evaluations

     NTG = 1-FR + SO.

     We prefer the multiplicative formula as a more complete expression of the relationship between free ridership and spillover.

     Previous work in Ontario indicates that free ridership is on the order of 10% to 60% across program segments, 50% overall on a savings-weighted basis. Spillover is on the order of 5%. Because spillover is generally small, the precision of the full NTG will in most cases be close to that of the net-of-free rider factor, even with a modest spillover sample size.
   - **Methods and Constraints:** We are using two data collection methods, each of which have different costs associated. Due to cost constraints we must limit our use of on-sites to those projects where it

will make the most difference in the estimate. These will be deployed on the largest and most complex projects as identified based on tracking data descriptions. TSERs will be used to collect the balance of the data that we do not have the funds to collect with On-sites. For smaller and simpler projects where the decisions made are more straight forward, TSER verification provides accurate data at a reasonable cost.

Define the unit of analysis: The unit of analysis is the level at which final estimates will be made. Some studies have multiple units of analysis: process evaluation results may be based on respondent level estimates, while impact evaluation results may be based on measure or project level estimates. Sampling units do not need to be the same as the unit of analysis, but identifying both early is crucial.

We are using the same definition for our sampling unit. Most customers have no more than three projects in a given year, and most projects are of only one or two measure types, so that we will be able to inquire about all of these in a single survey or interview of reasonable length.

We plan to ask each sampled customer about attribution for all of the customer's measures. Only a handful of customers have more than three (unit of analysis level) measures in 2016, with a maximum of six.

For customers with large numbers of projects and measures, we will ask about groups of measures or projects. The groupings will depend on details of the types of measures and savings magnitudes.

Identify the target population: The target population is the universe of items that inferences and estimates are desired for. In the initial scope of the NTG study, the primary target population was defined as future programs of the same type. Having future program years as the target population has two implications for the sample design. First, the applicable error associated with our estimates is the non-finite population corrected error (described in our discussion of sample size below) which requires larger sample sizes for a given precision. Second, analysis by sub-domains such as measure types within the programs becomes more important. The measure mix in programs changes from year to year and typically NTG varies more across measure types than within. For more accurate estimates of net savings for future program years, applying measure type NTG ratios will be preferred to program as a whole NTG ratios. At this time the question of prospective vs. retrospective application of NTG results is unresolved. The final sample design is expected to result in precision levels sufficient for either application of the results.

Establish the Sample Frame: The sample frame refers to the list or mechanism from which the sample is drawn. A perfect frame will match the target population exactly.

Since the target populations of this study are the future programs, we will not have a perfect sample frame; however, if the program designs remain relatively stable, using past program participants as the sample frame will provide a good list from which to draw our sample.

Determine sample size: Sample size refers to the number of items that are selected from the sample frame in order to draw inferences and create estimates about the target population. In stratified designs, sample sizes are determined for each stratum.

Critical to the sample size determination is the error ratio for each sampling cell with respect to the ratio to the estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean. Our experience with conducting similar NTG studies of commercial-industrial customers is that the error ratio for the free rider rate is between 0.7 and 0.8 within reasonably defined sampling cells.

In determining these sample sizes, the number of customers in the full population is also important for two reasons. First, if we are trying to estimate a parameter for a finite population, the sample size required is reduced by the Finite Population Correction or FPC. Second, we need to consider the number of completed surveys we can realistically complete given likely response rates.

Use of the FPC is appropriate when the parameter of interest represents a particular population. This situation applies when we are determining the free ridership factor or spillover rate for a particular program and time frame. When we determine these factors for all future theoretical projects, it is arguably more appropriate to treat the sample drawn from recent participants as coming from an essentially infinite population. Thus, for projection to future years we generally recommend against applying the FPC.

Stratification: Stratification is the partitioning of a target population. Stratification is discussed in depth in the sample design section in the body of the Scope of Work.

Sample Selection: Sample selection refers to the process of obtaining the sample of units from the sample frame. If all units on the sample frame are selected then the design is referred to as a census or certainty sample. Otherwise units may be selected either randomly or non-randomly, depending on the evaluation goals, constraints and amount of acceptable bias. The sample selection process is a critical feature of the sample design and has a direct impact on the expected precision and bias of estimates. The optimal sample selection process for a particular project can vary greatly.

Unit and Item non-response Unit and item nonresponse are potential sources of bias, depending on the nonresponse mechanism and the level of nonresponse encountered. Unit nonresponse refers to the absence of information from an entire sampled unit. Item nonresponse refers to the situation where some data are collected, but not all, from a sampled unit. The nonresponse mechanism refers to the process that is causing the nonresponse. If the probability of responding depends on the data items being sought then the nonresponse mechanism is said to be non-ignorable. Otherwise it is called an ignorable nonresponse mechanism. Nonresponse bias tends to be greater when the nonresponse mechanism is non-ignorable and as levels of item nonresponse increase.

There are various ways to address nonresponse in a sample. For example, weight adjustments are often used to account for unit nonresponse and item imputation techniques are often used to account for item nonresponse.

If nonresponse levels are low and the response mechanism is thought to be ignorable then one could ignore nonresponse and simply create estimates among the respondents.

We recommend treating unit nonresponse as ignorable for this study since it does not depend on the data items being sought. Instead, it depends on the willingness of the decision maker at the participating business agreeing to respond to the survey.

For item nonresponse in the scored portion of the surveys we recommend treating the nonresponse as non-ignorable if all three of the T, E, Q portions of the free ridership sequence contain non-response. Otherwise we plan to treat the item nonresponse as ignorable and will impute the average response for the missing item from among scored units of the same measure type and utility. The exception to this rule is when we find conflicting responses in our QC of the data collection that indicates the nonresponse is non-ignorable. For non-ignorable item nonresponse we will drop the unit from the analysis.

Expansion Sample expansion refers to the process of extrapolating results from a sample back to the target population of interest. Often times this is done using a sample weight. The weight is a numeric quantity associated with each responding unit and conceptually represents the amount of the target population the responding unit represents during the analysis. The sample weight is some function of the total number of units on the sample frame.

The sample weight for our analysis will be built from the inverse probability of selection, incorporating additional adjustment factors to account for nonresponse and coverage errors. The sample weight will be utilized along with the "size" of the unit (energy savings) to expand results using ratio estimation, as described in the ratio estimation appendix of this work plan.

Domains of interest: Often times, estimates for an entire target population are of interest, but so are estimates for various subgroups. Subgroups may or may not overlap. Identifying the population domains of interest is another critically important design feature because it affects the decisions being made about other design features, such as the desired sample size, stratification variables and primary and secondary estimates of interest.

Explore the tracking data

We explored the tracking data provided by Union and Enbridge to determine data availability, the number and types of measures installed, and the size and quantity of projects. We explored the Union and Enbridge datasets separately.

Enbridge custom participant data

The custom program participant data files provided by Enbridge included custom C&I energy efficiency projects claimed during the 2013-2015 program years and custom Low Income Multi-Family projects claimed in 2015 (Table 8-68). The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. There are 124 accounts that appear in both the 2015 program year and the 2013/14 program years.

Table 8-68. Enbridge Custom C&I and Multi-Residential program participation metrics by year

Program Year	Accounts	Gas Savings (m^3)
2013	680	53,030,333
2014	573	46,195,015
2015	706	51,330,067

The Enbridge custom project tracking data includes measure level savings specific to a measure, site and date. As part of defining the unit of analysis, we used the tracking data variables *Market Type*, *load type name*, *end use*, and *technology* to categorize measures into measure types that would be meaningful for data collection and expansion, shown in Table 8-69.

Table 8-69. Enbridge participation metrics by measure, 2013-2015

Measure Type	2013-2014 (SO)		2015 (CPSV/FR)	
	Accounts	Gas Savings (m^3)	Accounts	Gas Savings (m^3)
HVAC	636	32,807,840	380	19,105,965
Controls	337	17,821,495	175	13,868,059
Other Equipment	121	25,151,192	10	2,153,339
Operational Improvements	119	9,672,787	55	7,811,661
Heat Recovery	16	1,092,519	29	4,398,419
Steam and Hot Water	175	3,376,999	86	1,825,048
Process Heat	14	4,786,413	3	73,078
Building Shell	38	1,833,941	89	1,794,104
Greenhouse	10	2,682,162	3	300,394

Enbridge RunitRight participation data

For RunitRight, the program tracking data includes projects claimed in the 2014-2015 program years. These projects were all completed in 2013-2014; savings for a project in the program do not get claimed until after one year of site metering is complete.

Table 8-70. Enbridge RunitRight program participation metrics by year claimed

Program Year	Accounts	Gas Savings (m^3)
2014	45	625,088
2015	28	542,442

The RunitRight program has only one measure type. It also has several projects with negative savings. Negative savings (increases in energy use) are possible results from retro-commissioning projects, sometimes due to calculation method (billing analysis based savings without weather, occupancy adjustment or production adjustment) or due to actual increases in energy use. Negative saving measures need to be handled carefully in ratio estimation: high FR on large negative savings projects can result in overall program FR <0, which is not a valid result.[26] Our recommended approach to the problem is to produce and apply ratios with separate domains for positive and negative savings projects.

Union custom participant data

The participant data files provided by Union included energy efficiency projects claimed during the 2013-2015 program years. The records in the tracking data are per installed measure, so there may be multiple rows per project if more than one measure is installed, and there may also be more than one project per account. There are 67 accounts that appear in both the 2015 program year and the 2013/14 program years.

[26] Free ridership on negative savings results in more program savings, rather than less.

Table 8-71. Union participation metrics by year

Program Year	Accounts	Gas Savings (m^3)
2013	352	369,438,742
2014	392	285,752,549
2015	462	201,620,726

We used the *project type*, *equipment type*, and *project category* variables in the tracking data to categorize measures. Our first step was to distill the combined information from the three fields into measure types that would be meaningful for data collection and expansion, shown in Table 8-72. The largest measure types (by cumulative savings) were maintenance, steam and hot water, and optimization.

Table 8-72. Union participation metrics by measure, 2013-2015

Measure Type	2013-2014		2015	
	Accounts	Gas Savings (m^3)	Accounts	Gas Savings (m^3)
Maintenance	222	255,847,232	79	37,181,863
Steam and Hot Water	161	119,657,223	91	39,229,635
Optimization	91	94,790,733	28	16,936,421
Ag and Greenhouse	149	64,895,560	73	31,875,980
Heat Recovery	86	38,174,741	52	19,797,904
Other Equipment	56	27,104,377	13	20,653,141
Controls	78	16,785,704	128	13,267,526
HVAC	48	14,885,291	49	8,829,742
Process Heat	25	13,242,538	10	4,536,172
Building Shell	152	5,599,318	68	3,597,883
New Construction	19	3,714,489	5	4,589,777
Cogeneration	4	494,085	1	1,124,682

Define the unit of analysis

Following data exploration, we defined the unit of analysis, which established the level at which data will be analyzed but not the level at which it will be collected, which is the sampling unit. We further discuss this distinction and how the sampling unit is defined in the Task 2.5 section.

The definition of the unit of analysis is one of the most important and least discussed aspects of DSM program evaluation. Consider the following four dimensions: end -use, measure type, equipment or "action," and calculation approach. The program tracking databases include the first three dimensions and do not have an identifier for the fourth (though there may be a way to proxy it). Our example assumes that calculation type can be defined at a high level with reasonable accuracy based on existing database fields for the 2015 program year. Table 8-73 shows six measures performed at a site in a year through a program. Each of these categories could be considered a possible unit of analysis.

Table 8-73: Example dimensions used to define a unit of analysis

Measure ID	Enduse	Measure Type	Equipment or Action	Calc Type
M1	Process Heat	Boiler	Action	Complex
M2	Process Heat	Boiler	Equipment	Complex
M3	Space Heat	Boiler	Action	Simple
M4	Space Heat	Boiler	Equipment	Simple
M5	Space Heat	Furnace	Action	Simple
M6	Space Heat	Furnace	Equipment	Simple

- **The end use** can be important in decision making because lowering the cost per unit produced is a different decision than lowering the cost of heating a facility or office, for example. It can also be used as a proxy for the complexity of the calculation, as process-related end uses tend to have more complex and site-specific calculation approaches. End use can be used in surveys by listing the measure types that fall into the category; however, this is not ideal for NTG as the program's influence on decision making may differ by measure type, affecting the attribution response.
- **Measure type** is important for surveys to aid participant recall by providing a concrete, simple description of what equipment was altered or installed. This aggregation is less appropriate for CPSV where the calculation method may differ.
- **Equipment or Action** is a very important distinction for NTG. Continuous improvement actions, such as maintenance, operations, and optimization, have fewer barriers to implementation than equipment purchases due to lower total cost, shorter term planning horizons and often fewer approvals. Businesses typically have separate budgets for capital and operating expenses. Purchases of new or replacement equipment falls under a capital budget, while actions are usually part of the operating budget or performed by salaried employees. Capital budgets typically have long term planning and allocation, while an operating budget is by nature more flexible to conditions in a given year. The ability of programs to affect equipment and action decision making is necessarily different as well. For the unit of analysis, actions were put into three categories: maintenance, operational improvement, and optimization.
- **Calculation type** is important for CPSV. Simple, commonly implemented measures in custom programs do not require the same depth of data collection to verify calculations and inputs as more complex measures. Simple measures also use standardized calculation approaches that reduce variance. Evaluators tend to find fewer adjustments and, even when adjustments are found, the adjustment often affects all measures of a calculation approach similarly.

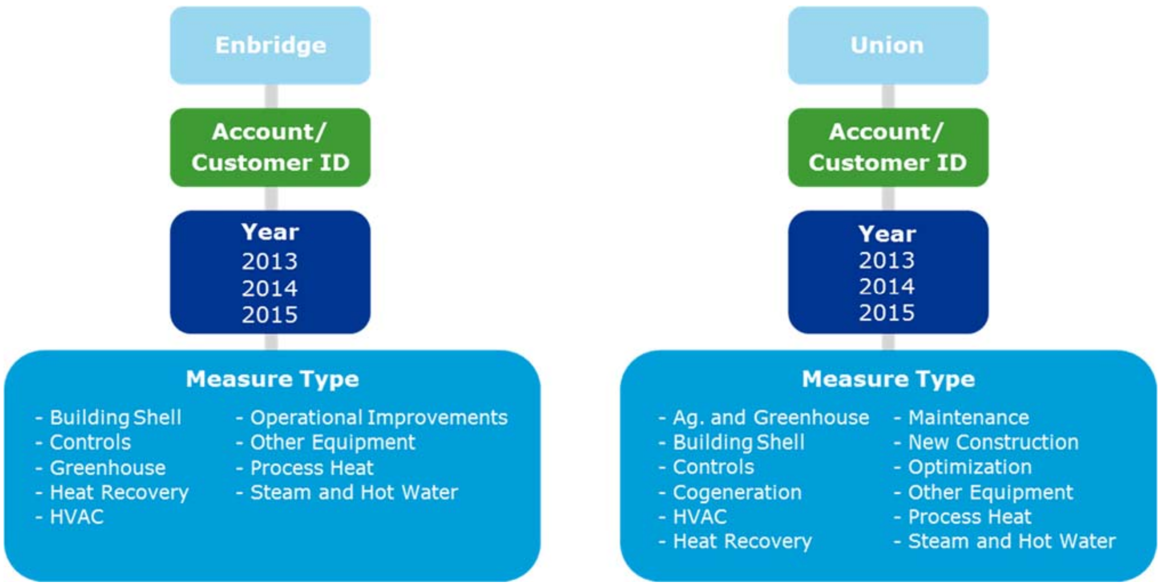
In the example shown in Table 8-73, aggregating across any of the four listed dimensions is a trade-off of accuracy for increased precision, reduced customer burden and reduced evaluation costs. Not aggregating makes the same trade-off, but in reverse.

We aggregated across elements that are likely to have a lesser effect on decision making (such as type of insulation) and did not aggregate across distinctions that are likely to play a larger role in how decisions were made (such as process vs space heat).

The unit of analysis for the evaluation, presented in Figure 8-1, aggregates the data to the utility, account, year, and measure type. For Union, aggregating the tracking data to the unit of analysis reduced the number of records from 744 to 597 records for 2015 and from 1,468 to 1,091 records for 2013 to 2014. For

Enbridge, the number of records for 2015 decreased from 955 to 858 records and for 2013 to 2014 decreased from 1,648 to 1,511 records.

Figure 8-1: Unit of analysis



For this evaluation, the unit of analysis and the sampling units are defined differently. While a unit of analysis separates units of different accounts/sites, program years or measure types, the sampling unit is specific to the customer. As an example, one Enbridge customer may have installed a new boiler in 2013 and insulation in 2014, which is two different units of analysis. Since they were installed by the same customer, however, they belong to one sampling unit. In the analysis phase, weights will be developed for each unit of analysis (account-measure type-year), but for the standard error calculation, data collected from a single customer (sample unit) will be a treated as a cluster rather than evaluated as if they are independent observations.

Once aggregated to the unit of analysis, Union had an average of 1.5 units of analysis per account in 2013 and 2014 and 1.3 units per account in 2015[27] while Enbridge has an average of 1.2 units per account in 2013, 2014, and in 2015. In general, Union accounts tended to have more units of analysis per account than Enbridge accounts. Only 26 Union accounts have 5 units and none had more than 5. For Enbridge, 9 accounts have 4 units and no accounts have more than 4. This will facilitate data collection, since it's reasonable to ask about 3-4 units.

At this time we are unable to comment on the number of units per customer, because some customers will likely have multiple accounts. Customers will be defined by their contact information which will be requested along with the documentation request following submission of the scope of work.

[27] We are assuming a 1:1 account to customer ratio for sampling. For the analysis, customer will be defined by contact information (phone number primarily), which is not included in the provided tracking data.

Stratify the NTG and CPSV data

There is a balance between having too many and too few strata.[28] In sample designs, more strata allow the design to control representativeness and estimated precision along more dimensions. Having more strata does not hurt overall precision, but it can increase the sample sizes required. Each stratification level serves to improve efficiency, improve representativeness, or both.

There are four populations across which the evaluation findings will be completely separate from one another.[29] These populations are defined by having separate program designs. The divisions between these populations are hard lines; none of the reported ratio results will include a mix of information across these populations. We can think of this as four evaluations using a common methodology and data collection effort:

- Union Large Volume
- Union Custom C&I
- Enbridge Custom C&I
- Enbridge RunitRight

Within the stratification segments (see **Figure** 8-2 and Figure 8-3) we categorize measures to improve the efficiency and representativeness of the sample. [30] The stratification for the 2015 data collection effort balances the needs of two studies, with the CPSV sample a subset of the NTG sample. Each has differing measure categorization priorities. [31]

- For NTG the measure categorization most predictive of free ridership rates is whether the project is installation of efficient equipment or whether the project was an action taken with existing equipment, regardless of whether that action is maintenance or an optimization that leads to energy savings.
- For CPSV the measure categorization most predictive of verification rates is a simple calculation versus one that is complex. Simple projects that follow consistent approaches and vary less from site to site typically have verification rates with lower variance than more complex projects that require more site-specific knowledge and truly custom calculations. Stratifying by rigour allows us to assign a lower ER (0.3) to the simple project strata and higher to the more complex strata (0.4 ER) which provides better sample allocation. Simple strata projects will receive a TSER verification, while complex strata projects will receive an on-site verification.

The final stratification level segments projects by the magnitude of energy savings resulting from that project. Large projects represent a greater portion of the population, so sampling them at increased rates will result in greater precision with fewer verification visits or calls. Smaller projects must also be sampled to ensure representativeness. DNV GL used cumulative savings as a measure of size for the 2015 sample designs and annual savings as a measure of size for 2013/14 sample designs. Cumulative savings were not

[28] DNV GL agrees with the approaches described in "Sampling Methodology for Custom C&I Programs" which was prepared by Navigant for the TEC in 2012 and used to inform previous CPSV sample designs. Our sample design approach is consistent with the approaches recommended and follows the recommended seven step process (pages 17-23).
Dan Violette, Ph.D. & Brad Rogers, M.S., MBA, Navigant Consulting, Inc. "A Sampling Methodology for Custom C&I Programs," Prepared for: Sub-Committee of the Technical Evaluation Committee. November 12, 2012 (Revised October 28, 2014).

[29] For the CPSV, LI MF will be reported with MR MF either together with Custom C&I or as a separate Multi-Family domain, depending on final sample sizes and precisions.

[30] Page 14 in the Navigant report provides an explanation of the rationale for stratification.

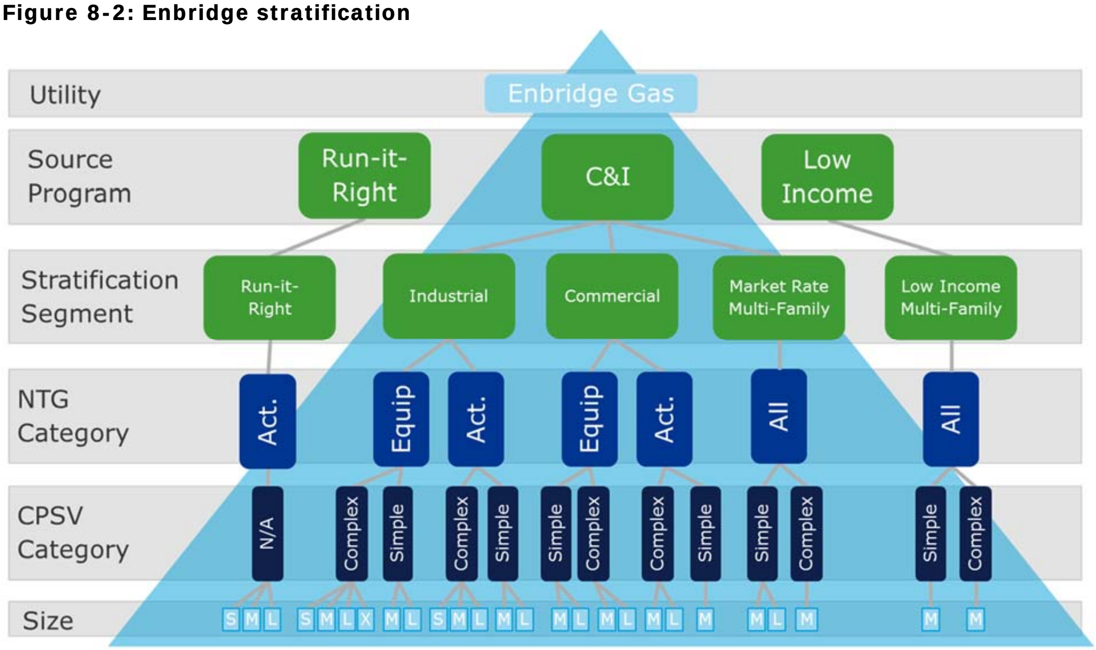
[31] The current stratification plan has more aggregated program segment categories than were described in the original proposal. When developing the proposal sample design, we did not have access to the data or savings amounts specific to measure types.

provided for 2013/14.[32] In terms of sample allocation, using annual savings will select longer life measures at a lower rate than would occur if cumulative savings are used.

It is important to note that the stratification used for sampling and expansion does not need to correspond directly to the level of reporting. For example, while we have chosen to use broad categories of customer segments in our stratification, this does not preclude reporting by more disaggregate customer segments.

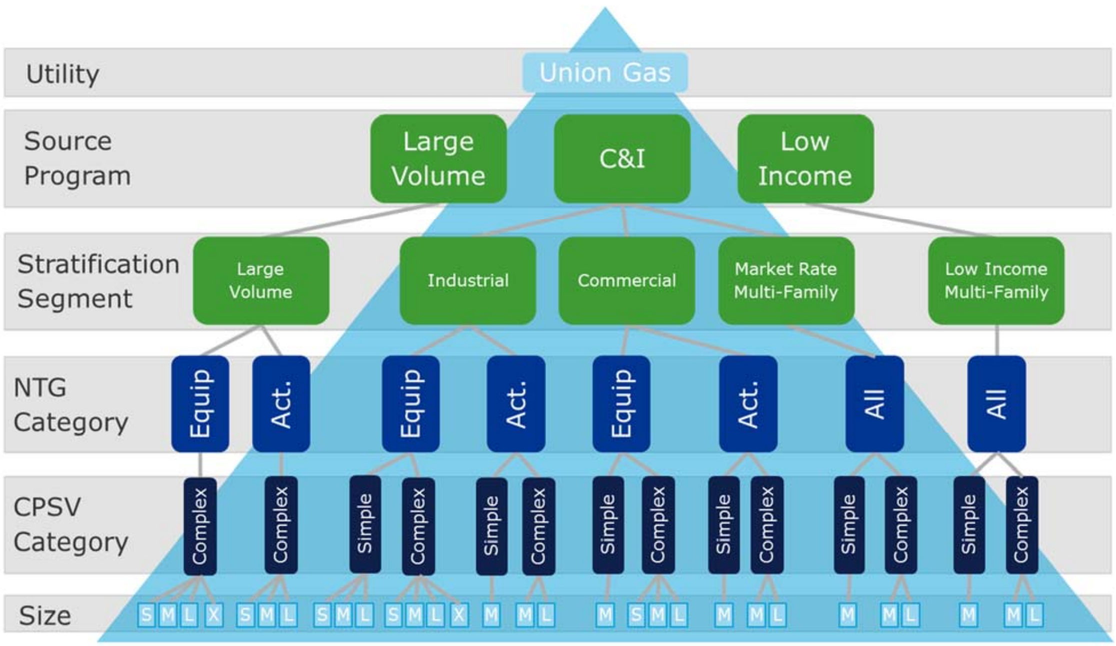
Figure 8-2 and Figure 8-3 show the CPSV and NTG stratification for Enbridge and Union respectively.

Figure 8-2: Enbridge stratification



[32] The August 4, 2016 data provided by Enbridge included cumulative savings for 2015, but not 2013 and 2014.

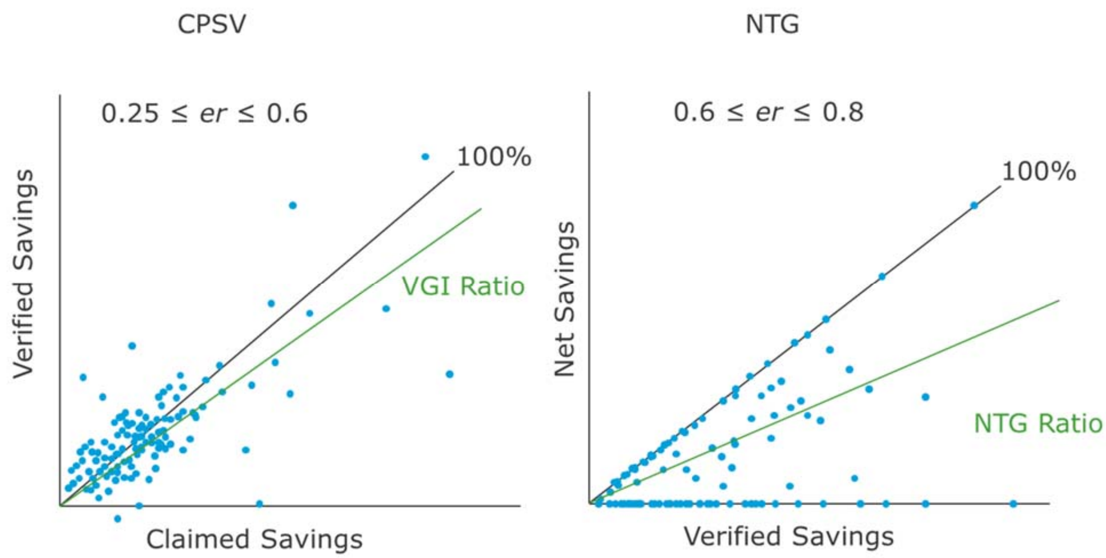
Figure 8-3: Union stratification



Design the 2015 samples

Critical to the sample size determination is the error ratio for each sampling cell with respect to the ratio to be estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean. Free ridership is measured as a percentage between 0 and 100%, with clustering of responses on the extremes. The clustering of responses at 0 and 100% means that the error ratio for NTG studies is generally higher than that for engineering verification, where most of the estimates cluster reasonably close to the tracking savings estimates. Figure 27 shows the expected clustering of results for the two study types.

Figure 8-4: Error ratio example-plots



Our experience with conducting similar studies of commercial-industrial customers is that the error ratio for NTG factors is between 0.6 and 0.8 within reasonably defined sampling cells. SO typically has an error ratio higher than that of FR. Our sample design assumes an ER of 0.6 for FR and 0.8 for SO.

Including the Equipment vs. Action level of stratification allows us to use a 0.6 ER assumption for FR, rather than the 0.7 ER assumption that we would use without.

The CPSV sample of the 2015 program year will target a subset of sites selected for the FR portion of the study. CPSV error ratios are typically lower than those for FR. We are using error ratios ranging from 0.3 to 0.4 for the CPSV portion of the study. Including a stratification level based on assumed complexity allows us to vary these ERs to better allocate our sample. Specifically, we used an error ratio of 0.4 for "complex" Commercial and Industrial strata, 0.35 for "complex" Multi-Family strata, and 0.3 for the less complex TSER strata.

The error ratios for CPSV are based on previous CPSV efforts for the utilities that have achieved or come close to achieving 90/10 precision at the program level using an error ratio assumption of 0.35. Using an error ratio from a study performed by a different firm working for different clients (even though they are the same programs) is a risk. We are mitigating this risk by using a unit of analysis smaller than site-level in our sample design, but collecting data on all projects at the site from the same program year. This approach provides an additional margin of error for the evaluation by collecting more data than is projected by the sample design approach.[33] The cost of the additional data collection is low since engineers will already be on the phone or on-site with the customer.

[33] Sampling at the sub-site level allows us to use measure characteristics more effectively in sampling and expansion. Over-collected data (units of analysis that were not selected randomly) will be given a weight of one (representing themselves alone) to ensure the final results are not biased by collecting additional data from multiple measure sites.

2015 Enbridge stratification

The 2015 Enbridge stratification is presented in **Figure** 8-2. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total, there are 26 Strata.

Table 8-74 shows the 2015 Enbridge sample design in table form with the expected relative precisions and sample for targeted programs shown for each portion of the study. Data collection for FR will be completed through IDI, while the CPSV group indicates strata that will have on-site data collection (complex) or TSER (simple) for gross savings verification.

Table 8-74: 2015 Enbridge CPSV and FR sample design

				Sample Frame		FR Sample Design		CPSV Sample Design	
Stratification Segment	**NTG Group**	**CPSV Group**	**Size Strata**	**N**	**m3**	**n**	**Rel. Prec.**	**n**	**Rel. Prec.**
Industrial	Action	Complex	3	13	18,898,127	8	**10%**	7	**10%**
		Simple	2	8	4,964,165	4		4	
	Equipment	Complex	4	70	276,569,945	24		15	
		Simple	2	25	43,925,065	6		6	
Commercial	Action	Complex	2	3	10,988,780	3	**10%**	3	**10%**
		Simple	1	24	3,875,430	4		4	
	Equipment	Complex	3	59	61,573,901	22		9	
		Simple	2	293	236,656,958	34		10	
Market Rate Multi-Family	All	Complex	1	53	23,584,650	8		5	
		Simple	2	175	129,568,929	19		8	
Low Income	All	Complex	1	6	5,125,020	0	**N/A**	2	
		Simple	1	104	58,676,555	0		6	
RunitRight	Optimization	IDI	3	28	2,712,210	17	**10%**	0	**N/A**
Total				**861**		**149**		**79**	

Table 8-75 shows the anticipated relative precisions for less aggregated program segments. We expect that the final relative precisions will be close to 90/10 for these segments as well as the targeted programs above.

Table 8-75: Enbridge expected precisions by program segment

Stratification Segment	Sample Frame		NTG		CPSV	
	N	Savings	n	Relative Precision	n	Relative Precision
Industrial	118	22,806,549	41	9%	30	9%
Commercial	376	18,098,912	64	10%	27	12%
MR MF + LI MF	336	10,424,606			21	13%
MR MF	237	7,363,563	27	20%		
RunitRight	28	542,442	18	10%		

Table 8-76 provides the detailed sample design.

Table 8-76: Detailed 2015 Enbridge CPSV and FR sample design

Strata	Utility	Program	NTG Category	CPSV Category	Measures in Frame	FR Measure Target	CPSV Measure Target	Cumulative Gas Savings in Frame (m3)	Fraction of Frame Total Reported Cumulative Savings (m3)
211101	Enbridge	Industrial	Action	Complex	8	4	3	2,231,087	0.3%
211102	Enbridge	Industrial	Action	Complex	4	3	3	3,678,905	0.4%
211103	Enbridge	Industrial	Action	Complex	1	1	1	12,988,135	1.5%
211201	Enbridge	Industrial	Action	Simple	7	3	3	2,028,590	0.2%
211202	Enbridge	Industrial	Action	Simple	1	1	1	2,935,575	0.3%
212101	Enbridge	Industrial	Equipment	Complex	47	7	4	44,621,995	5.1%
212102	Enbridge	Industrial	Equipment	Complex	13	7	4	52,578,105	6.0%
212103	Enbridge	Industrial	Equipment	Complex	7	7	4	76,310,125	8.7%
212104	Enbridge	Industrial	Equipment	Complex	3	3	3	103,059,720	11.7%
212201	Enbridge	Industrial	Equipment	Simple	24	5	5	23,332,790	2.7%
212202	Enbridge	Industrial	Equipment	Simple	1	1	1	20,592,275	2.3%
221101	Enbridge	Commercial	Action	Complex	2	2	2	774,895	<0.1%
221102	Enbridge	Commercial	Action	Complex	1	1	1	10,213,885	1.2%
221201	Enbridge	Commercial	Action	Simple	24	4	4	3,875,430	0.4%
222101	Enbridge	Commercial	Equipment	Complex	50	13	4	20,106,586	2.3%
222102	Enbridge	Commercial	Equipment	Complex	8	8	4	31,966,255	3.6%
222103	Enbridge	Commercial	Equipment	Complex	1	1	1	9,501,060	1.1%
222201	Enbridge	Commercial	Equipment	Simple	265	17	5	88,190,023	10.1%
222202	Enbridge	Commercial	Equipment	Simple	28	17	5	148,466,935	16.9%
224101	Enbridge	Commercial	Multi-Residential	Complex	53	8	5	23,584,650	2.7%
224201	Enbridge	Commercial	Multi-Residential	Simple	139	10	4	53,999,911	6.2%
224202	Enbridge	Commercial	Multi-Residential	Simple	36	9	4	75,569,018	8.6%
241301	Enbridge	Run-it-right	Action	N/A	19	8	0	373,925	<0.1%
241302	Enbridge	Run-it-right	Action	N/A	5	5	0	923,845	0.1%
241303	Enbridge	Run-it-right	Action	N/A	4	4	0	1,414,440	0.2%
254101	Enbridge	Low Income	N/A	Complex	6	0	2	5,125,020	0.6%
254201	Enbridge	Low Income	N/A	Simple	104	0	6	58,676,555	6.7%

2015 Union stratification

The Union stratification is shown in Figure 8-3. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total, there are 30 strata.

Table 8-77 shows the 2015 Union sample design in table form with the expected relative precisions and sample for targeted programs shown for each portion of the study. Data collection for FR will all be completed through IDI, while the CPSV group indicates strata that will be have on-site data collection (complex) or TSER (simple) for gross savings verification.

Table 8-77: 2015 Union CPSV and FR sample design

Stratification Segment	NTG Group	CPSV Group	Size Strata	Sample Frame		FR Sample Design		CPSV Sample Design	
				N	m3	n	Rel. Prec.	n	Rel. Prec.
Industrial	Action	Complex	1	21	75,487,148	7	10 %	6	10 %
		Simple	1	44	102,200,503	4		3	
	Equipment	Complex	4	136	862,582,429	35		17	
		Simple	3	111	165,066,284	10		9	
Commercial	Action	Complex	2	8	81,635,903	5	10 %	4	
		Simple	1	13	22,029,892	6		3	
	Equipment	Complex	3	109	142,631,725	14		7	
		Simple	1	42	14,831,059	5		3	
Market Rate Multi-Family	All	Complex	2	6	7,409,515	3		2	
		Simple	1	1	44,260	1		1	
Low Income Multi-Family	All	Complex	2	2	1,454,295	0	N/A	2	
		Simple	1	35	4,466,365	0		3	
Large Volume	Action	Complex	3	35	404,398,149	10	10 %	8	10 %
	Equipment	Complex	4	37	846,481,549	22		13	
Total				**579**		**115**		**75**	

Table 8-78 shows the anticipated relative precisions for less aggregated program segments. We expect that the final relative precisions will be close to 90/10 for these segments as well as the targeted programs above.

Table 8-78: 2015 anticipated precisions by program segment

Program Segment	Sample Frame		NTG		CPSV	
	N	Savings	n	Relative Precision	n	Relative Precision
Industrial	310	78,037,717	61	10%	38	10%
Commercial	171	16,132,513	33	10%	19	11%
Large Volume	72	106,719,551	31	10%	23	10%
MR MF+LI MF	44	730,945			11	13%
MR MF	7	394,489	5	18%		

Table 8-79 provides the detailed sample design.

Table 8-79: Detailed 2015 Union CPSV and FR sample design

Strata	Utility	Program	NTG Category	CPSV Category	Measures in Frame	FR Measure Target	CPSV Measure Target	Cumulative Gas Savings in Frame (m3)	Fraction of Frame Total Reported Cumulative Savings (m3)
111101	Union	Industrial	Action	Complex	21	7	6	75,487,148	2.8%
111201	Union	Industrial	Action	Simple	44	4	3	102,200,503	3.7%
112101	Union	Industrial	Equipment	Complex	104	13	6	183,932,142	6.7%
112102	Union	Industrial	Equipment	Complex	22	12	5	242,844,358	8.9%
112103	Union	Industrial	Equipment	Complex	9	9	5	347,468,949	12.7%
112104	Union	Industrial	Equipment	Complex	1	1	1	88,336,980	3.2%
112201	Union	Industrial	Equipment	Simple	91	5	4	50,638,424	1.9%
112202	Union	Industrial	Equipment	Simple	19	4	4	73,398,020	2.7%
112203	Union	Industrial	Equipment	Simple	1	1	1	41,029,840	1.5%
121101	Union	Commercial	Action	Complex	7	4	3	50,040,503	1.8%
121102	Union	Commercial	Action	Complex	1	1	1	31,595,400	1.2%
121201	Union	Commercial	Action	Simple	13	6	3	22,029,892	0.8%
122101	Union	Commercial	Equipment	Complex	104	9	3	20,998,185	0.8%
122102	Union	Commercial	Equipment	Complex	4	4	3	44,746,640	1.6%
122103	Union	Commercial	Equipment	Complex	1	1	1	76,886,900	2.8%
122201	Union	Commercial	Equipment	Simple	42	5	3	14,831,059	0.5%
123101	Union	Commercial	Multi-family	Complex	5	2	1	2,316,375	<0.1%
123102	Union	Commercial	Multi-family	Complex	1	1	1	5,093,140	0.2%
123201	Union	Commercial	Multi-family	Simple	1	1	1	44,260	<0.1%
131101	Union	Large Volume	Action	Complex	28	5	4	126,323,149	4.6%
131102	Union	Large Volume	Action	Complex	6	4	3	215,015,820	7.9%
131103	Union	Large Volume	Action	Complex	1	1	1	63,059,180	2.3%
132101	Union	Large Volume	Equipment	Complex	25	10	4	114,682,330	4.2%
132102	Union	Large Volume	Equipment	Complex	5	5	3	137,740,059	5.0%
132103	Union	Large Volume	Equipment	Complex	4	4	3	200,140,680	7.3%
132104	Union	Large Volume	Equipment	Complex	3	3	3	393,918,480	14.4%
153101	Union	Low Income	N/A	Complex	1	0	1	20,865	<0.1%
153102	Union	Low Income	N/A	Complex	1	0	1	1,433,430	<0.1%
153201	Union	Low Income	N/A	Simple	35	0	3	4,466,365	0.2%

Design the spillover samples

The sample design for spillover omits the CPSV category, but is otherwise consistent with the sample design for the 2015 FR and CPSV evaluation task. For spillover, the ER used was 0.8; 90/10 precision was targeted.

2013/14 Enbridge stratification

The 2013/14 Enbridge stratification is presented in Figure 8-5. The final stratification includes 4 evaluation programs, two NTG categories, two CPSV categories and up to three size categories optimized for sampling efficiency. In total, there are 28 strata.

Figure 8-5: 2013/14 Enbridge stratification

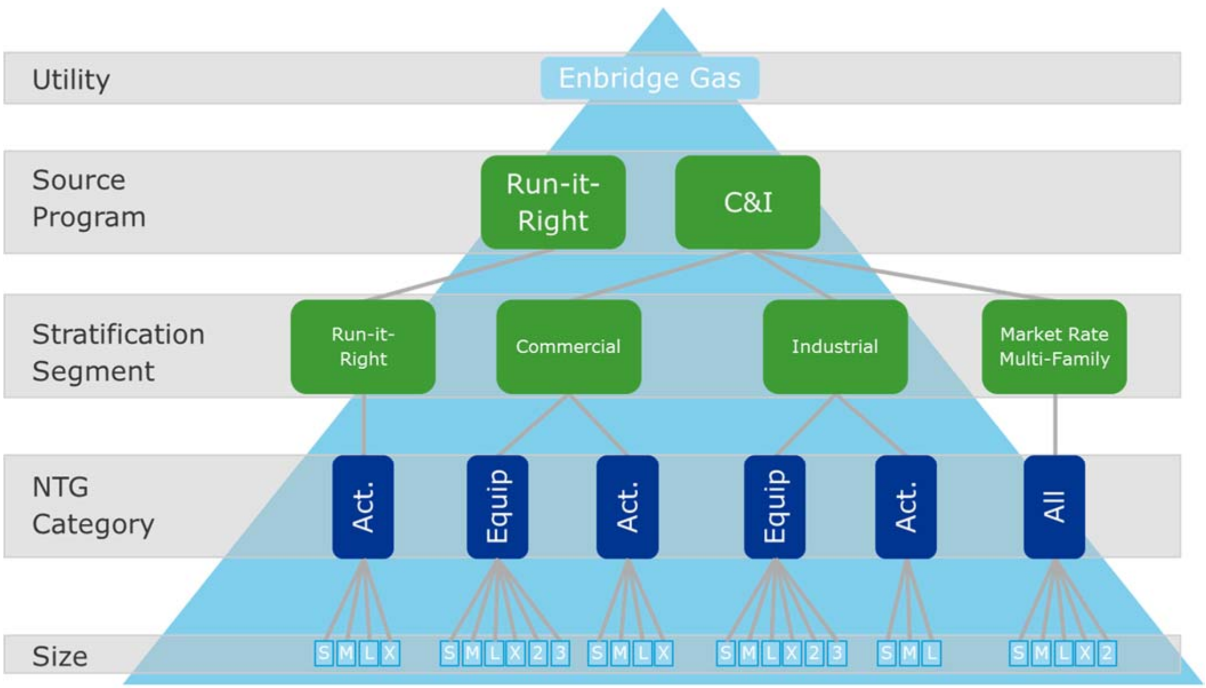


Table 8-80 shows the number of accounts and savings in the sample frame and the targeted spillover sample size for each grouping.

Table 8-80: 2013/14 Enbridge spillover sample design

Stratification Segment	NTG Group	Size Strata	Sample Frame		SO Sample Design	
			N	m3	n	Rel. Prec.
Industrial	Action	3	40	5,067,923	20	10%
	Equipment	6	191	41,899,589	50	
Commercial	Action	4	79	4,604,864	25	10%
	Equipment	6	603	27,240,429	60	
MR MF	All	5	553	20,412,543	65	
RunitRight	Action	4	45	625,088	26	10%
Total			**1,511**		**246**	

2013/14 Union stratification

The Union stratification is presented in Figure 8-6. In total, there are 35 strata.

Figure 8-6: 2013/14 Union stratification

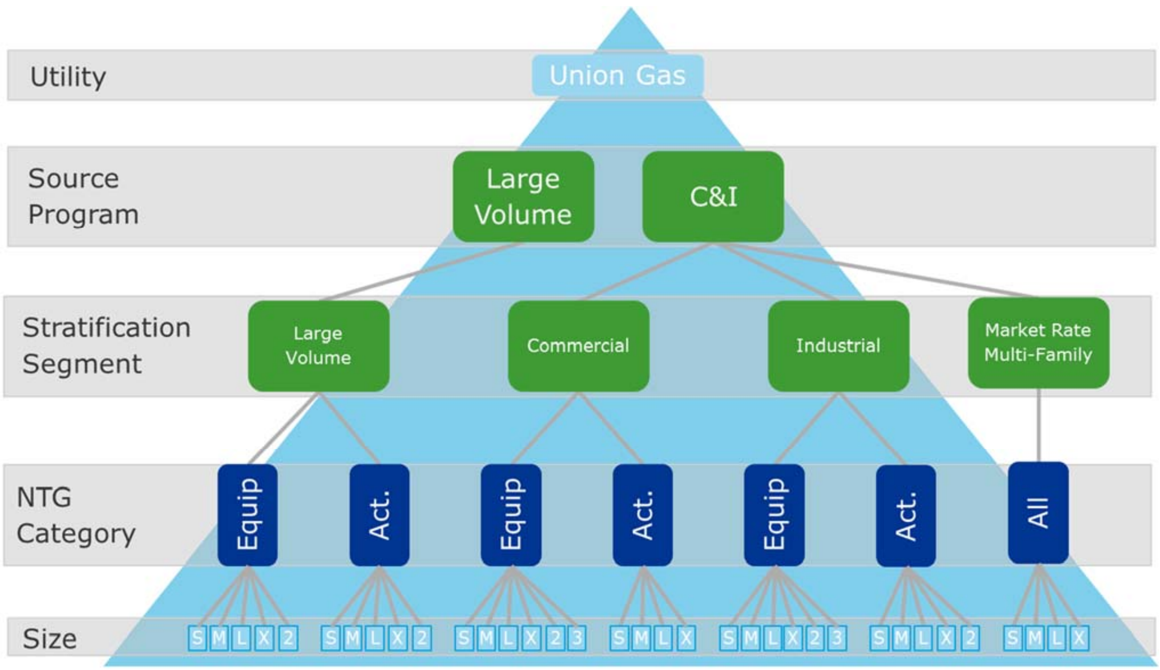


Table 8-81 shows the number of accounts and savings in the sample frame and the targeted spillover sample size for each grouping.

Table 8-81: Union spillover sample design

Utility	Stratification Segment	NTG Group	Size Strata	Sample Frame N	Sample Frame m3	SO Sample Design n	SO Sample Design Rel. Prec.
Union	Industrial	Action	5	167	64,448,800	38	10%
		Equipment	6	412	107,347,726	57	
	Commercial	Action	4	74	9,687,715	24	10%
		Equipment	5	190	15,744,760	40	
	MR MF	All	2	38	564,428	8	
	Large Volume	Action	5	130	317,638,812	38	10%
		Equipment	5	94	139,759,050	33	
	Total			**1,105**		**238**	

Prepare the sample and backup sample

Once we have completed the final sample design, we will submit a data request to the utilities. The specific types of information we will be requesting are outlined in Table 8-82. The decision maker may not necessarily be located at the site where the project occurred and may be the same for multiple projects at multiple sites. The technical expert is someone who will be able to answer questions regarding the specific engineering specifications of the equipment. Program energy advisors are the primary Account Manager or Energy Solutions Consultant that worked with the customer on the sampled projects. Vendors are the third-party firms that were involved in the sale or design of the equipment, or the sale and performance of the O&M services.

Table 8-82: Information to be requested

Requested Information	Project Year	
	2013/14	2015
Site Address	√	√
Project Documentation	√	√
Decision Maker Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√
Technical Expert Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√
Program Energy Advisor Information: ▪ Full Name ▪ Email Address ▪ Direct Business Phone Number		√
Vendor Contact Information: ▪ Full Name ▪ Role ▪ Mailing Address ▪ Email Address ▪ Direct Business Phone Number	√	√

For the 2015 NTG sample we will request documentation and contact information for 50% more projects that are in the primary sample. This corresponds to a minimum 66% response rate. If response rates are lower than 66% in specific stratum, we will request documentation and contact information for additional projects in the stratum.

For the 2013/14 spillover sample, we will request contact information for three times the number of sampled projects. This corresponds to a minimum 33% response rate. We will not request project documentation for the spillover sample until we have identified the sites that require follow up engineering interviews. To protect respondent confidentiality, we will request documentation for more sites than will receive follow up calls. Overall this staging of requests will reduce the amount of project documentation that the utilities need to provide, while ensuring efficient data collection.

Backup sample will only be contacted if needed to meet targeted number of completes.

Once we have received the requested contact information, we will identify instances where a contact was involved in multiple projects, even across sites. While the projects are conducted at the site level, the decision maker, technical expert, or vendor may have been involved in projects at multiple sites. For example, multiple participating sites for the same retail chain may have one energy manager from the corporate office but the technical expert may be site specific. Using this contact information and considering cross-site involvement, we will assemble the CATI and the IDI sample frame.

APPENDIX J. LCNS Methodology

Life Cycle Net Savings (LCNS) is a methodology for determining the FR component of NTG by estimating program effect over the life of the program measure. In this appendix, the terms FR and attribution are used interchangeably as complements of one another. This appendix does not include spillover.

Notation:

VGS_S = Verified Gross Savings based on ISP or code efficiency equipment baseline (annual)

VGS_E = Verified Gross Savings based on pre-existing equipment baseline (annual)

VGS_L = Verified Gross Lifetime Savings

$Y_{V.EUL}$ = Verified Estimated Useful Life (Years) of installed efficient equipment

$Y_{V.RUL}$ = Verified Remaining Useful Life (Years) of replaced equipment[34]

Y_A = Years Accelerated

Y_R = Remaining Useful Life of pre-existing equipment

A_E = Efficiency Attribution

A_Q = Quantity (size) Attribution

F_E = Efficiency free ridership

F_Q = Quantity (size) free ridership

SPA = Simple Program Attribution (function of efficiency and quantity free ridership, not timing)

NS_L = Net Lifetime Savings

NS_A = Net Acceleration Period Savings

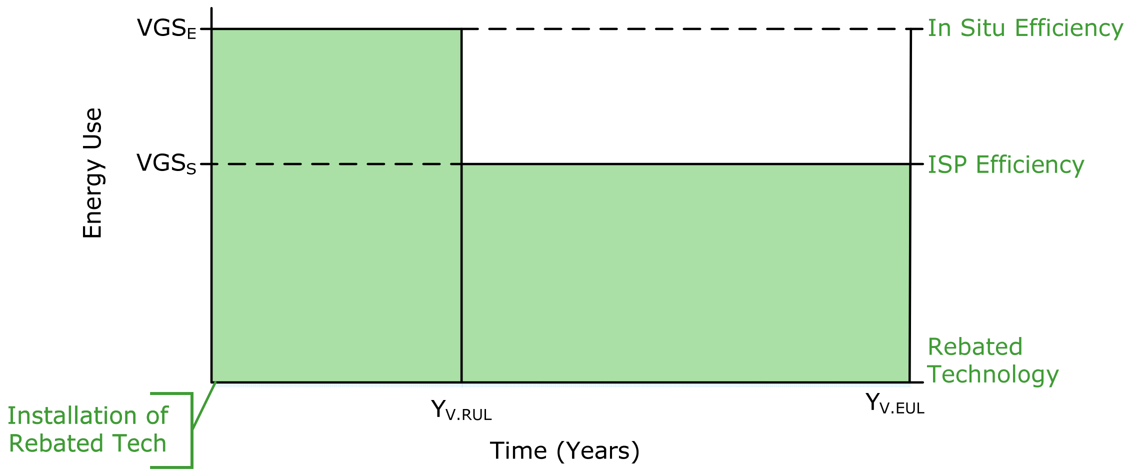
NS_P = Net Post-Acceleration Period Savings

Verified lifetime savings

First we consider the verified savings that make up the denominator in the NTG ratio. Figure 8-7 shows the verified lifetime savings for a measure.

[34] RUL of existing equipment is also applicable as defining the estimated useful life for some retrofit add-on measures

Figure 8-7: Verified lifetime savings for a measure



Verified lifetime savings are calculated as the difference in energy use of the incentivized measure and the energy use of the in-situ measure for the remaining useful life of the in-situ measure plus the verified savings of the ISP or code baseline measure for rest of the (verified) life of the new measure.

$$VGS_L = VGS_E \times Y_{V.RUL} + VGS_S \times Y_{V.EUL}$$

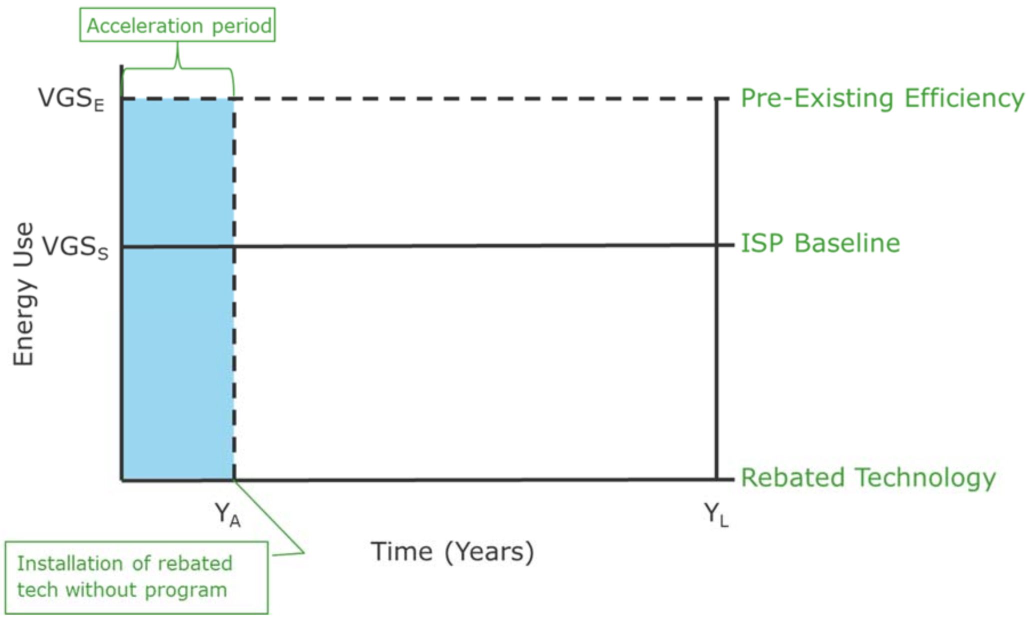
Timing

The treatment of timing is how LCNS differs from other estimation approaches for attribution. In LCNS the response to the question "when would you have performed the measure without the program" defines the number of years that the program accelerated (advanced) the measure. This period is referred to as the "acceleration period" and shown as the distance from the origin to Y_A along the x-axis.

During the acceleration period, the customer would not have installed a new measure (efficient or standard). Instead the appropriate baseline equipment for this time period is the pre-existing equipment that they had been using. This section shows how this difference in baseline affects the net savings estimate for the measure relative to the gross savings.

During the acceleration period (Y_A), the attributable savings are calculated as the difference in energy use of the incentivized equipment and the energy use of the replaced equipment (a pre-existing efficiency baseline). As a result, during the acceleration period the net savings (blue box up to VGS_E) may be higher than the verified gross savings (VGS_S) if the efficiency of the pre-existing equipment was less than the standard program baseline. Savings during the acceleration period are, by definition, attributable. Figure 8-8 shows the attributable savings in the acceleration period for an accelerated measure.

Figure 8-8: Acceleration Period Savings



Acceleration period savings are calculated as:

$$NS_A = VGS_E \times Y_A$$

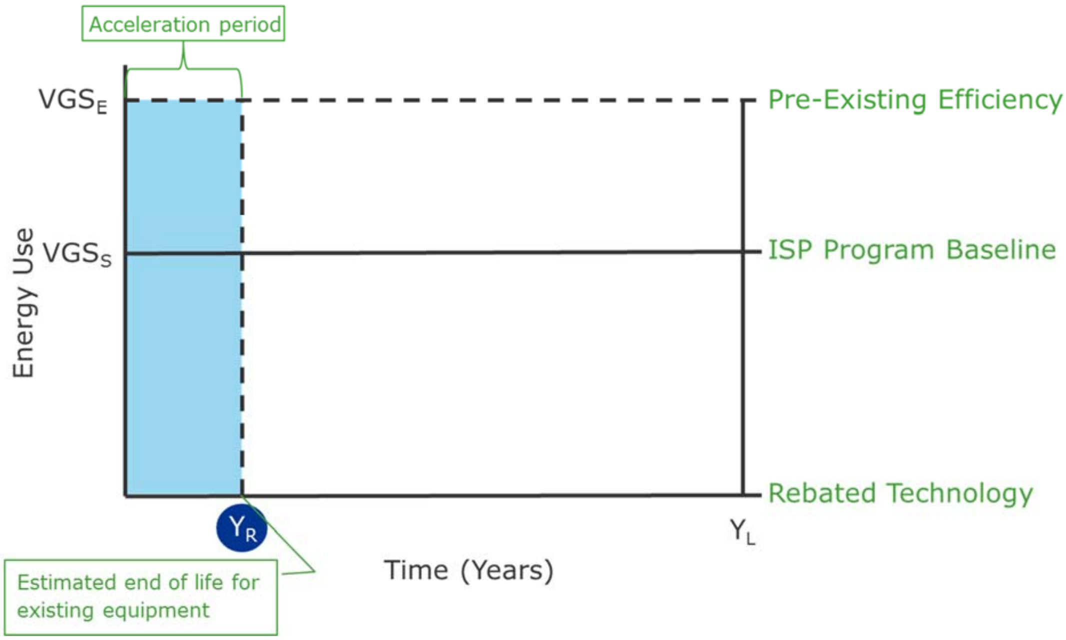
Special Case: "Never"

Some respondents will indicate that they would "never" have replaced the existing equipment. A customer "Never" would have installed the project if they:

1. respond to initial timing question by saying they never would have installed it without the program
2. respond to second timing question by saying they would have installed it more than four years later without the program
3. respond to the initial quantity question by saying they would not have replaced any of the units without the program

For these measures, the acceleration period is defined by the remaining useful life of the pre-existing measure (Y_R) and the applicable baseline is versus pre-existing efficiency (VGS_E) as shown in Figure 8-9.

Figure 8-9: Acceleration period savings for "never" cases



Acceleration period savings for "Never" would have installed measures are calculated as:

$$NS_A = VGS_E \times Y_R$$

Efficiency and quantity

In the post-acceleration period attribution is based on the program effect on the efficiency and quantity of what was installed.

Efficiency attribution, A_E, measures the effect the program had on the *efficiency* of the equipment installed. The efficiency attribution measures the proportion of savings attributable to the program for increasing the efficiency of the equipment above what would have been installed otherwise.

Quantity attribution, A_Q, measures the effect the program had on the *size or amount* of the equipment installed. The quantity attribution measures the proportion of savings attributable to the program for increasing or decreasing the quantity of equipment above or below what would have been installed otherwise.

The Simple Program Attribution (SPA) is the fraction of annual verified gross savings that are attributable to the program and is a function of the efficiency free-ridership (f_E) and the quantity free-ridership (f_Q).

The free-ridership values for efficiency and quantity are calculated from the attribution factors. The complement of attribution is free-ridership. Attribution measures the portion of the savings that result because of the actions of the program. Free-ridership measures the portion of the savings that would have happened in the absence of the program. The free-ridership equivalents of the attribution factors are used to determine program net savings.

$$f_E = 1 - A_E$$

$$f_Q = 1 - A_Q$$

The fraction of verified gross savings that would have occurred without the program is the product of the fraction of units that would have been installed without the program, and the fractional unit savings that these units would have had without the program.

$$f_{QE} = f_Q f_E$$

For example, if two-thirds as many units would have been installed without the program ($f_Q = 2/3$), and the savings per unit would have been only half as much ($f_E = 1/2$), the portion of the savings that would have occurred without the program would be

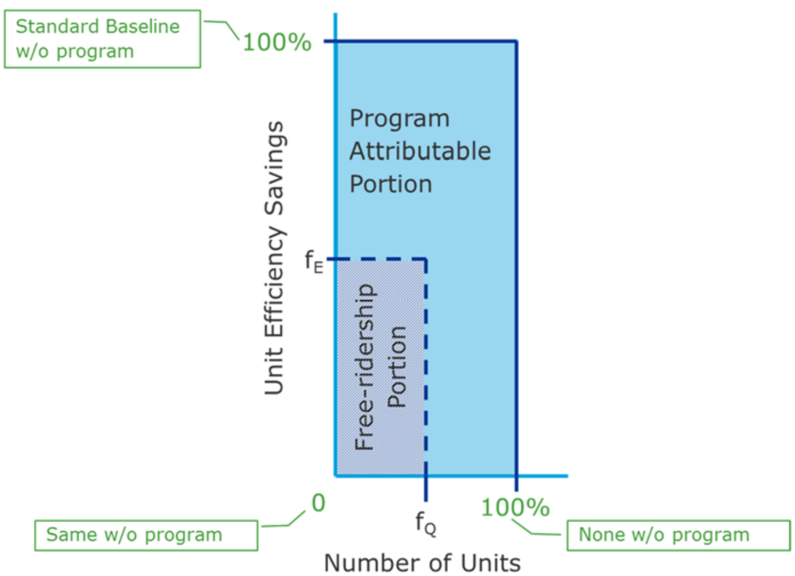
$$f_{QE} = (2/3) \times (1/2) = 1/3.$$

The SPA is the complement of this free rider portion.

$$SPA = 1 - f_{QE} = 1 - f_Q f_E$$

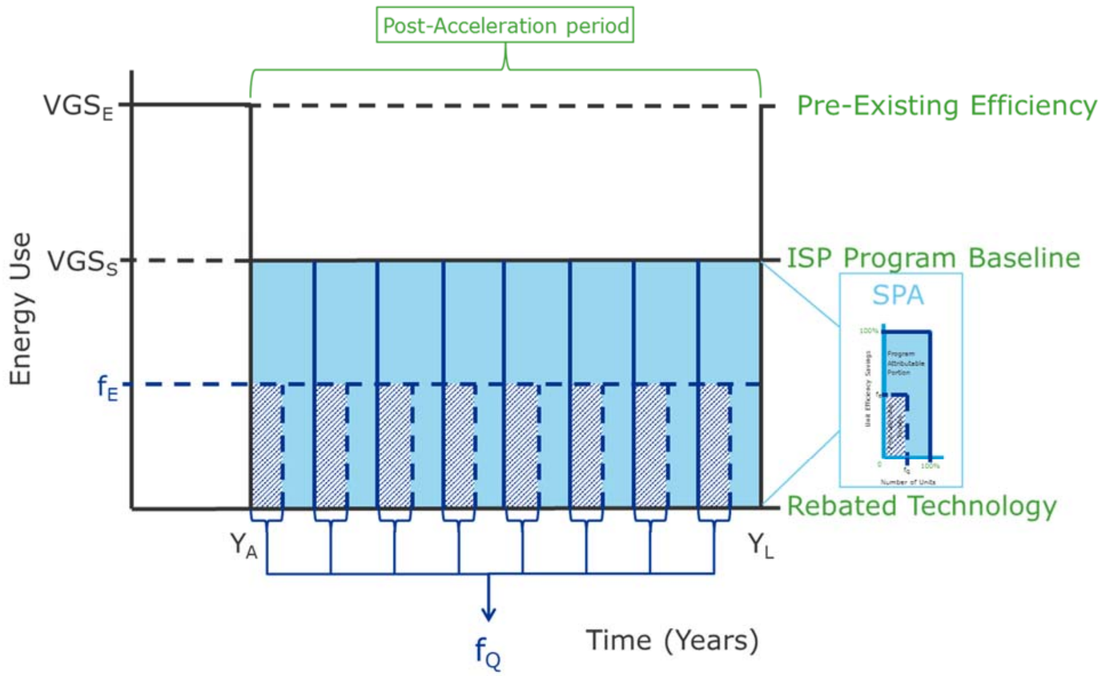
The relationship is illustrated in Figure 8-10.

Figure 8-10: Graphical derivation of the SPA equation



SPA is the attribution of each year savings in the post-acceleration period. Figure 8-11 shows the program attributable and free-ridership portions of each year's savings in the post-acceleration period. The blue rectangles represent SPA as discussed and shown from above. The height of the SPA box is equivalent to the baseline used for verified savings. The grey "missing pieces" are the free ridership for each year's savings. Because attribution is three dimensional and this is a two-dimension document, we are representing both years and quantity on the x-axis. Years are denoted by the dark blue vertical lines, while the quantity FR (f_Q) is shown as the width of the grey box.

Figure 8-11: Post-acceleration period attributable savings



The net savings in the post-acceleration period are calculated as:

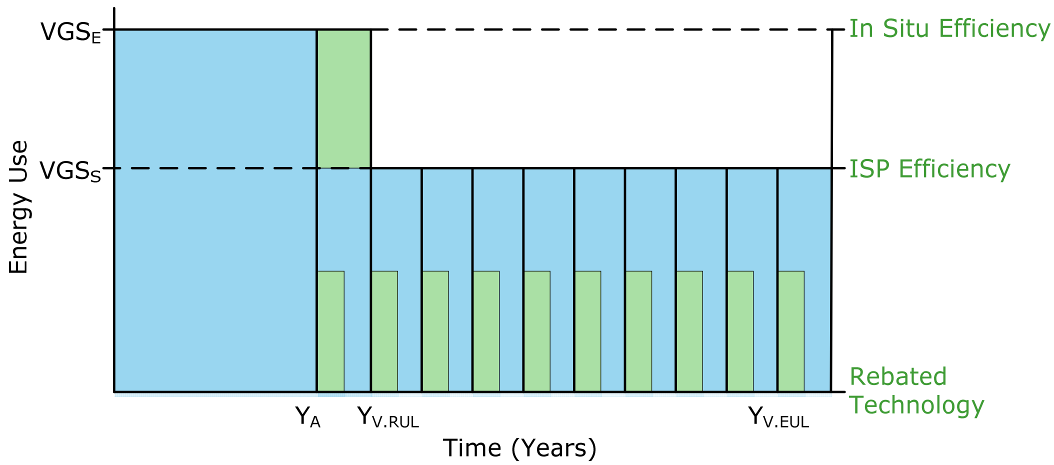
$$NS_P = VGS_S \times SPA \times (Y_L - Y_A)$$

Note that for the special case discussed relating to acceleration period savings, "Never", SPA= 100%.

Calculating attribution

Figure 8-12 shows the attributable savings across the lifetime of the measure NS_L (blue) overlaid on the verified gross lifetime savings VGS_L (green). The figure shows that with the effect of the dual baseline verification included in the net savings estimate and in the verified savings estimate that net savings will always be less than or equal to gross savings.

Figure 8-12: Attributable vs. verified gross savings for a measure



The formula for each individual measure's estimate of lifetime net savings is:

$$NS_L = NS_A + NS_P$$

or

$$NS_L = VGS_E \times Y_A + VGS_S \times (SPA) \times (Y_{V.EUL} - Y_A)$$

The formula for each individual measure's attribution is:

$$Attr = \frac{NS_L}{VGS_L}$$

or

$$Attr = \frac{VGS_E \times Y_A + VGS_S \times (SPA) \times (Y_{V.EUL} - Y_A)}{VGS_E \times Y_{V.RUL} + VGS_S \times (Y_{V.EUL} - Y_{V.RUL})}$$

Four years is the time horizon beyond which we assume the respondent cannot answer with certainty. Anything beyond four years (Y_A>=4) is treated as a "never would have installed" response (100% attributable), rather than an accelerated measure.

Special Case: FR Sampled Projects not sampled for CPSV

The sample for the CPSV portion of the study is a subset of the free ridership sample. This means that for projects included in the FR study, but not included in CPSV we will not be calculating verified savings. For expansion of the NTG ratio and for calculating post-acceleration period savings we will use the final ratio application domain level Gross RR to estimate verified savings for measures not in the CPSV.

For acceleration period savings, we will use the A/P ratio of accelerated projects in the CPSV to estimate the pre-existing baseline savings. The A/P ratio refers to the ratio between the annual Acceleration Period Savings and the annual Post-Acceleration Period Net Savings. It is always one or larger. Like the application of Gross RR, the A/P ratio will be estimated at the application domain level for use in estimating net savings for the FR-only sampled measures.

APPENDIX K. DETERMINING ATTRIBUTION PARAMETERS

The attribution factors defined in the previous section are determined from the participant responses gathered during the survey. This section provides an overview of the survey data and how it is used to determine each attribution factor. It also includes more detailed sections for each factor that show exactly how all survey responses are handled.

General procedure

This section provides an overview of the attribution factors and how they are determined.

- Timing attribution, A_T: The timing attribution is determined from the acceleration period, Y_A, which is in turn provided directly by the respondent and the verified savings versus existing equipment provided by the evaluation engineers. There is no timing attribution effect for values of Y_A greater than four; in those instances, we assume that the measure would never have been installed without the influence of the program.
- Efficiency attribution, A_E: The efficiency attribution is based on the answers to questions DAT2a and DAT2b which ask about the efficiency level that would have been installed in absence of the program. Respondents who indicate that they would have installed a lesser-efficient piece of equipment in the absence of the program are asked what efficiency they would have installed instead. An efficiency attribution value is assigned based on the response. Standard efficiency based on program definitions will be used to bracket the finer cut as defined in the project documentation provided by the utilities.
- Quantity attribution, A_Q: The quantity attribution is based on the percentage change in quantity caused by the program, ΔQ, which is in turn provided directly by the respondent. The timing section next shows the attribution assignment based on responses to DAT3a and DAT3b.

The next few sections deal with determining the timing, efficiency, and quantity attributions on a more detailed level.

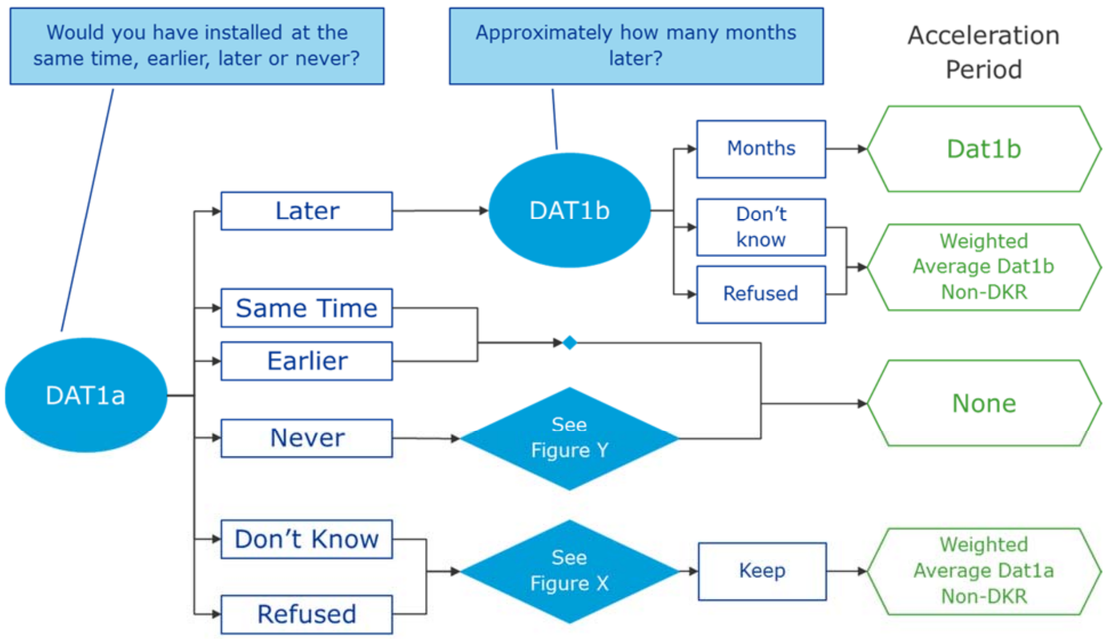
Timing

The timing attribution, A_T, is determined from the first set of attribution survey questions. These questions are used to determine if the program accelerated implementation of a measure or caused it to be implemented before it would have been without the program. The two relevant questions are labelled DAT1a and DAT1b.

- DAT1a: "Without < the program>, would you have <installed, preformed> <measure> at the same time, earlier, later, or never?"
    - DAT1a_O: "Why do you say that?"
- DAT1b: "Approximately how many months later?" (DAT1b is only asked if DAT1a is "Later.")

Note that these questions ask about the timing of installing equipment, not installation of efficient equipment in particular. For example, if the measure was replacement of a high-efficiency boiler, the question asks when the boiler would have been replaced without the program. Engineers conducting the interviews are trained to ensure clarity for these questions. Figure 8-13 shows a decision tree for DAT1a and DAT1b.

Figure 8-13: Decision tree for the acceleration period



The measure is considered accelerated if the respondent indicates that the measure would have been installed less than four years later without the influence of the program. The acceleration period is determined based on the answer to DAT1b. If the respondent is unable to answer DAT1b, the measure is assigned the average acceleration period across all accelerated measures in the same measure group.

If the respondent answers DAT1a with Earlier or Same Time then there is no acceleration period. If the respondent answers DAT1a with Never and the Quantity and Efficiency sections apply to the measure then the survey skips to the next section and there is no acceleration period. If the respondent answers DAT1a with Don't Know or Refused but does provide answers to inform the Quantity and Efficiency Attributions then the measure is assigned the average Acceleration Attribution for all measures in the same primary domain.[35]

[35] The primary domain is the domain that the attribution factor will be applied to in calculating the final net savings for the programs.

Table 8-83: Timing attribution assignments

Coarse Cut (DAT1a) (Would you have implemented the measure at the same time absent the program)	Finer Cut (DAT1b)	Acceleration period
Same time	NA	None
Earlier	NA	None
Later	0 < years <4	A_T=DAT1b Acceleration period equals response to DAT1b
	4<= years	Equivalent to "Never" A_T=A_R Acceleration period equals remaining useful life of replaced equipment, SPA=100%
	Don't know/refused	Weighted average of "later" cases for primary domain, 0 < years <4
Never	NA	A_T=A_R Acceleration period equals remaining useful life of replaced equipment, SPA=100%
Don't know/refused	NA	Weighted average of all respondents for primary domain

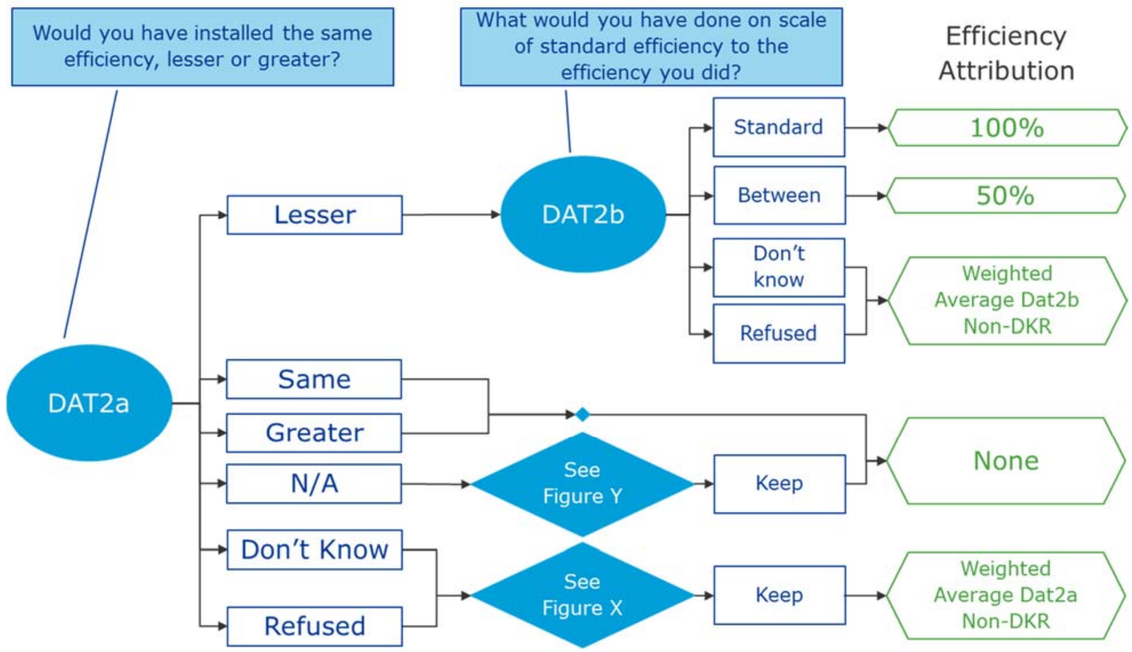
Efficiency

Efficiency Attribution, A_E, gives the program credit for increasing the efficiency of a measure above what would have been installed in the absence of the program. The two relevant questions are DAT2a and DAT2b.

- DAT2a: "Without <the program>, would you have installed the same efficiency as what you installed, lower efficiency, or higher efficiency?"
- DAT2b: "Without <the program>, would you have installed <measure> that was "standard efficiency on the market at that time," or "between standard efficiency and the efficiency that you installed?" (DAT2b is only asked if DAT2a is "Lesser.")

The program receives nonzero Efficiency Attribution if the respondent indicates that they would have installed a less efficient measure without the influence of the program. The magnitude of the Efficiency Attribution is determined based on the answer to DAT2b, as shown in Table 8-84. Figure 8-14 shows the corresponding decision tree for DAT2a and DAT2b.

Figure 8-14: Decision tree for efficiency attribution



If the respondent answers DAT2a with Greater or Same then the survey skips to the next section and there is zero Efficiency Attribution. If efficiency is not applicable to this measure but quantity is applicable and the measure would have been installed anyway then the survey skips to the next section and the Efficiency Attribution will not affect the Simple Program Attribution. If the respondent answers DAT2a with Don't Know or Refused but does provide answers to inform the Quantity Attribution and Acceleration Period then the measure is assigned the average Efficiency Attribution for all measures in the same measure group.

Table 8-84: Efficiency attribution assignments

Coarse Cut (DAT2a) (what efficiency would have been implemented absent the program)	Finer Cut (DAT2b)	Efficiency Attribution
Same	NA	0%
Lower	Standard efficiency or according to code	100%
	Between standard efficiency and the efficiency that was installed	50%
	Don't know/refused	Weighted average of above cases for primary domain
Greater	NA	0%
Don't know/refused	NA	Weighted average of all respondents for primary domain

Quantity

Quantity Attribution, A_Q, gives the program credit for increasing the quantity of a measure above what would have been installed in the absence of the program. The two relevant questions are DAT3a and DAT3b.

- DAT3a: "Without <the program>, how different would the <number/size> of the <equipment type> have been? Would you say you would have installed the same amount, less, more, or not have installed anything?"
- DAT3b: "By what percentage did you change the amount of <equipment type> installed because of <the program>?" (DAT3b is only asked if DAT3a is "Less" or "More.")

The program receives nonzero Quantity Attribution if the respondent indicates that they would have installed less of the measure or a smaller measure without the influence of the program (for example: "I would have replaced as many doors"_. The program also receives nonzero Quantity Attribution if the respondent indicates that they would have installed more of the measure or a larger measure without the influence of the program (for example: "I would have installed a bigger furnace, but I through the program I learned it was unnecessary"). The latter case covers situations where the program effect was in "right sizing" the measure. The magnitude of the Quantity Attribution is determined based on the answer to DAT3b, as shown in Table 8-85. Figure 8-15 shows a decision tree for DAT3a and DAT3b.

Figure 8-15: Decision tree for quantity attribution

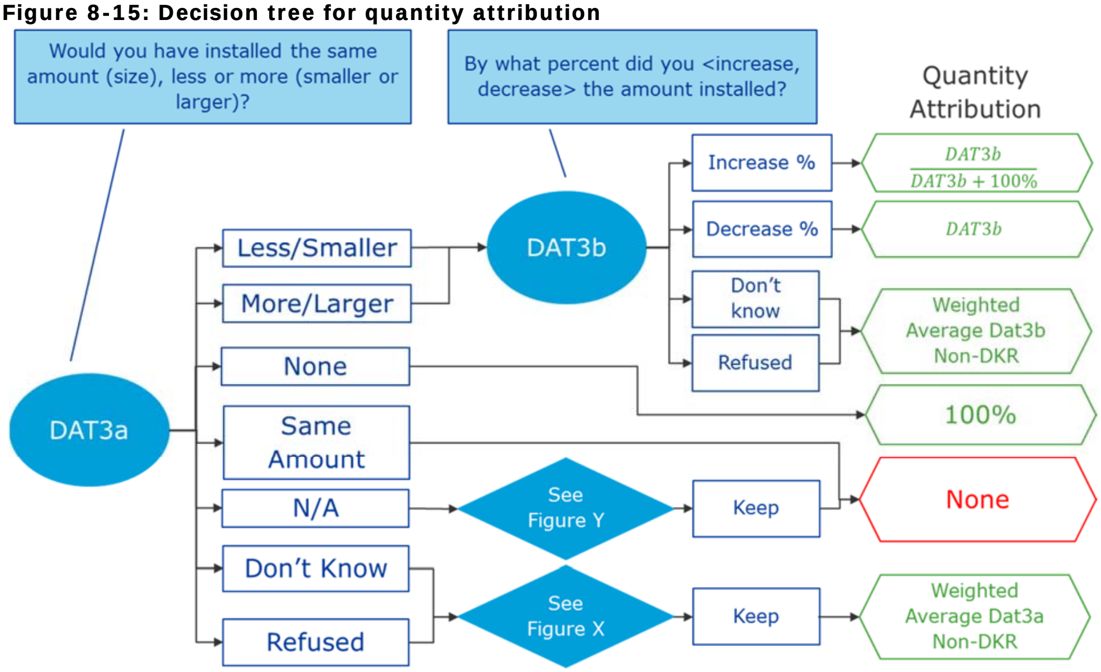


Table 8-85: Quantity attribution assignments

Coarse Cut (DAT3a) (How much equipment would have been replaced absent the program)	Finer Cut (DAT3b)	Quantity Attribution
Same	N/A	0%
Less/Smaller	ΔQ	AQ = ΔQ / (ΔQ + 100%)
	Don't know/refused	Weighted average of "less" cases for primary domain
More/Larger (right sizing)	ΔQ	AQ = ΔQ
	Don't know/refused	Weighted average of "more" cases for primary domain
None	N/A	100%
Don't know/refused	N/A	Weighted average of all respondents for primary domain

If the respondent would have installed a smaller measure without the program then the Quantity Attribution is calculated as:

A_Q = Inc / (Inc + 100%)

where

Inc = percentage change in quantity because of the program.

If the respondent would have installed a larger measure without the program, then the Quantity Attribution is calculated as:

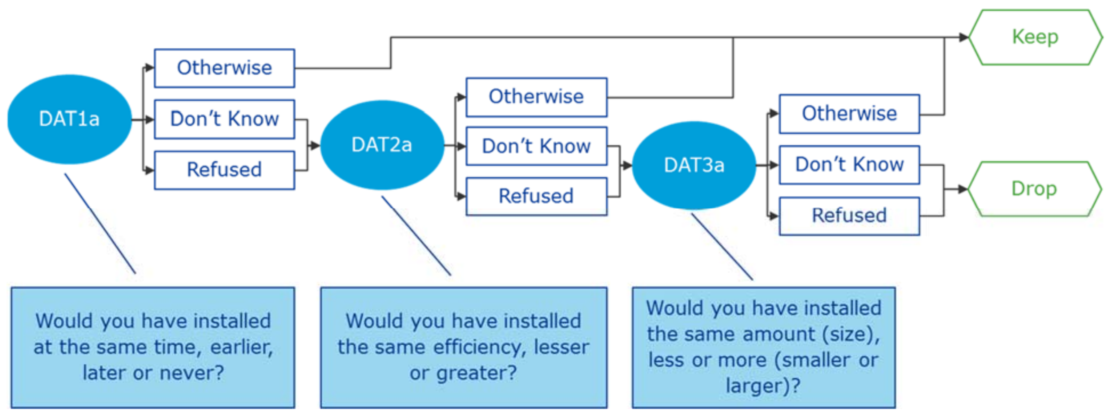
A_Q = Inc.

If the respondent answers DAT3a with Same Amount or None then the survey skips to the next section and there is zero Quantity Attribution. If quantity is not applicable to this measure but efficiency is applicable and the measure would have been installed anyway then the survey skips to the next section and the Quantity Attribution will not affect the Simple Program Attribution. If the respondent answers DAT3a or DAT3b with Don't Know or Refused but does provide answers to inform the Efficiency Attribution and Acceleration Period then the measure is assigned the average Quantity Effect for all measures in the same measure group.

What if they "Don't Know" or "Refuse?"

Some respondents are unable or unwilling to answer the relevant questions in the survey attribution sequence. If a participant is unable or unwilling to answer *all* of the attribution questions then the participant is dropped from the attribution analysis. However, the respondent information will still be included as part of the installation rate and the VGI. Figure 8-16 shows a decision tree that indicates the relationship between the question responses and how they affect the attribution. If a measure goes to the "Keep" decision then the ultimate resolution of each effect is shown in the previous tables.

Figure 8-16: NTG case retention decision tree for don't know / refused

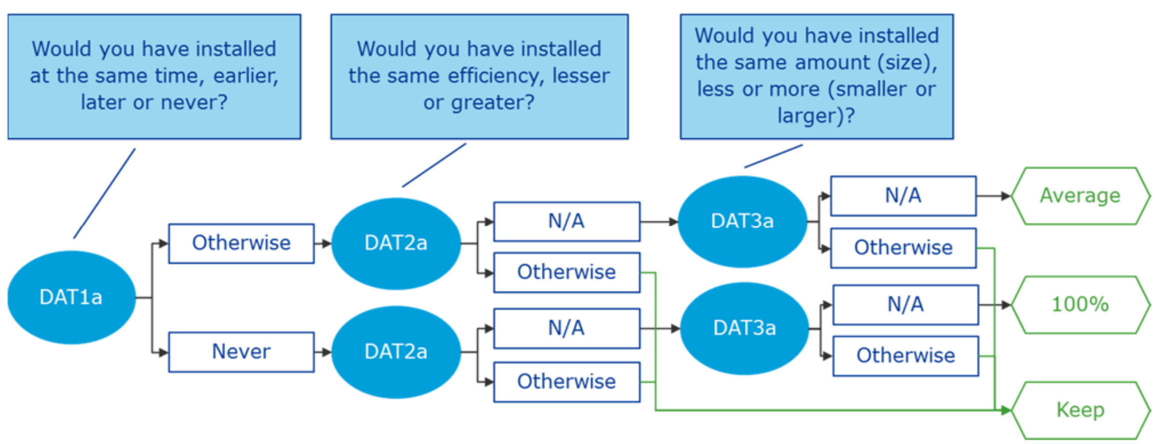


When efficiency and quantity don't apply

Quantity and efficiency questions do not apply to all measures. Efficiency questions do not apply if the equipment type is inherently an efficiency improvement; that is, the "standard efficiency" baseline would be not to install anything. Variable frequency drives (VFDs) or heat recovery systems are examples. Quantity questions do not apply when varying quantity or size does not make sense in the context of the measure.

Figure 8-17 shows a decision tree that indicates the relationship between the question responses and how they affect attribution. If a respondent indicates that a measure would never have been installed without the program and the DAT2a and DAT3a questions do not apply then the attribution is 100%. If the respondent would have installed the project at the same time, earlier, or later and the DAT2a and DAT3a questions do not apply then the measure is assigned the average savings-weighted attribution across all measures in that measure group.

Figure 8-17: Decision tree for not applicable



Example Attribution Calculations

Table 8-86 provides several examples of how survey responses are translated into an NTG ratio. The examples in the table show primarily early replacement (on the gross savings) measures, but the non-ER measures would work the same way. E and Q are the attribution portions, not free ridership (i.e. 0% in column Q means 100% free ridership for quantity/ size).

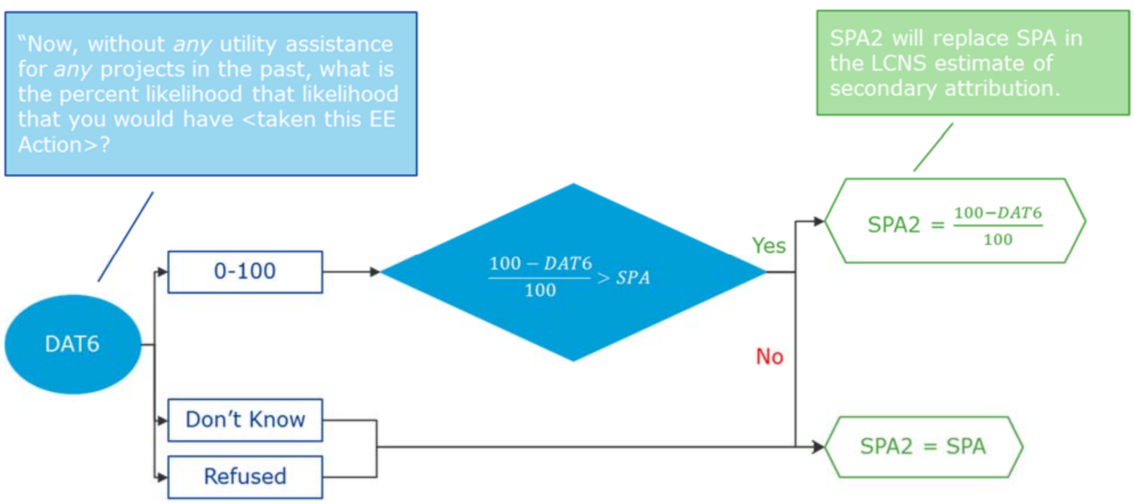
Table 8-86: Attribution Examples

Example	DAT1a	DAT1b	DAT2a	DAT2b	DAT3a	DAT3b	VGS_E	VGS_S	$Y_{V.RUL}$	$Y_{V.EUL}$	VGS_L	Y_A	E	Q	SPA	NS_L	NTG
Accl only	Later	Two Years	Same		Same		100	50	3	10	650	2	0%	0%	0%	200	**31%**
"Never" for timing	Never		Same		Same		100	50	3	10	650	3	0%	0%	100%	650	**100%**
No attribution	Same		Same		Same		100	50	3	10	650	0	0%	0%	0%	0	**0%**
Accl with partial efficiency	Later	Two Years	Less	Between	Same		100	50	3	10	650	2	50%	0%	50%	400	**62%**
"Never" with partial eff.	Never		Less	Between	Same		100	50	3	10	650	3	50%	0%	100%	650	**100%**
Partial eff. only	Same		Less	Between	Same		100	50	3	10	650	0	50%	0%	50%	250	**38%**
Accl with partial eff. and partial quantity	Later	Two Years	Less	Between	Less	Half	100	50	3	10	650	2	50%	50%	75%	500	**77%**
"Never" with partial eff. and partial quantity	Never		Less	Between	Less	Half	100	50	3	10	650	3	50%	50%	100%	650	**100%**
Partial efficiency and partial quantity	Same		Less	Between	Less	Half	100	50	3	10	650	0	50%	50%	75%	375	**58%**
"None" is equal to "Never"	Same		Same		None		100	50	3	10	650	3	100%	0%	100%	650	**100%**
Full eff. credit, no accel. or quantity (ER)	Same		Less	Standard	Same		100	50	3	10	650	0	0%	100%	100%	500	**77%**
Full eff. credit, no accel. or quantity (non-ER)	Same		Less	Standard	Same		0	50	0	10	500	0	0%	100%	100%	500	**100%**

Secondary attribution

Secondary attribution, the longer-term effect of the program on participant decision making will be assessed based on a single question (DAT6). DAT6 asks the respondent about the likelihood of the project given all program assistance for all projects since the programs were started. The greater of the score from DAT6 and the primary SPA will be used as the SPA in calculating the secondary attribution. Secondary attribution is an estimate of LCNS attribution based on all program efforts, not just program efforts focused on this project. This secondary attribution approach is lower rigour than the primary approach and provides a sense of the incremental effect that historical program efforts have on projects today. This score is not intended for application in determining program net savings.

Figure 8-18: Secondary attribution scoring

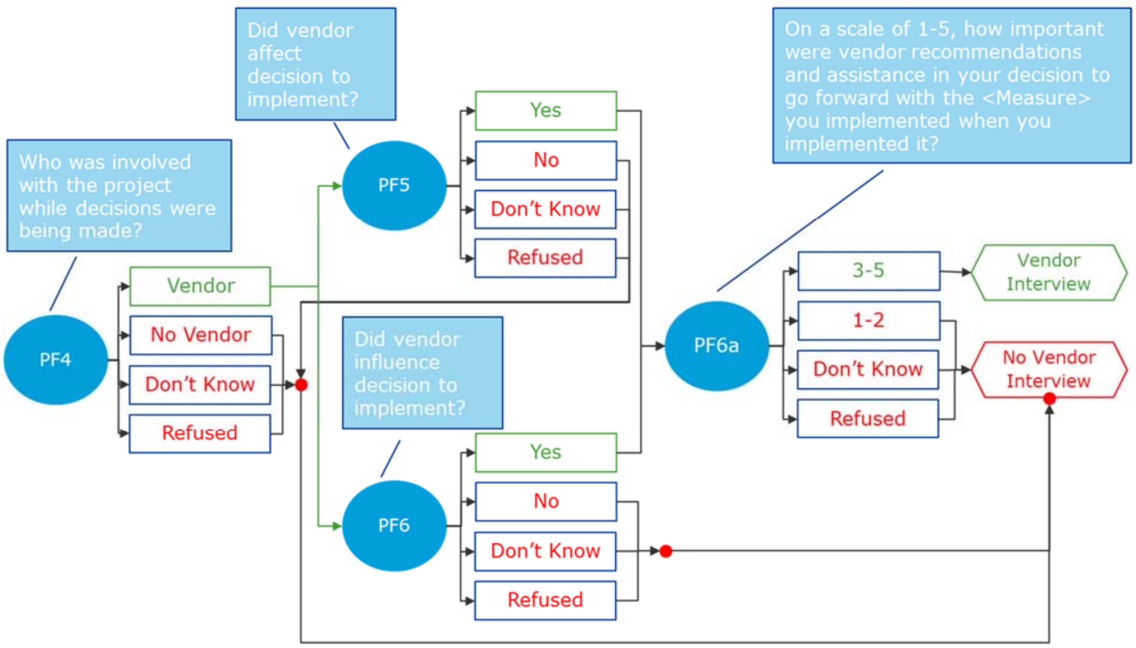


Incorporating vendor effect

DNV GL will take two steps to determine when a vendor survey is necessary to supplement the participant survey. They are:

1. When we request project documentation and site contact information for each sampled project we will also ask the utilities to provide vendor contact information for projects with vendor involvement.
2. Each survey completed with a participant is reviewed to determine the effect the supplier had on the participant’s decision to install a given measure relative to the program’s effect. If a participant indicates that the program did not influence their decision to install high-efficiency equipment but the vendor did have substantial influence, then we will complete a survey with the vendor. The decision tree is shown in Figure 8-19.

Figure 8-19. Decision tree to trigger vendor interview



For measures with both participant surveys and vendor surveys, the analysis will produce two separate attribution values. The first reflects the influence that the program had on the participant's decision to install the measure. The second reflects the influence that the program had on the vendor's business practices and therefore their ability to sell the measure. We choose the higher of the two values as the final program attribution for that measure. That is, if either the vendor or the customer indicates that the program influenced the decision to install the measure, we conclude that the program influenced the decision. In the event that a vendor interview is triggered, but is either not completed or results in an inconclusive vendor score, vendor attribution for the measure will be the average attribution of all completed vendors within the evaluation program.

The vendor attribution scoring method will be included with the vender interview guide.

Quality control by interviewers and analysts

Each of the components of attribution, Timing (DAT1a/ DAT1a_O/DAT1b), Efficiency (DAT2a/DAT2a_O/DAT2b) and Quantity (DAT3a/ DAT3a_O/DAT3b), have a question sequence that follows the same pattern:

DATXa.	What would you have done without the program?
DATXa_O.	Why do you say that?
DATXb.	<If DATXa=program effect> How different would the project have been?

Quality control for each component of attribution consists of comparing the final component attribution score (t, e, q) to the open-ended response for the "DATXa_O. Why do you say that?" question.

Interviewers are trained to probe if the response to the open-ended question is inconsistent with the scored response to DATXa.

During the analysis phase, the analyst will put measures into three bins: full attribution, partial attribution and full free rider for each component. The analyst works bin at a time to compare each verbatim open ended response to the score for the attribution component. Assessing verbatim responses by bin reduces analyst error and speeds the review. If an open-ended response appears inconsistent with the score received, the case is elevated to PM review.

Overall attribution scores are compared to the DAT0 score and assesses for consistency. A high attribution score from the TEQ questions should usually correspond to a "somewhat unlikely" or" very unlikely" to implement response to DAT0. Inconsistent scores are referred to PM review.

Overall attribution scores are also assessed for consistency with the DAT4 verbatim, by bins as described for the QC of the component scores. Inconsistent scores are referred to PM (Ben Jones) review.

Non-Zero attribution scores are also assessed for consistency with the responses to PF8 and PF9. Any non-zero score that also has a response of "after making decision" or "after installing" is considered inconsistent and referred to PM (Ben Jones) review.

The overall attribution score will also be compared to DAT6 (the secondary attribution question). In theory, DAT6 should be equal to or greater to the overall attribution score for all measures, but because the question is a scalar 1-10 and the primary attribution is scored by asking about influence on specific aspects of the project inconsistencies are expected. For QC, all instances where the secondary attribution is more than 20% lower than overall primary attribution will trigger a PM review.

Quality control PM Review

Analysts are instructed to have a low bar ("when in doubt flag for review"), most of the measures flagged for PM review result in no change. For each site that has a measure flagged for PM review, the PM (Ben Jones) will review the full survey, including all measures and responses. The PM may also follow up with the interviewer to better understand the combination of responses. If the PM determines that the flagged score (whether of a component or overall) is not clearly contradicted by the overall story told by the respondent throughout the interview, the PM makes no change. If the flagged score is clearly contradicted (approximately 1% of cases in DNV GL's experience), the PM decides among three options:

- drop the measure from the sample (for very muddled responses, much more common with CATI than IDI)
- replace the inconsistent response with a "Don't Know" (effectively using the average if it is clear that there should be some attribution for the component, but unclear how much)
- adjust the flagged score to more accurately reflect the intent of the respondent (employed in cases where there is overwhelming evidence of intent, for instance the open-ended response says clearly what the score should be)

For all adjusted scores, project sponsor (Tammy Kuiken) approval is required.

APPENDIX L. Spillover Methodology

The spillover portion of the study includes participant spillover only. The participant spillover analysis will provide separate estimates of spillover for inside-like, inside-unlike, outside-like, and outside-unlike spillover. Each of the estimates will be generated based on ratio estimation relative to the program measure savings. Some spillover data was collected as part of the combined CPSV/NTG data collection. Spillover results will be provided in a separate volume.

Spillover "refers to effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program."[36] As in many jurisdictions, Ontario's Demand-Side Management Guidelines recognize the importance of spillover in determining program benefits and requires "comprehensive and convincing empirical evidence" to support any program spillover claim.

Key challenges to providing convincing quantified evidence of spillover for a particular customer include:

- Determining that a particular subsequent action was due to the influence of the program
- Confirming that the action was not taken as part of the original or another program, hence already counted by the program
- Quantifying the savings associated with confirmed spillover actions.

DNV GL's proposed approach provides a high level of rigor to address each of these issues.

- We determine program influence using participant surveys that start with the framing used for our free ridership questions. This framing helps ensure more meaningful responses to questions of the influence of the experience with the program in implementing the original measure on subsequent actions. As for the free rider surveys, obtaining the right respondents is also essential to obtaining meaningful responses to these questions.
- We confirm that the actions tentatively identified as spillover were not already counted by another program by cross-checking tracking data bases. Also critical to separation of spillover from program-claimed savings is understanding what savings if any are claimed by the programs for facilitation support such as opportunity identification, feasibility studies, audits, and related continuous improvement program engagement.
- We quantify the savings for confirmed spillover actions by collecting engineering specifications and calculating associated savings. This approach gives more accurate results than asking customers to estimate the magnitude of spillover savings relative to the original measure.

Thus, our participant spillover methodology addresses the following key issues:

- *Locating the right decision-maker* - Large commercial and industrial companies have multiple decision-makers and it is often difficult to find someone who is familiar with both the tracked program-influenced measure and the spillover measure. Employee turnover can also complicate this. Our approaches to ensure appropriate respondents are discussed above.
- *Avoiding double-counting* – Companies that received financial incentives from an energy efficiency program for one measure are likely to seek these incentives for future measures. Hence it is important

[36] Ontario Energy Board Demand Side Management Guidelines for Natural Gas Utilities, EB-2008-0346, June 2011, Chapter 7.

to get the program's latest tracking data to make sure that a potential participant spillover measure did not receive program support.

- *Estimating program attribution for potential spillover measures* - A common way of assessing participant spillover is to ask how much the participant's experience with the tracked program-influenced measure influenced their decision to implement measures that are candidates for spillover attribution. It is difficult to turn this "fuzzy" assessment of program influence into a more concrete attribution factor necessary for attributing a certain quantity of m^3 from the spillover measure to the program.
- *Estimating the energy savings for the participant spillover measures.* Because spillover measures occurred outside the program, evaluators do not have access to the same information about the size, type, and quantity of the implemented energy-efficient measures that they would find in a program tracking database.

Our approach to these issues is described in more detail below. This approach is based on one we used successfully in Wisconsin C&I programs over many years.

Understanding energy-related standard practices

The first objective of the survey will be to find out whether the participant's company or organization had installed any energy-efficient equipment or made any energy-efficient changes in operation or maintenance (O&M) procedures after the implementation of the tracked project. But before doing that we will collect some information about the company or organization's energy-related decision-making process. We will ask the participants a series of questions about:

- Who in their company makes decisions about equipment replacement and retrofit projects;
- What information sources are used in making these decisions; and
- Possible barriers to energy efficiency implementation.

This information will be valuable for a number of different reasons. First, it should help program implementers devise strategies for increasing program awareness and mitigating barriers to project implementation, especially for participants who did not identify any subsequent energy-efficient projects after the tracked project. Second, by shedding light on the project decision-making process, it should help the evaluators make better judgments about assigning program attribution to a given project. Finally, it should make the survey appear less peremptory for those who did not report any new energy-efficient projects after the tracked projects, since otherwise their survey would be terminated fairly quickly.

After we collect this information about participant energy practices, we will ask the participants whether their company/organization had installed any energy-efficient projects after the installation of the tracked project. If the participants report no subsequent actions, we will terminate the survey since there is no participant spillover to be measured. If they do identify subsequent projects, then we will collect some basic information about the project including:

- The approximate year of the project;
- The geographic location of the project (e.g. city);
- The types of energy-efficient measures installed or energy-efficient O&M practices implemented; and
- Whether the tracked project and the subsequent project were in the same facility or not (needed for the calculation of inside vs. outside spillover).

Because this information will be collected by CATI program surveyors who do not have an energy background, we will not ask them to try to collect too detailed information about the energy-efficient project.

It just needs to be detailed enough to allow the evaluators to make a reasonable match with any projects in the program tracking data.

Calculating program attribution for candidate spillover actions

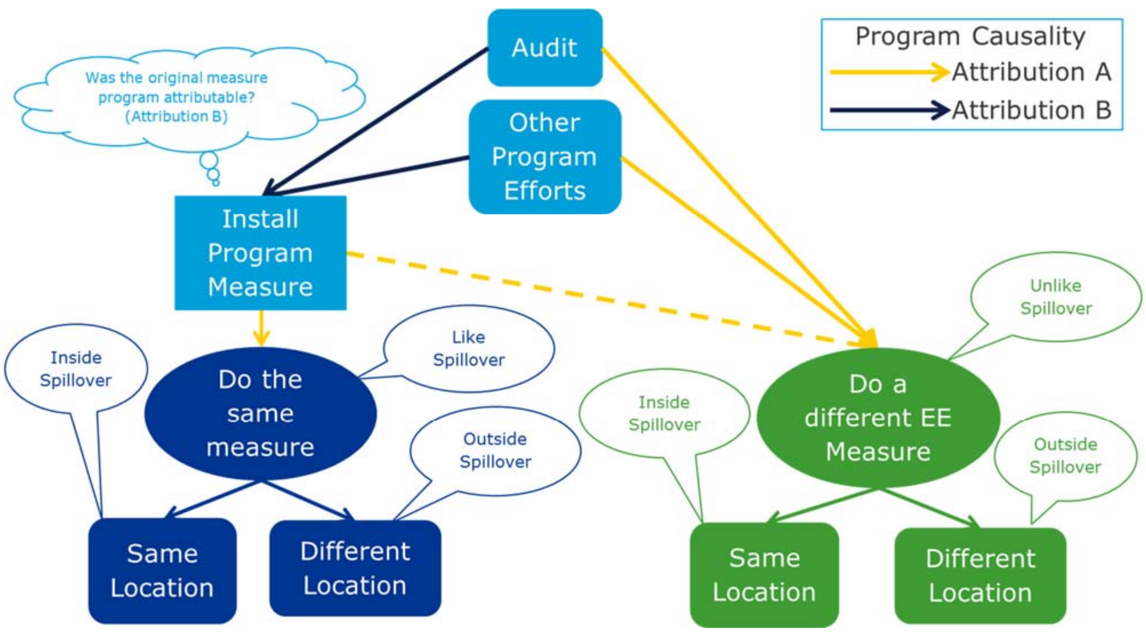
The next stage of the survey will focus on program attribution. Our method only awards spillover energy savings if two criteria are met:

ES1. The potential spillover project is at least partially attributable to the participant's experience with the program in implementing the earlier tracked project (Attribution Factor A).

For like spillover, the original tracked project is at least partially attributable to the program (Attribution Factor B). For unlike spillover, Attribution B will apply if the respondent indicates that the original program measure (separate from other program efforts) was a factor in their decision.

Figure 8-20 shows how program causality ties to different types of spillover. Attribution B applies to like spillover in all cases, while for unlike spillover attribution B applies to the spillover only if the original program measure was part of the program influence that led to the spillover measure being implemented.

Figure 8-20: Program influence on spillover by type



If a measure met these two criteria, we assign it spillover savings according to the following formula:

(Spillover Savings) = (the measure's savings) X (Attribution Factor A) X (Attribution Factor B).

We apply both Attribution Factor A and Attribution Factor B because if the program had no influence on the original tracked project, the program should not get credit for any additional measure installations resulting from that tracked project. To reduce respondent fatigue, Attribution Factor A will be asked in the CATI survey, while Attribution B will only be asked in the Engineering follow up IDI. If Attribution A is zero we will not conduct a follow up interview.

To determine attribution factor B we will use the FR question battery already described in this SOW. For Attribution factor A we will use a scoring method that will be triggered off the question, "If you had not made the earlier energy-efficiency improvements I just listed, how likely would you have been to make this additional energy efficiency improvement?" The scoring method, which we used in Wisconsin for many years, is shown in Table 8-87. If the participant said they were very likely to have made the additional energy efficiency improvement without the program, then we will terminate the survey since there will be no participant spillover to be measured. If the subsequent measure is fully or partially attributable, then for unlike spillover a follow up question will be administered to assess whether Attribution B is applicable.

Table 8-87: Program Attribution for Subsequent Measures

If had not made tracked program-influenced energy efficiency improvement, reported likelihood of making subsequent energy efficiency improvement		Assigned Attribution Factor A
1	Not likely at all	1.00
2	Not very likely	0.90
3	Somewhat likely	0.55
4	Very likely	0.00

The reason we use a different method for Attribution Factor A than for Attribution Factor B is that the character of influence is different. For the program's influence on the tracked project (Attribution Factor B) financial incentives usually account for much of the influence in terms of reducing payback periods and therefore we want to measure things like acceleration effects. However, with participant spillover the influence is less tangible and more likely to be general positive experience with a new energy-efficient technology and the energy savings it produces. We believe that using a Likert scale question will better capture the less tangible character of this type of influence.

Avoiding double counting of energy savings

Once a participant has identified a subsequent project that is attributable – e.g. one where Attribution Factor A and Attribution Factor B are both greater than zero -- then we will conduct some additional checks to insure that the subsequent project is not also a tracked project. Some of these checks will occur in the survey itself. For example, we will ask the participants if they recall receiving financial incentives from an energy efficiency program for the subsequent projects. We will also examine the program tracking data to make sure that the subsequent project is not in the tracking program data for future years. For example, if we interview a 2013 participant and they identify a subsequent project in 2014 we will look at the 2014-2015 program tracking data (we will look at both program years in case their memory of the project timing was faulty) to see if we can find that project. If we do find the subsequent project in program tracking data, then we will remove that project as a candidate for spillover energy savings since the savings for that project has already been claimed by the program.

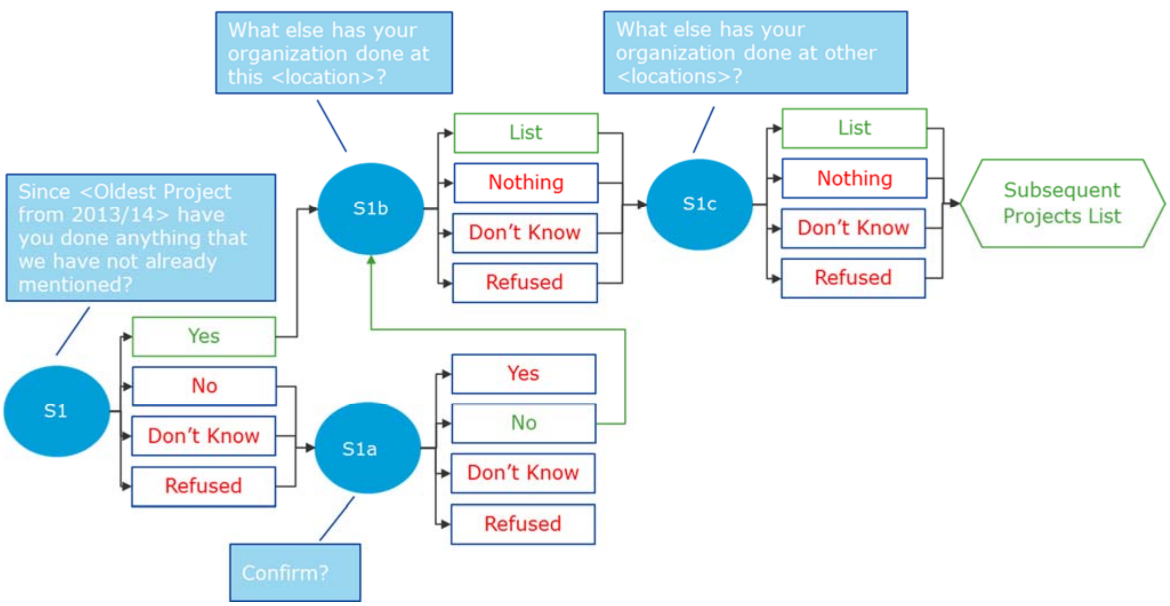
Estimating energy savings for participant spillover measures

Once a project has been identified as having spillover energy savings (it is program attributable and we could not locate it in the program tracking data) the final step will be to estimate its energy savings. To estimate the annual energy savings for participant spillover measures, we plan to have engineers conduct follow-up interviews with the persons identified in the CATI surveys as being most familiar with the spillover projects. The engineers will have some basic project information collected from the CATI survey as well as some information about deemed savings algorithms for that measure which will allow them to prepare ahead of time the types of questions they will need to ask (e.g., about baseline measures, hours-of-use, etc.). Once they have conducted the interview and collected the necessary information they will calculate the first-year savings and EUL for the measure. If a deemed savings algorithm exists for that measure they will use that as a default. If none exists then they will use their best professional judgment to estimate the energy savings. This process will work equally well for both like and unlike spillover.

Spillover decision trees

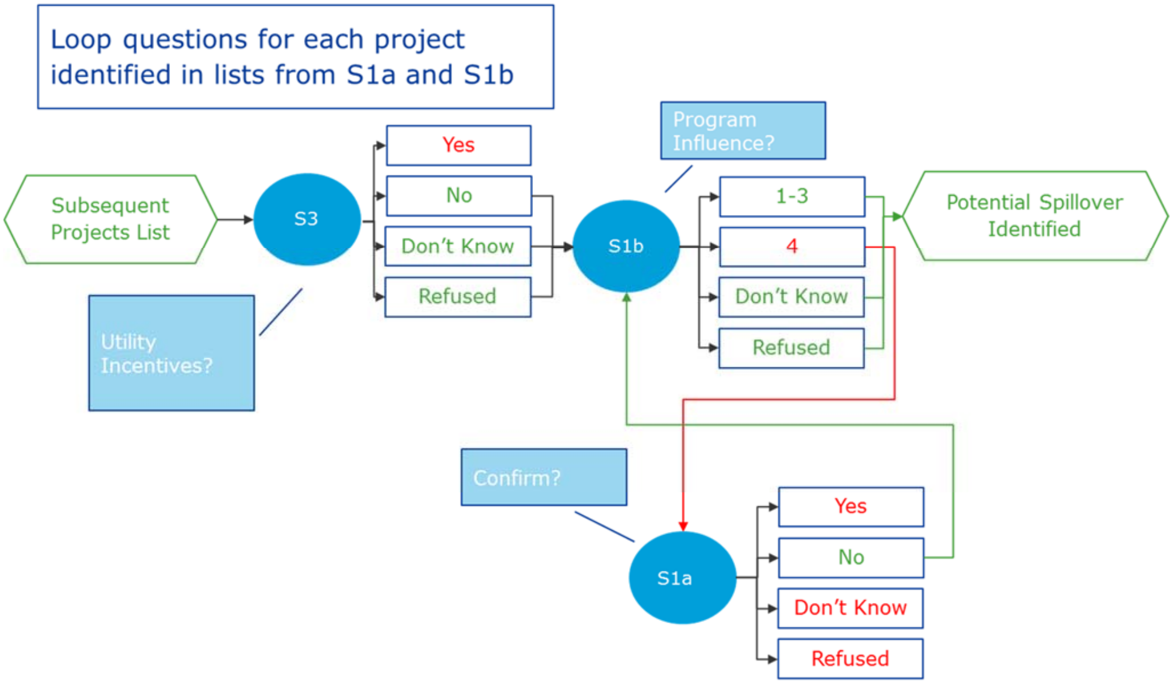
The initial participant IDI and participant CATI each include a spillover module that produces a list of potential spillover projects for each participant. The first part of the module (Figure 8-21) generates a list of changes to energy using equipment at the same location as the original measure and another list of changes to equipment at other locations.

Figure 8-21. Spillover module Part 1: identify subsequent projects



The second part of the module (Figure 8-22) loops through the list of subsequent projects to eliminate projects that received utility incentives and to establish program influence. The projects identified that were program influenced are referred to as potential spillover and will receive a follow up engineering interview to quantify savings.

Figure 8-22. Spillover module Part 2: subsequent project loop



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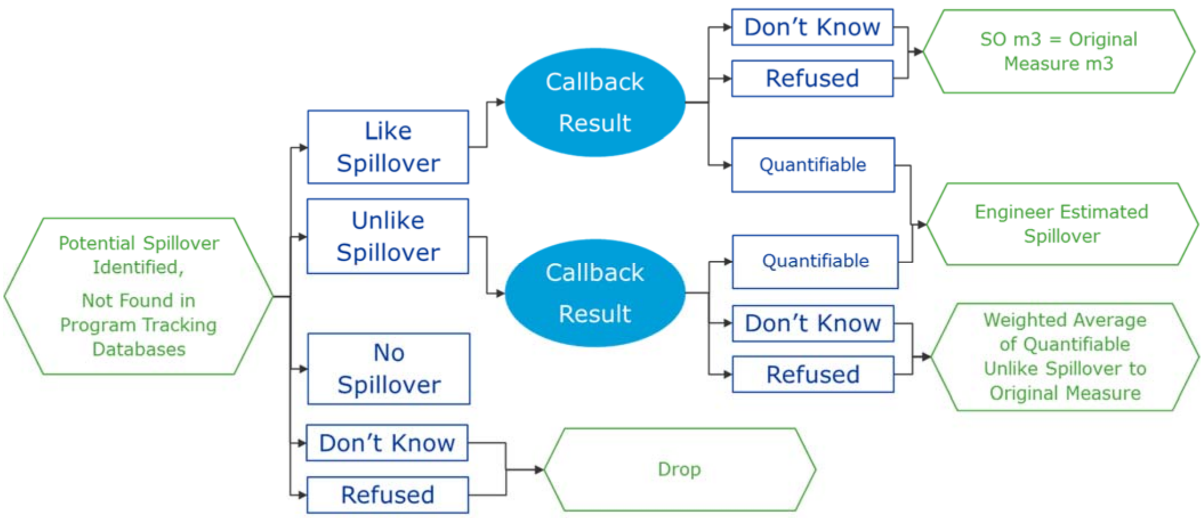
Potential spillover projects that are not found in program tracking databases will receive a call from a DNV GL engineer. If the customer refuses the interview or the evaluation engineer is not able to find a contact who can answer technical questions, the spillover will be quantified in one of two ways (Figure 8-23). If the project is like spillover we will use the savings of the original program measure as the basis for the savings estimate. If the project is unlike spillover we will use the average of other sites with unlike spillover for the estimate.

Figure 8-23. Spillover callback high-level process



APPENDIX M. SAMPLE EXPANSION AND RATIO ESTIMATION

Sample weights

this appendix describes how we calculate the sample weights for each stratum. In lay terms the weight is simply the number of units in the sample frame (N) divided by the number of completed units in the sample (n). The interpretation of the weight is that each completed sample unit represents N/n units in the population (sample frame).

Notation:

N_x = number of units of analysis in stratum X

n_x = number of completed sample units of analysis in stratum X

The weight W_x is calculated as

$$W_x = N_x / n_x$$

We can understand the weight as meaning the response for one sampled unit in stratum X is representative of W_x units in the population. Table 2 shows a simple example. In the example, we completed 2 surveys with participants in the "North" and 10 surveys with participants in the "South." The weight for the "Northerners" is greater than that of the "Southerners," but because we completed more surveys with "Southerners" the combined weight of the "South" will be in proportion to its share of the population (both the population and sum of weights is 20).

Table 2: Example Sample Weights

Stratum Definition	Sample Frame (N)	Sample Completes (n)	Weight (W)	Interpretation
North	10	2	5 = 10/2	Each response represents 5 Northern participants
South	20	10	2 = 20/10	Each response represents 2 Southern participants

Without sample weights, the data collected from the "North" would be 17% (2/12) of the final result, while with weights, the "North" is 33% (10/30). The un-weighted result would be less accurate than the weighted result if the measured value differs along North/South lines. For example, if the "North" is more conservative than the "South" then political surveys without sample weights would end up with inaccurate results. If responding to surveys is negatively correlated with conservatism, then the weights help correct for the systemic bias in response rates.

The sample weight associated with an observation is consistent regardless of the segmentation of the data that we report by (reporting domains). This means that we can segment the data multiple ways in the report, with the final overall results consistent no matter the domain.

Special cases

There are some special cases where the sample weight for a project needs to be set to 1 in order to use the data collected without biasing the result. Our sample design targets measures within a site and sample weights are developed at that level as well. When we collect data from a customer we will collect data on all of a customer's measures in a single IDI or site visit. This maximizes the data collected on each customer contact, but requires special handling to ensure that extra data collected does not bias the sample. To eliminate the potential bias of over representing multiple measure sites, we first identify units that were completed as an add-on when another measure was selected for a site.

For each stratum in our sample design the units are randomly ordered for selection in a list. If seven units are targeted for the stratum then the first seven units on the list are the primary sample and the rest of the list comprises the full backup sample (when we request project documentation we will restrict the backup sample for the request in order to reduce burden on utility staff). If a site has two measures in different strata and one is selected in the primary sample, we will request documents on both measures and ask about both, regardless of whether the second measure is in the primary or backup sample in its stratum. After collecting data on both measures we will assess whether the second measure was selected in its stratum based on how far down the list we had to go to complete our target. If the second measure's spot on the list was selected, then the measure will be counted as a normal complete and included in the stratum's N/n weight calculation. If the measure's spot on the list did not come up, the data collected for the measure will be used, but the measure will not be included in the N/n weight for its strata. Instead it will be given a weight of 1 so that it represents itself and no other measures. For variance estimates, the measure will remain in its sampled stratum.

Table 8-88 provides an example. Both site A and Site B were had measures in Stratum X selected in the sample. Each responded to our interview. Both sites also had a measure in Stratum Y. The evaluation completed data collection for both measures for each site. Due to where each of the sites' second measures were on the original priority list in stratum Y, the second measure for each site received different weights despite being in the same stratum.

Table 8-88: Determining non-randomly selected measures

Strata	Priority	Site	Measure	Survey Status	Selection Type	Weight
X	1	**A**	**A1**	**Complete**	**Random**	**3 / 2**
X	2	**B**	**B1**	**Complete**	**Random**	**3 / 2**
X	3	C	C1	live		
Y	1	D	D1	Complete	Random	8/3
Y	2	E	E1	Refused		
Y	3	**A**	**A2**	**Complete**	**Random**	**8 / 3**
Y	4	F	F1	Complete	Random	8/3
Y	5	G	G1	live		
Y	6	**B**	**B2**	**Complete**	**Not Random**	**1 / 1**
Y	7	H	H1	live		
Y	8	I	I1	live		
Y	9	J	J1	live		

The measures in Stratum X each were selected randomly. Measure A1 was first on the priority list and measure B1 was second. Because both A1 and B1 were completed and the target was 2 for the strata, site C was not called. Because site C was not called, measure C1 had a final survey status of "live." In the case of stratum X, there were 3 measures and 2 were completed. This resulted in a sample weight of 3/2 for each of the two completed measures.

In stratum Y four measures were completed. In this example the target for the stratum was achieved prior to calling site G. The evaluation attempted data collection for the first 4 measures on the list. Site E refused the survey or otherwise did not respond. Sites D, A, F and G completed the survey, but B did not come up in the priority list until after site G (the first "live" site in the list). In this case measure B2 was not selected randomly and needs to be treated as a special case. Measure B2 is removed from the stratum Y weight calculation, so the three measures that were completed receive a weight of 8/3 (once measure B3 is removed there are eight measures in the frame, and 3 completed measures). Measure B2 receives a weight of 1.

Ratio estimation

The calculation of the adjustment factors for tracking system gross and net savings uses appropriate case weights corresponding to the sampling rate as discussed above. The energy saving estimates (tracking savings, installed savings, verified savings or net savings) of the sampled units (measures, projects, sites) are present in both the numerator and the denominator of the ratios, when combined with the sample weights the ratio estimation method produces unbiased, savings weighted adjustment factors.

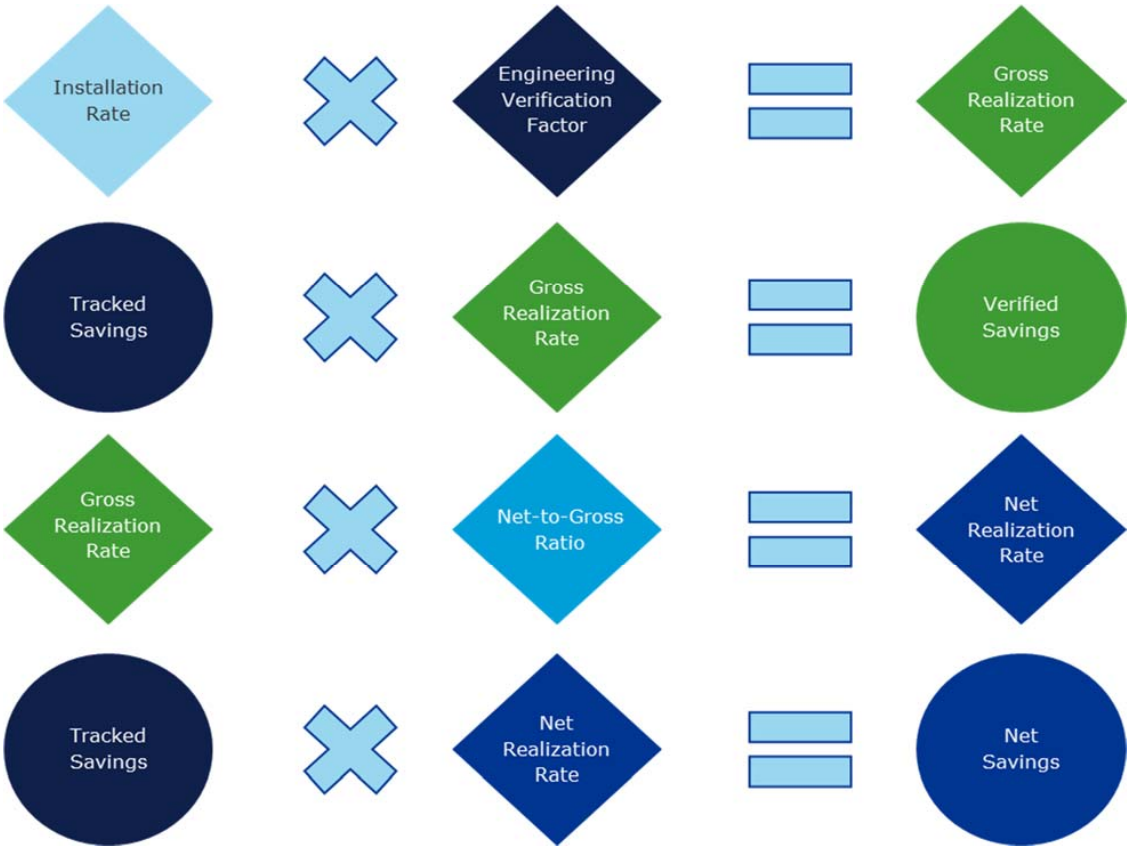
Collecting data on verified and net savings for the same set of measures provides a more accurate estimate of net savings. Integrating the two allows the evaluation to calculate net savings for a measure as a function of verified savings rather than tracking savings. This means that projects carry the weight of their specific verified savings in the net-to-gross ratio rather than tracking savings or a broader estimate of verified savings. Large verification adjustments can have a large effect on the relative weight of specific projects in the NTG.

For an individual measure:

- Installed savings are a function of the tracking savings. When the measure is installed the installed savings equal tracking savings and when the measure is not installed, then installed savings are zero.
- Verified savings are calculated independent of the tracking savings by evaluation engineers using the best available methods and information.
- Net savings are a function of verified savings. Attribution for the measure multiplied times verified savings plus spillover savings associated with the measure.

Individual measure results are expanded to the estimate population savings (circles) using ratios (diamonds), as shown in Figure 8-24. Ratios are applied for each of the primary reporting domains and then summed to calculate the total for the program overall.

Figure 8-24: Ratios used to estimate verified and net savings



Two general ratio calculation approaches are employed: directly calculated and combined. The description of the process is easiest to understand through an example. The example below has three directly calculated adjustment factors: the installation rate, the engineering adjustment, and the net-to-gross factor. Each of these is calculated as a ratio estimator over the sample of interest (Cochran, 1977, p.165). The formulas for these factors are given below.

Notation: The following terms are used in calculating the adjustment factors:

G_{Tj} = tracking estimate of gross savings for measure *j*

G_{Ij} = tracking estimate of gross savings for measure *j*, adjusted for non-installation

G_{Vj} = engineer verified estimate of gross savings for measure *j*,

N_{Vj} = Net verified estimate of gross savings for measure *j*,

W_{Vj} = weighting factor for measure j used to expand the CPSV sample to the full population

W_{Nj} = weighting factor for measure j used to expand the FR sample to the full population

The installation rate R_I is calculated using the CPSV sample as

$$R_I = \frac{\sum_{j\varepsilon A} G_{Ij} w_{Vj}}{\sum_{j\varepsilon A} G_{Tj} w_{Vj}}$$

The Engineering Adjustment R_E is calculated from the CPSV sample as

$$R_E = \frac{\sum_{j\varepsilon V} G_{Ej} w_{Vj}}{\sum_{j\varepsilon V} G_{Ij} w_{Vj}}$$

The Attribution ratio R_A is calculated from the FR sample as[37]

$$R_A = \frac{\sum_{j\varepsilon N} N_{Vj} w_{Nj}}{\sum_{j\varepsilon N} G_{Vj} w_{Nj}}$$

The procedure used for calculating ratio estimation by domains provides the correct standard error of the estimate for each domain and overall. The procedure also takes into account defined clusters of observations (customers) and stratification. The standard error is calculated using two methods.

The first method recognizes the sample as drawn from a finite population: the measures completed within the analysis period with associated energy impacts in the program-tracking database. This calculation uses the Finite Population Correction (FPC) factor. This factor is a reduction to the calculated variance that accounts for the fact that a relatively large fraction of the population of interest has been observed directly and is not subject to uncertainty. It is appropriate to apply precision statistics, such as confidence intervals, based on the standard error calculated in this manner when quantifying the results of the program during the study period only. The FPC factor reduces the calculated sampling error around the estimate more for smaller populations than for large.

The second calculation treats the population of interest as essentially infinite. Thus, the measures completed to date and the sample selected from them is regarded as random instances of a virtually infinite number of measures that could have been completed under the program. In this case, the FPC is not included. It is appropriate to apply standard errors calculated in this manner when applying the verification factors developed from this study to tracked savings from other years to estimate verified savings in those years.

The Gross RR, R_V, is calculated by chaining together the installation rate and the calculation adjustment:

$$R_V = R_I R_E = \left[\frac{\sum_{j\varepsilon V} G_{Ij} w_{Vj}}{\sum_{j\varepsilon V} G_{Tj} w_{Vj}}\right]\left[\frac{\sum_{j\varepsilon V} G_{Cj} w_{Vj}}{\sum_{j\varepsilon V} G_{Ij} w_{Vj}}\right]$$

This is an example of a chained ratio estimator using a nested sample. The standard error for the chained ratio is approximated by the formula:

$$SE(AB) \cong AB\sqrt{\left[\left(\frac{SE(A)}{A}\right)^2 + \left(\frac{SE(B)}{B}\right)^2\right]}$$

(This formula overstates the standard error, because it ignores the correlation between the numerator of R_I and the denominator of R_E, which reduces the variance of the product.)

[37] For the net-to-gross ratio, the verified gross savings for measures in the FR only sample (G_{Vj}) were estimated based on the gross RRs found for measures of the same measure type in the CPSV sample.

Likewise, the Net RR, R_N, is calculated by chaining together the gross realization rate and the net-to-gross ratio:

$$R_N = R_V R_A$$

The same standard error approximation formula allows (an over-estimate of) the standard errors of each of the realization rates to be calculated from the two separate standard errors.

Ratio estimation example

This section provides an example of the ratio estimation procedure. The results in this section are for explanatory purposes only.

The installed savings, and engineering verified savings, are calculated at the measure level and summed to the Measure Type level for each customer in the sample that completed a survey. Attribution is collected at the measure type level and is a function of the verified measure type savings for the customer. The sample weights are applied to the measure type level savings which is the unit of analysis. Table 8-89 shows the reported, installed and verified savings and NTG for Example Customer A's four measures reported in the program tracking database.

Table 8-89: Example Customer A in CPSV and NTG sample

Measures	Measure Type	Reported m3	Installed m3	Verified m3	NTG
Space Heat Boiler 1	Space Heat	80,000	80,000	100,000	100%
Space Heat Boiler 2	Space Heat	56,000	56,000	55,000	
Process Heat	Process Heat	150,000	150,000	120,000	80%
Steam Trap Repair	Maintenance	12,000	12,000	14,000	20%

DNV GL engineers confirmed the customer installed all of the measures that were reported by the program; therefore, installed savings are equal to the reported savings. If a measure was initially reported as not installed, a second DNV GL engineer would contact the customer to verify this result. The engineering review produced adjustments to the installed savings for the first three of Customer A's reported measures, resulting in differences between the verified gross savings and installed savings for those measures.

The attribution rate is calculated for each measure type using the customer and supplier survey, if applicable, for Example Customer A using the methods that will be provided with the survey instruments. The measure type level attribution rates are then applied to the aggregated measure type level verified gross savings to estimate measure level net savings. Example Customer A received 100% attribution for the two space heat measures, 80% attribution for the process heat measure, and 20% attribution for the maintenance measure. Table 8-90 shows the verified gross and net savings for Example Customer A.

Table 8-90: Example Customer A net savings

Measure Type	Verified m3	NTG	Net m3
Space Heat	155,000	100%	155,000
Process Heat	120,000	80%	96,000
Maintenance	14,000	20%	2,800

Similar estimates are created for each customer in the sample. For this example, we assume Example Customers A to F comprise the Industrial Sector sample. Table 8-91 shows the un-weighted customer and commercial sector savings results.

Table 8-91: Example industrial sector measure-type-level sample

Customer	Measure Type	Reported m3	Installed m3	Verified m3	Net m3
A	Space Heat	136,000	136,000	155,000	155,000
A	Process Heat	150,000	150,000	120,000	96,000
A	Maintenance	12,000	12,000	14,000	2,800
B	Process Heat	250,000	250,000	180,000	180,000
B	Maintenance	20,000	20,000	14,000	0
C	Space Heat	150,000	150,000	140,000	35,000
D	Process Heat	80,000	80,000	81,000	81,000
E	Space Heat	70,000	70,000	70,000	0
F	Space Heat	14,000	14,000	13,000	0

Each customer in the sample frame is assigned to a sampling stratum as described in the sampling plan. Each customer in the sample is assigned a sampling weight based on the sample design and the number of completed sample points in each stratum. Assume that Example Customers A and C each have a space heat measure in a stratum that has four measures in the sample frame. The sampling weight for the space heat measures for Customers A and C is equal to the number of customers in the sample frame stratum divided by the number of stratum customers in the sample, or 4/2 = 2. The weighted savings for each customer is equal to the weight times the savings value. Table 4 shows the weights and savings (un-weighted and weighted) for each customer in the Example Industrial Sector if we assume the measure type weights shown.

Table 8-92: Example industrial sector measure-type-level weighted savings

			Reported m3		Installed m3		Verified m3		Net m3	
Customer	Measure Type	Weight	unweighted	weighted	unweighted	weighted	unweighted	weighted	unweighted	weighted
A	Space Heat	2	136,000	272,000	136,000	272,000	155,000	310,000	155,000	310,000
A	Process Heat	3.5	150,000	525,000	150,000	525,000	120,000	420,000	96,000	336,000
A	Maintenance	20	12,000	240,000	12,000	240,000	14,000	280,000	2,800	56,000
B	Process Heat	1	250,000	250,000	250,000	250,000	180,000	180,000	180,000	180,000
B	Maintenance	18	20,000	360,000	20,000	360,000	14,000	252,000	0	0
C	Space Heat	2	150,000	300,000	150,000	300,000	140,000	280,000	35,000	70,000
D	Process Heat	3.5	80,000	280,000	80,000	280,000	81,000	283,500	81,000	283,500
E	Space Heat	15	70,000	1,050,000	70,000	1,050,000	70,000	1,050,000	0	0
F	Space Heat	25	14,000	350,000	14,000	350,000	13,000	325,000	0	0

The next step is to determine program overall adjustment factors. For kWh the Industrial Sector the installation rate, engineering verification factor, and attribution adjustment factor are:

- 3,627,000 weighted installed m^3 / 3,627,000 weighted reported m^3 = 100% installation rate
- 3,380,500 weighted verified gross m^3 / 3,627,000 weighted installed m^3= 93.2% eng. verification factor
- 1,235,500 weighted net m^3 / 3,380,500 weighted verified gross m^3 = 36.5% attribution adjustment.

The verified gross RR is the product of the installation rate and the engineering verification factor, or 100% times 93.2%= 93.2% for this example. The net RR is the product of the verified gross RR and the attribution adjustment, or 93.2% times 36.5% = 34.018% for this example.

The same principle can be applied to each Measure Type to get the Measure Type level adjustment factors. With the unit of analysis remaining the same (at the measure type level), the same process can be used to produce adjustment factors for any domain that we are able to define for the whole sample.

Applying ratios to domains

Ratio application refers to multiplying the gross RR and net RR times the program tracking savings to produce the total verified and net savings results for a program.

The general formula for total verified gross savings is:

The general formula for total net savings is:

The body of the report discusses how to calculate the population adjustment factors, which are based on a finite, fixed distribution of projects. You can also calculate for subsets, called domains. Viewing domain-level results allows for insights into program performance that can lead to program improvements. Domain-level ratios can also be used to apply ratios and calculate overall program savings totals. The ratio results will be generated for each of the domains of interest (subsets of the population that stakeholders agree are important) and overall for each of the utilities' programs.

The level at which one applies the ratios has an effect on the overall verified and net savings estimate for each program. There are two basic approaches that we take. The first is to apply the overall program ratio. This is appropriate to retrospective evaluation where the population that the applied ratio is the same as the population of study and is static.

The second is to apply the ratio at the domain level. This is appropriate for all uses and recommended for estimating savings for programs or program years that are not the same as the population of study. Another approach is to apply the ratio at the stratum level. This is really a subset of the domain application approach where the domain used is the sample strata.

We recommend applying ratios by domains in most cases in order to improve accuracy. Assuming a sufficient sample size in each domain, domain-level precisions are usually sufficient for the approach. While 90/10 relative precision is typically the threshold targeted for an overall result, precisions usually have lower threshold for domain-level application as the resulting precision of the overall result will be better than the component parts.

If one domain has an extreme adjustment, the accuracy of the overall result is improved if domain level ratios are applied to the domain level savings. Table 8-93 shows an example where we apply the gross RR and net RR directly and by domains. The sample weighted savings in the example closely match the population savings: one domain, process heat, is 3.2% different, while the other domains are each within 3% and overall the difference is less than 1%. The ratios and resulting savings are also similar, within one% of one another. Though the results in the example are similar, the final net savings are more accurate when calculated by domains. In the example, both space heat and maintenance measures had very different attributions from process heat and each were slightly over-represented in the weighted sample savings, which resulted in lower net savings when we applied the overall ratio directly.

Table 8-93: Example of ratios applied overall vs. by domains

	A	B	C	D		
Measure Type	**Population m3**	**Sample Weighted m3**	**Gross RR**	**Net RR**	**Verified Gross Savings (A*C)**	**Net Savings (A*D)**
Space Heat	1,950,000	1,972,000	99.6%	19.3%	1,943,078	375,761
Process Heat	1,090,000	1,055,000	83.7%	75.8%	912,810	826,024
Maintenance	585,000	600,000	88.7%	9.3%	518,700	54,600
Overall - Ratios Applied Directly	3,625,000	3,627,000	93.2%	34.1%	3,378,636	1,234,819
Overall - Ratios Applied by Domains and Summed	3,625,000		93.1%	34.7%	3,374,589	1,256,384
Difference			0.1%	-0.6%	4,047	-21,566

Neither applying the overall ratio directly nor by domains has an inherent systemic bias, but when the differences among the domain ratios are significant, applying by domains results in improved accuracy.

The choice between how to apply the ratios does not affect whether or which domains are reported. There is a large inherent value in looking at program results by multiple domains in order to better understand where the program is doing well and what areas have room for improvement.

Criteria for selecting domains for reporting and application

DNV GL will select the domains that are reported and those that will be applied to estimate gross and net savings for the programs.

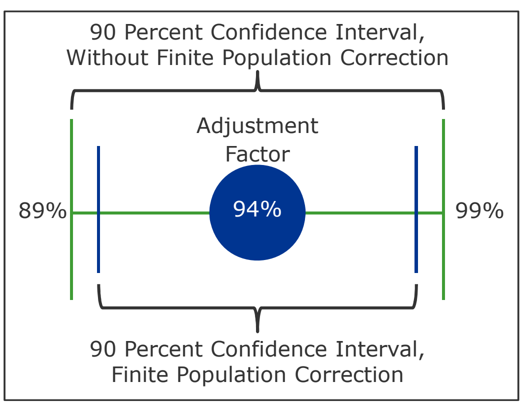
Table 8-94: Relevant statistics.

Term	Definition
Ratio / Adjustment factor	A point estimate of the evaluation findings expressed as a percent.
+ / - or Absolute Precision	If the evaluation were repeated several times selecting samples from the same population, 90%[38] of the time the ratio would be within this range of the ratio
Confidence interval	The upper bound is defined by the ratio plus the absolute precision. the lower bound is defined by the ratio minus the absolute precision.
Relative Precision	The relative precision is calculated as the absolute precision divided by the ratio itself. By convention, relative precisions are the statistic that are targeted in sampling (i.e., 90/10 is a relative precision metric)
Finite population correction (FPC)	FPC is a factor that reduces the measured error of samples drawn from small populations (less than 300). FPC applies when the ratio is applied to the same population from which the sample was drawn.

Figure 51 shows an example:

- the adjustment factor (ratio) as a blue point
- the 90% confidence interval *with finite population correction* (blue)
- the 90% confidence interval *without finite population correction* (green)

Figure 8-25: Ratio diagram example



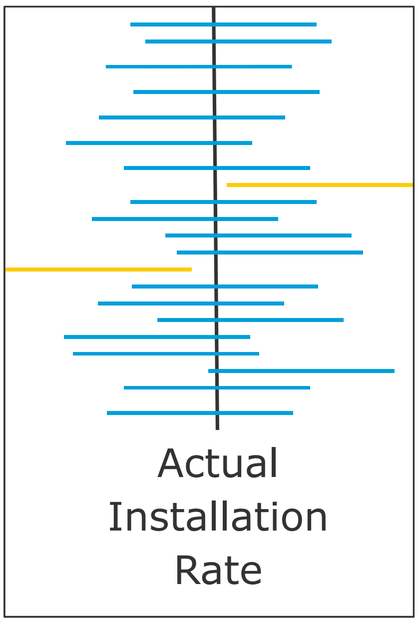
The plus/minus (±) error (%) indicated at the 90% confidence interval is the absolute difference between the estimated percentage and the upper or lower confidence bound. For example, in Figure 51, the ratio is 94% and the non-FPC 90% confidence interval is ± 5 percentage points (i.e., 94% ± 5%).[39] Another way of

[38] 90% is the confidence limit that we are using.

[39] The critical value for calculating the confidence interval ± for each adjustment factor is determined using Student's t-distribution and n-1 for the degrees of freedom, where n is the sample size. The critical value for the gross savings adjustment factor is determined using the degrees of

saying this is that there is a 90% probability that the actual ratio for the next year's program lies between 89 and 99%. Figure 8-26 demonstrates this concept by showing twenty hypothetical confidence intervals calculated from twenty different samples of the same population. Eighteen out of twenty (90%) include the true population ratio

Figure 8-26. Ninety Percent Confidence Interval



Note: Each horizontal line represents a confidence interval. Yellow confidence intervals do not include the actual ratio.

The relative precision of the ratio is calculated as 5%/94% =5.3%.

For low ratios, relative precisions may be quite high, even when the confidence interval around the ratio is quite narrow. Consider a ratio of 40% with the same 5% absolute precision as in the above example. While the absolute precisions are the same, the latter ratio (40%) has a relative precision of 5%/40% =12.5%.

Because relative precisions can over-represent error for low ratios (and under-represent errors for ratios above 100%), we prefer to set thresholds for reporting and application based on the absolute precision rather than the relative precision.

For determining which ratios to report and apply we will use the following rules:

- The minimum sample size for a reporting or application domain will be five.
- The absolute precision threshold for reporting ratio for a domain will be +/- 20% at 90% confidence with FPC-on.
- The absolute precision threshold for applying ratio for a domain will be +/- 15% at 90% confidence with FPC-on for retrospective application.
- The absolute precision threshold for applying ratio for a domain will be +/- 20% at 90% confidence with FPC-off for prospective application.

freedom based on the minimum sample size for the components of the adjustment factor. The gross savings adjustment factor is a product of the installation rate and the engineering verification factor. For 2-tailed estimates (ratios that could be above or below 100%) the appropriate t-stat used to calculate precision from the standard error is close to 1.645.

Reporting domains will be defined as combinations of the following categorizations where sample sizes and precisions allow:

- Stratification segments
- NTG Category (for FR and SO)
- CPSV Category (for Gross results)
- Measure types (shown in later tables)

Table 8-95 and Table 8-97 present the maximum number of reporting domains for the NTG results and Table 8-98 and Table 8-99 present the maximum number of reporting domains for the CPSV results.

There will be cases where some of the groups defined by a categorization have sufficient precision, while others do not. In these cases, we will combine the groups that do not meet reporting thresholds into an "other" group. For example, we may have sufficient precision to report separate ratios for Enbridge Commercial Controls, Heat Recovery and HVAC, but not enough to report the ratios for the other six measure types. In this case, we will report the three groups that we have sufficient precision for and group the rest into a "Balance of commercial/Other" group. Table 8-96 provides an example of how the Enbridge NTG domains presented in Table 8-95 could potentially be collapsed during ratio estimation.

No results will be reported that blend Union and Enbridge samples. Large Volume and RunitRight will also not be combined with other programs segments due to their different designs.

For application of CPSV results our initial list of application domains will be within stratification segment with separate domains for each CPSV category and measure type (as shown in the tables below). Those domains that meet the pre-defined precision and sample size criteria, described above, will have results applied at this level. For the rest of the list we will combine domains in the most logical manner appropriate to the ratio in order to achieve combinations that meet criteria and where possible are a meaningful grouping of measures. For example, we will combine CPSV categories within measure types and combine measure types within CPSV categories as is most reasonable given the estimation approaches used (i.e. if there is little difference in simple vs complex measures in the calculation method for building shell measures we would combine the simple and complex building shell first rather than simple building shell into a "simple-other" domain).

For application of NTG results the same process will be used as for CPSV, but with the NTG category substituting for the CPSV category.

Table 8-95. Enbridge NTG domains

Utility	Program	NTG Category	Measure Type
Enbridge	Commercial	Action	Operational Improvements
Enbridge	Commercial	Equipment	Building Shell
Enbridge	Commercial	Equipment	Controls
Enbridge	Commercial	Equipment	HVAC
Enbridge	Commercial	Equipment	Heat Recovery
Enbridge	Commercial	Equipment	Steam and Hot Water
Enbridge	Industrial	Action	Operational Improvements
Enbridge	Industrial	Equipment	Building Shell
Enbridge	Industrial	Equipment	Controls
Enbridge	Industrial	Equipment	Greenhouse
Enbridge	Industrial	Equipment	HVAC
Enbridge	Industrial	Equipment	Heat Recovery
Enbridge	Industrial	Equipment	Other Equipment
Enbridge	Industrial	Equipment	Process Heat
Enbridge	Industrial	Equipment	Steam and Hot Water
Enbridge	Multi-Residential	All	Controls
Enbridge	Multi-Residential	All	HVAC
Enbridge	Multi-Residential	All	Heat Recovery
Enbridge	Multi-Residential	All	Operational Improvements
Enbridge	Multi-Residential	All	Steam and Hot Water
Enbridge	RunitRight	Action	RunitRight

Table 8-96. Example of potential Enbridge NTG domain collapsing

Utility	Program	NTG Category	Measure Type
Enbridge	Commercial & Multi-Residential	Equipment	Controls
Enbridge	Commercial & Multi-Residential	Equipment	HVAC
Enbridge	Commercial & Multi-Residential	Equipment	Steam and Hot Water
Enbridge	Commercial	Equipment	Other Commercial Equipment
Enbridge	Industrial	Action	Operational Improvements
Enbridge	Industrial	Equipment	Controls
Enbridge	Industrial	Equipment	Heat Recovery
Enbridge	Industrial	Equipment	Other Industrial Equipment
Enbridge	Multi-Residential	All	Multi-Residential Other
Enbridge	RunitRight	Action	RunitRight

Table 8-97. Union NTG domains

Utility	Program	NTG Category	Measure Type
Union	Commercial	Action	Controls
Union	Commercial	Action	Maintenance
Union	Commercial	Action	Optimization
Union	Commercial	Action	Steam and Hot Water
Union	Commercial	Equipment	Building Shell
Union	Commercial	Equipment	Controls
Union	Commercial	Equipment	HVAC
Union	Commercial	Equipment	Heat Recovery
Union	Commercial	Equipment	New Construction
Union	Commercial	Equipment	Other Equipment
Union	Commercial	Equipment	Steam and Hot Water
Union	Industrial	Action	Controls
Union	Industrial	Action	HVAC
Union	Industrial	Action	Maintenance
Union	Industrial	Action	Optimization
Union	Industrial	Action	Steam and Hot Water
Union	Industrial	Equipment	Ag and Greenhouse
Union	Industrial	Equipment	Building Shell
Union	Industrial	Equipment	Controls
Union	Industrial	Equipment	HVAC
Union	Industrial	Equipment	Heat Recovery
Union	Industrial	Equipment	Other Equipment
Union	Industrial	Equipment	Process Heat
Union	Industrial	Equipment	Steam and Hot Water
Union	Large Volume	Action	HVAC
Union	Large Volume	Action	Heat Recovery
Union	Large Volume	Action	Maintenance
Union	Large Volume	Action	Optimization
Union	Large Volume	Action	Other Equipment
Union	Large Volume	Equipment	Ag and Greenhouse
Union	Large Volume	Equipment	Building Shell
Union	Large Volume	Equipment	Controls
Union	Large Volume	Equipment	HVAC
Union	Large Volume	Equipment	Heat Recovery
Union	Large Volume	Equipment	New Construction
Union	Large Volume	Equipment	Other Equipment
Union	Large Volume	Equipment	Steam and Hot Water
Union	Multi-Family	All	Controls
Union	Multi-Family	All	New Construction
Union	Multi-Family	All	Steam and Hot Water

Table 8-98. Enbridge CPSV domains

Utility	Program	CPSV Category	Measure Type
Enbridge	Commercial	Complex	Building Shell
Enbridge	Commercial	Complex	Controls
Enbridge	Commercial	Complex	HVAC
Enbridge	Commercial	Complex	Heat Recovery
Enbridge	Commercial	Complex	Operational Improvements
Enbridge	Commercial	Complex	Steam and Hot Water
Enbridge	Commercial	Simple	Building Shell
Enbridge	Commercial	Simple	Controls
Enbridge	Commercial	Simple	HVAC
Enbridge	Commercial	Simple	Heat Recovery
Enbridge	Commercial	Simple	Operational Improvements
Enbridge	Commercial	Simple	Steam and Hot Water
Enbridge	Industrial	Complex	Building Shell
Enbridge	Industrial	Complex	Controls
Enbridge	Industrial	Complex	Greenhouse
Enbridge	Industrial	Complex	HVAC
Enbridge	Industrial	Complex	Heat Recovery
Enbridge	Industrial	Complex	Operational Improvements
Enbridge	Industrial	Complex	Other Equipment
Enbridge	Industrial	Complex	Steam and Hot Water
Enbridge	Industrial	Simple	Building Shell
Enbridge	Industrial	Simple	Greenhouse
Enbridge	Industrial	Simple	HVAC
Enbridge	Industrial	Simple	Heat Recovery
Enbridge	Industrial	Simple	Operational Improvements
Enbridge	Industrial	Simple	Other Equipment
Enbridge	Industrial	Simple	Process Heat
Enbridge	Industrial	Simple	Steam and Hot Water
Enbridge	Multi-Residential	Complex	Controls
Enbridge	Multi-Residential	Complex	HVAC
Enbridge	Multi-Residential	Complex	Heat Recovery
Enbridge	Multi-Residential	Complex	Steam and Hot Water
Enbridge	Multi-Residential	Simple	Controls
Enbridge	Multi-Residential	Simple	HVAC
Enbridge	Multi-Residential	Simple	Heat Recovery
Enbridge	Multi-Residential	Simple	Operational Improvements
Enbridge	Multi-Residential	Simple	Steam and Hot Water

Table 8-99. Union CPSV domains

Utility	Program	CPSV Category	Measure Type
Union	Commercial	Complex	Building Shell
Union	Commercial	Complex	Controls
Union	Commercial	Complex	HVAC
Union	Commercial	Complex	Heat Recovery
Union	Commercial	Complex	Maintenance
Union	Commercial	Complex	New Construction
Union	Commercial	Complex	Optimization
Union	Commercial	Complex	Other Equipment
Union	Commercial	Complex	Steam and Hot Water
Union	Commercial	Simple	Building Shell
Union	Commercial	Simple	Controls
Union	Commercial	Simple	HVAC
Union	Commercial	Simple	Heat Recovery
Union	Commercial	Simple	Maintenance
Union	Commercial	Simple	Optimization
Union	Commercial	Simple	Other Equipment
Union	Commercial	Simple	Steam and Hot Water
Union	Industrial	Complex	Ag and Greenhouse
Union	Industrial	Complex	Building Shell
Union	Industrial	Complex	Controls
Union	Industrial	Complex	HVAC
Union	Industrial	Complex	Heat Recovery
Union	Industrial	Complex	Maintenance
Union	Industrial	Complex	Optimization
Union	Industrial	Complex	Other Equipment
Union	Industrial	Complex	Process Heat
Union	Industrial	Complex	Steam and Hot Water
Union	Industrial	Simple	Ag and Greenhouse
Union	Industrial	Simple	Building Shell
Union	Industrial	Simple	Controls
Union	Industrial	Simple	HVAC
Union	Industrial	Simple	Heat Recovery
Union	Industrial	Simple	Maintenance
Union	Industrial	Simple	Optimization
Union	Industrial	Simple	Process Heat
Union	Industrial	Simple	Steam and Hot Water
Union	Large Volume	Complex	Ag and Greenhouse
Union	Large Volume	Complex	Building Shell
Union	Large Volume	Complex	Controls
Union	Large Volume	Complex	HVAC
Union	Large Volume	Complex	Heat Recovery
Union	Large Volume	Complex	Maintenance
Union	Large Volume	Complex	New Construction
Union	Large Volume	Complex	Optimization
Union	Large Volume	Complex	Other Equipment
Union	Large Volume	Complex	Steam and Hot Water
Union	Multi-family	Complex	Controls
Union	Multi-family	Complex	Heat Recovery
Union	Multi-family	Complex	New Construction
Union	Multi-family	Complex	Other Equipment
Union	Multi-family	Simple	Building Shell
Union	Multi-family	Simple	Controls
Union	Multi-family	Simple	HVAC
Union	Multi-family	Simple	Steam and Hot Water

APPENDIX N. DATA COLLECTION INSTRUMENTS

The embedded documents below are the interview guides used for participant and vendor data collection for the NTG portion of the evaluation.

Participant IDI

Vendor IDI

APPENDIX O. FREE-RIDERSHIP SURVEY DATA QUALITY CONTROL

This appendix includes summaries of survey questions used to QC the attribution results. The QC process involves comparison of scored question responses to question responses in the same interview. Interviews with potentially conflicting responses are reviewed by the PM, who reads the entire interview before determining if an adjustment to a score is required. In total, 29 measure free ridership scores were adjusted through this process and five measures were dropped. Table 8-100 provides the count of measures adjusted for each utility and whether the adjustment increased (Inc) or decreased (Dec) attribution for that measure.

Table 8-100. PM Quality Assurance Adjustments.

PM Quality Assurance Status			Union			Enbridge			Overall		
			Inc	Dec	Total	Inc	Dec	Total	Inc	Dec	Total
Total Measures Completed from FR IDIs					281			177			458
Not Adjusted					260			164			424
PM Adjustments from QA	Dropped				4			1			5
	Assign DNK Attribution, but unclear amount.	Timing	1	0	1	0	0	0	1	0	1
		Efficiency	3	0	3	7	0	7	10	0	10
		Quantity/Size	2	0	2	1	0	1	3	0	3
	Adjust Score Attribution Clear based on open, conflicted with scored response	Timing	1	0	1	1	1	2	2	1	3
		Efficiency	3	1	4	1	0	1	3	2	5
		Quantity/Size	0	1	1	0	0	0		1	1
	Gross Baseline Efficiency Adjustment		3	2	5	0	1	1	3	3	6

The attribution results used to create the following tables also include the vendor component of attribution. Consequently, the attribution bin may be higher than reported by the customer alone. This section includes the following tables:

- PF8 responses by overall attribution bin
- PF9 responses by overall attribution bin.
- Dat0 responses versus overall attribution bin
- Dat6 responses versus overall attribution bin
- Dat6 responses versus overall spa bin

Union Commercial and Industrial Programs

Table 8-101. PF8 and Attribution Bin, Union Custom C&I programs*

PF8. For the project, did you become aware of utility program incentives and services…?					
Attribution Bin	PF8	Customers	Units of Analysis	Measures	Percent Savings
Full	Before starting the project	16	31	43	18%
	As soon as you began exploring equipment options	*	*	*	<1%
	While exploring equipment options, but before making equipment decision	*	*	*	5%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	*	*	*	<1%
	Don't Know/ Refused	0	0	0	0%
Partial	Before starting the project	26	46	64	23%
	As soon as you began exploring equipment options	6	7	10	4%
	While exploring equipment options, but before making equipment decision	*	*	*	<1%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	*	7	9%
None	Before starting the project	26	35	45	27%
	As soon as you began exploring equipment options	*	*	5	5%
	While exploring equipment options, but before making equipment decision	*	*	*	2%
	After making an equipment decision	5	6	6	3%
	After installing the equipment	*	5	5	4%
	Don't Know/ Refused	*	*	*	<1%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-102. PF9 and Attribution Bin, Union Custom C&I programs*

PF9. When did the utility first get involved in this project? Was it…					
Attribution Bin	PF9	Customers	Units of Analysis	Measures	Percent Savings
Full	Before starting the project	12	24	31	15%
	As soon as you began exploring equipment options	*	7	13	3%
	While exploring equipment options, but before making equipment decision	*	*	*	5%
	After making an equipment decision	*	*	*	<1%
	After installing the equipment	*	*	*	<1%
	Don't Know/ Refused	0	0	0	0%
Partial	Before starting the project	16	30	42	16%
	As soon as you began exploring equipment options	12	20	32	12%
	While exploring equipment options, but before making equipment decision	5	5	5	8%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	*	*	1%
None	Before starting the project	13	19	25	20%
	As soon as you began exploring equipment options	7	8	11	5%
	While exploring equipment options, but before making equipment decision	*	5	5	2%
	After making an equipment decision	8	9	9	5%
	After installing the equipment	*	7	9	7%
	Don't Know/ Refused	6	6	6	<1%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-103. Dat0 and Attribution Bin, Union Custom C&I programs*

DAT0. Without the program, would you say the likelihood of [installing / performing] the project was...?					
Attribution Bin	**Dat0**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	Very likely	*	*	6	2%
	Somewhat likely	*	*	5	3%
	Not very likely	6	7	8	3%
	Very unlikely	10	21	30	14%
	Don't Know/ Refused	0	0	0	0%
Partial	Very likely	12	13	15	11%
	Somewhat likely	17	19	25	13%
	Not very likely	7	20	34	11%
	Very unlikely	*	*	*	1%
	Don't Know/ Refused	*	*	6	1%
None	Very likely	33	41	46	30%
	Somewhat likely	9	10	16	11%
	Not very likely	*	*	*	<1%
	Very unlikely	0	0	0	0%
	Don't Know/ Refused	*	*	*	<1%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-104. Dat6 and Attribution Bin, Union Custom C&I programs*

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
Attribution Bin	Dat6	Customers	Units of Analysis	Measures	Percent Savings
Full	0%	8	18	25	15%
	1% to 25%	6	8	12	<1%
	26% to 50%	*	*	*	2%
	51% to 75%	*	*	*	2%
	76% to 99%	0	0	0	0%
	100%	*	*	5	3%
	Don't Know/ Refused	*	*	*	<1%
Partial	0%	*	*	*	<1%
	1% to 25%	*	*	*	<1%
	26% to 50%	*	*	*	3%
	51% to 75%	*	*	*	3%
	76% to 99%	*	*	7	3%
	100%	31	41	49	32%
	Don't Know/ Refused	*	*	*	<1%
None	0%	*	*	*	<1%
	1% to 25%	9	12	26	12%
	26% to 50%	6	19	21	9%
	51% to 75%	*	*	8	2%
	76% to 99%	6	6	6	3%
	100%	11	15	19	11%
	Don't Know/ Refused	*	*	*	<1%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-105. Dat6 and SPA Bin, Union Custom C&I programs

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
SPA Bin	Dat6	Customers	Units of Analysis	Measures	Percent Savings
Full	0%	8	18	25	15%
	1% to 25%	6	8	12	<1%
	26% to 50%	*	*	*	2%
	51% to 75%	*	*	*	2%
	76% to 99%	0	0	0	0%
	100%	*	*	5	3%
	Don't Know/ Refused	*	*	*	<1%
Partial	0%	*	*	*	<1%
	1% to 25%	7	8	15	5%
	26% to 50%	*	*	*	3%
	51% to 75%	*	5	5	3%
	76% to 99%	6	6	9	3%
	100%	38	53	63	40%
	Don't Know/ Refused	*	*	*	<1%
None	0%	0	0	0	0%
	1% to 25%	5	5	12	7%
	26% to 50%	6	19	21	9%
	51% to 75%	*	*	7	2%
	76% to 99%	*	*	*	3%
	100%	*	*	5	3%
	Don't Know/ Refused	0	0	0	0%

Union Large Volume

Table 8-106. PF8 and Attribution Bin, Union Large Volume*

PF8. For the project, did you become aware of utility program incentives and services…?					
Attribution Bin	PF8	Customers	Units of Analysis	Measures	Percent Savings
Full	Before starting the project	*	*	*	<1%
	As soon as you began exploring equipment options	*	*	*	<1%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	Before starting the project	9	16	28	24%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
None	Before starting the project	12	21	37	64%
	As soon as you began exploring equipment options	*	*	*	<1%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	*	*	*	<1%
	After installing the equipment	*	6	9	9%
	Don't Know/ Refused	*	*	5	2%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-107. PF9 and Attribution Bin, Union Large Volume*

PF9. When did the utility first get involved in this project? Was it…					
Attribution Bin	PF9	Customers	Units of Analysis	Measures	Percent Savings
Full	Before starting the project	*	*	*	<1%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	*	*	*	<1%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	Before starting the project	6	12	24	21%
	As soon as you began exploring equipment options	*	*	*	2%
	While exploring equipment options, but before making equipment decision	*	*	*	1%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
None	Before starting the project	6	14	21	46%
	As soon as you began exploring equipment options	7	7	10	8%
	While exploring equipment options, but before making equipment decision	*	*	*	2%
	After making an equipment decision	*	*	8	9%
	After installing the equipment	*	6	9	9%
	Don't Know/ Refused	*	*	*	1%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-108. Dat0 and Attribution Bin, Union Large Volume*

DAT0. Without the program, would you say the likelihood of [installing / performing] the project was...?					
Attribution Bin	**Dat0**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	Very likely	0	0	0	0%
	Somewhat likely	*	*	*	<1%
	Not very likely	*	*	*	<1%
	Very unlikely	*	*	*	<1%
	Don't Know/ Refused	0	0	0	0%
Partial	Very likely	*	6	14	11%
	Somewhat likely	*	8	12	9%
	Not very likely	*	*	*	3%
	Very unlikely	*	*	*	1%
	Don't Know/ Refused	0	0	0	0%
None	Very likely	19	31	51	70%
	Somewhat likely	*	*	*	5%
	Not very likely	0	0	0	0%
	Very unlikely	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-109. Dat6 and Attribution Bin, Union Large Volume*

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
Attribution Bin	Dat6	Customers	Units of Analysis	Measures	Percent Savings
Full	0%	0	0	0	0%
	1% to 25%	*	*	*	<1%
	26% to 50%	*	*	*	<1%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	*	*	*	<1%
	Don't Know/ Refused	0	0	0	0%
Partial	0%	0	0	0	0%
	1% to 25%	*	*	*	3%
	26% to 50%	0	0	0	0%
	51% to 75%	0	0	0	0%
	76% to 99%	*	*	6	7%
	100%	16	29	46	64%
	Don't Know/ Refused	0	0	0	0%
None	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	*	*	*	<1%
	51% to 75%	*	*	*	4%
	76% to 99%	*	*	*	3%
	100%	6	9	19	17%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-110. Dat6 and SPA Bin, Union Large Volume*

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
SPA Bin	Dat6	Customers	Units of Analysis	Measures	Percent Savings
Full	0%	0	0	0	0%
	1% to 25%	*	*	*	<1%
	26% to 50%	*	*	*	<1%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	*	*	*	<1%
	Don't Know/ Refused	0	0	0	0%
Partial	0%	0	0	0	0%
	1% to 25%	*	*	*	3%
	26% to 50%	0	0	0	0%
	51% to 75%	*	*	*	4%
	76% to 99%	*	5	7	9%
	100%	18	34	54	69%
	Don't Know/ Refused	0	0	0	0%
None	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	*	*	*	<1%
	51% to 75%	0	0	0	0%
	76% to 99%	*	*	*	<1%
	100%	*	*	11	13%
	Don't Know/ Refused	0	0	0	0%

Enbridge Commercial and Industrial Programs

Table 8-111. PF8 and Attribution Bin, Enbridge Custom C&I programs*

PF8. For the project, did you become aware of utility program incentives and services…?					
Attribution Bin	PF8	Customers	Units of Analysis	Measures	Percent Savings
Full	Before starting the project	11	16	22	12%
	As soon as you began exploring equipment options	*	*	*	<1%
	While exploring equipment options, but before making equipment decision	*	*	*	<1%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	*	*	4%
Partial	Before starting the project	33	47	60	31%
	As soon as you began exploring equipment options	8	9	11	14%
	While exploring equipment options, but before making equipment decision	*	*	*	<1%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	*	*	1%
None	Before starting the project	31	42	47	28%
	As soon as you began exploring equipment options	6	7	8	3%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	*	*	*	2%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	*	*	3%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-112. PF9 and Attribution Bin, Enbridge Custom C&I programs*

PF9. When did the utility first get involved in this project? Was it…					
Attribution Bin	**PF9**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	Before starting the project	7	12	17	9%
	As soon as you began exploring equipment options	*	*	*	1%
	While exploring equipment options, but before making equipment decision	*	*	*	1%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	5	5	5%
Partial	Before starting the project	15	21	22	19%
	As soon as you began exploring equipment options	10	12	13	10%
	While exploring equipment options, but before making equipment decision	*	*	12	3%
	After making an equipment decision	*	*	*	4%
	After installing the equipment	*	*	*	3%
	Don't Know/ Refused	15	21	26	9%
None	Before starting the project	8	11	13	7%
	As soon as you began exploring equipment options	7	8	8	5%
	While exploring equipment options, but before making equipment decision	7	8	8	9%
	After making an equipment decision	9	11	12	6%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	12	16	19	8%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-113. Dat0 and Attribution Bin, Enbridge Custom C&I programs*

DAT0. Without the program, would you say the likelihood of [installing / performing] the project was...?					
Attribution Bin	Dat0	Customers	Units of Analysis	Measures	Percent Savings
Full	Very likely	*	*	*	<1%
	Somewhat likely	*	*	*	3%
	Not very likely	7	12	15	9%
	Very unlikely	6	6	6	5%
	Don't Know/ Refused	0	0	0	0%
Partial	Very likely	13	16	17	10%
	Somewhat likely	19	22	31	27%
	Not very likely	14	20	25	10%
	Very unlikely	*	*	*	<1%
	Don't Know/ Refused	*	*	*	<1%
None	Very likely	33	40	46	28%
	Somewhat likely	10	14	14	8%
	Not very likely	0	0	0	0%
	Very unlikely	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-114. Dat6 and Attribution Bin, Enbridge Custom C&I programs*

Dat6. Without *any* utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
Attribution Bin	**Dat6**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	0%	5	10	12	9%
	1% to 25%	*	*	*	2%
	26% to 50%	*	*	7	5%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	*	*	*	1%
	Don't Know/ Refused	0	0	0	0%
Partial	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	*	*	*	<1%
	51% to 75%	*	*	*	3%
	76% to 99%	5	7	7	3%
	100%	31	37	41	29%
	Don't Know/ Refused	*	5	7	<1%
None	0%	*	*	*	<1%
	1% to 25%	*	5	5	2%
	26% to 50%	12	18	23	12%
	51% to 75%	5	7	7	5%
	76% to 99%	9	10	18	6%
	100%	13	16	18	18%
	Don't Know/ Refused	*	*	*	3%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-115. Dat6 and SPA Bin, Enbridge Custom C&I programs*

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
SPA Bin	Dat6	Customers	Units of Analysis	Measures	Percent Savings
Full	0%	5	10	12	9%
	1% to 25%	*	*	*	2%
	26% to 50%	*	*	7	5%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	*	*	*	1%
	Don't Know/ Refused	0	0	0	0%
Partial	0%	*	*	*	<1%
	1% to 25%	*	*	*	2%
	26% to 50%	10	14	19	10%
	51% to 75%	*	5	5	5%
	76% to 99%	8	11	19	6%
	100%	39	47	53	42%
	Don't Know/ Refused	*	5	7	<1%
None	0%	0	0	0	0%
	1% to 25%	*	*	*	<1%
	26% to 50%	6	6	6	3%
	51% to 75%	*	5	5	4%
	76% to 99%	5	6	6	3%
	100%	*	6	6	5%
	Don't Know/ Refused	*	*	*	3%

RunitRight

Table 8-116. PF8 and Attribution Bin, RunItRight*

PF8. For the project, did you become aware of utility program incentives and services…?					
Attribution Bin	PF8	Customers	Units of Analysis	Measures	Percent Savings
Full	Before starting the project	*	6	6	26%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	Before starting the project	5	9	9	66%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	*	*	9%
None	Before starting the project	0	0	0	0%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-117. PF9 and Attribution Bin, RunItRight*

PF9. When did the utility first get involved in this project? Was it…					
Attribution Bin	**PF9**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	Before starting the project	*	6	6	26%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	Before starting the project	*	*	*	27%
	As soon as you began exploring equipment options	*	*	*	19%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	*	5	5	28%
None	Before starting the project	0	0	0	0%
	As soon as you began exploring equipment options	0	0	0	0%
	While exploring equipment options, but before making equipment decision	0	0	0	0%
	After making an equipment decision	0	0	0	0%
	After installing the equipment	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-118. Dat0 and Attribution Bin, RunItRight*

DAT0. Without the program, would you say the likelihood of [installing / performing] the project was...?					
Attribution Bin	**Dat0**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	Very likely	0	0	0	0%
	Somewhat likely	0	0	0	0%
	Not very likely	*	6	6	26%
	Very unlikely	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	Very likely	*	5	5	48%
	Somewhat likely	*	*	*	7%
	Not very likely	*	*	*	19%
	Very unlikely	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
None	Very likely	0	0	0	0%
	Somewhat likely	0	0	0	0%
	Not very likely	0	0	0	0%
	Very unlikely	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-119. Dat6 and Attribution Bin, RunItRight*

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
Attribution Bin	**Dat6**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	*	6	6	26%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	0	0	0	0%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
None	0%	0	0	0	0%
	1% to 25%	*	*	*	7%
	26% to 50%	*	*	*	12%
	51% to 75%	0	0	0	0%
	76% to 99%	*	*	*	7%
	100%	*	5	5	48%
	Don't Know/ Refused	0	0	0	0%

For confidentiality reasons the numbers of customers, units of analysis and measures less than 5 are not displayed.
*Attribution includes both a customer and a vendor component when the customer indicated that the vendor was influential in their decision. Consequently, the attribution bin may be higher for a measure than indicated by the customer.

Table 8-120. Dat6 and SPA Bin, RunItRight*

Dat6. Without any utility assistance for this or any other projects in the past, what is the percent likelihood that you would have done this project? (0% means no chance and 100% means definitely completed without assistance)					
SPA Bin	**Dat6**	**Customers**	**Units of Analysis**	**Measures**	**Percent Savings**
Full	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	*	6	6	26%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%
Partial	0%	0	0	0	0%
	1% to 25%	0	0	0	0%
	26% to 50%	*	*	*	12%
	51% to 75%	0	0	0	0%
	76% to 99%	*	*	*	7%
	100%	*	5	5	48%
	Don't Know/ Refused	0	0	0	0%
None	0%	0	0	0	0%
	1% to 25%	*	*	*	7%
	26% to 50%	0	0	0	0%
	51% to 75%	0	0	0	0%
	76% to 99%	0	0	0	0%
	100%	0	0	0	0%
	Don't Know/ Refused	0	0	0	0%

APPENDIX P. CPSV Details

CPSV data collection

Data collection for the TSER sample will be completed via the IDI as described above. Prior to the TSER IDI the interviewing engineer will review project documents and calculations to identify the specific CPSV questions to include in the interview. Following the interview the engineer will complete the TSER verification report, embedded below. Verification reports completed by DNV GL engineers will be reviewed by an Itron engineer and verification reports completed by Itron engineers will be reviewed by a DNV GL engineer.

On-site sample customers will not have engineering questions asked during the IDI. Instead these customers will be asked permission for a follow up site visit. Customers who agree to the site visit will receive a follow up call from Stantec to schedule the visit. Utility staff will be informed of the scheduled visit and invited to attend. Following the on-site visit, the Stantec engineer will complete the on-site verification report, embedded below. An Itron engineer will review the report.

Appendix F has the template forms that each of the data collection approaches will use for the CPSV.

Completed verification reports will be compiled into a draft report to be reviewed by the OEB and EAC. The steps in the CPSV review process are shown in Table 8-121.

Table 8-121: CPSV steps

Step	Activity
1	NTG/CPSV Evaluation Team reviews project files provided by utilities ▪ Missing or incomplete documentation will be requested from utilities following review (final opportunity for utilities to provide new information).
2	NTG/CPSV Evaluation Team conducts IDI with customers ▪ Collects required CPSV data for TSER sample projects
3	NTG/CPSV Evaluation Team schedules site visits with on-site sample customers, informs utility
4	NTG/CPSV Evaluation Team conducts customer site visit ▪ Collects required CPSV data for On-site sample projects
5	NTG/CPSV Evaluation Team drafts project verification reports ▪ Contacts utility staff/customer to clarify any site/operational details if needed.
6	EC Team conducts internal review of individual project verification reports ▪ Itron reviews projects verified by Stantec and DNV GL ▪ DNV GL reviews projects verified by Itron
7	EC Team shares draft report, including all site verification reports, with OEB for quality control, redacted as necessary.
8	EC Team (OEB team) shares final draft report with EAC, redacted as necessary
9	EAC provides written comments on final draft report
10	EC Team/OEB hold EAC meeting to discuss comments
11	EC Team finalizes report

Gross realization rate

The gross RR is developed through data collected during the CPSV effort, which will verify program-achieved gross savings for measures at a sample of sites. The two components are the installation rate and the engineering verification factor.

- The installation rate is derived through the participant survey data collection, which confirms that the reported equipment / measure or something like it was installed at the facility. The resulting analysis value is binary; any similar project to the one reported is considered installed. At the individual measure level, the installation rate is either 100% or 0%.
- The engineering verification factor is derived from the data collected during the participant survey data collection for TSER projects and through the on-site visits for other projects. Differences between the reported measure and the "substantially similar" measure installed at the facility are accounted for here. The engineering adjustment factor is the ratio of the evaluator-verified savings to the program-reported savings.

The majority of the CPSV process involves determining the evaluator-verified savings estimate for each measure. The measure-level results are then combined using weights from the sample design to an overall adjustment factor.

To get the evaluation-verified savings for each evaluated measure, the CPSV effort will verify savings based on the applicable standard program baseline and measure life based on the best available information. The formula for estimating measure level verified savings is shown here:

$$VGS_L = VY_L \times VGS_S$$

Where:

VGS_L – Verified Gross Savings versus standard efficiency equipment on the market (lifetime)

VY_L – Verified Estimated Useful Life of the equipment/action

VGS_S – Verified Gross Savings versus standard efficiency equipment on the market (annual)

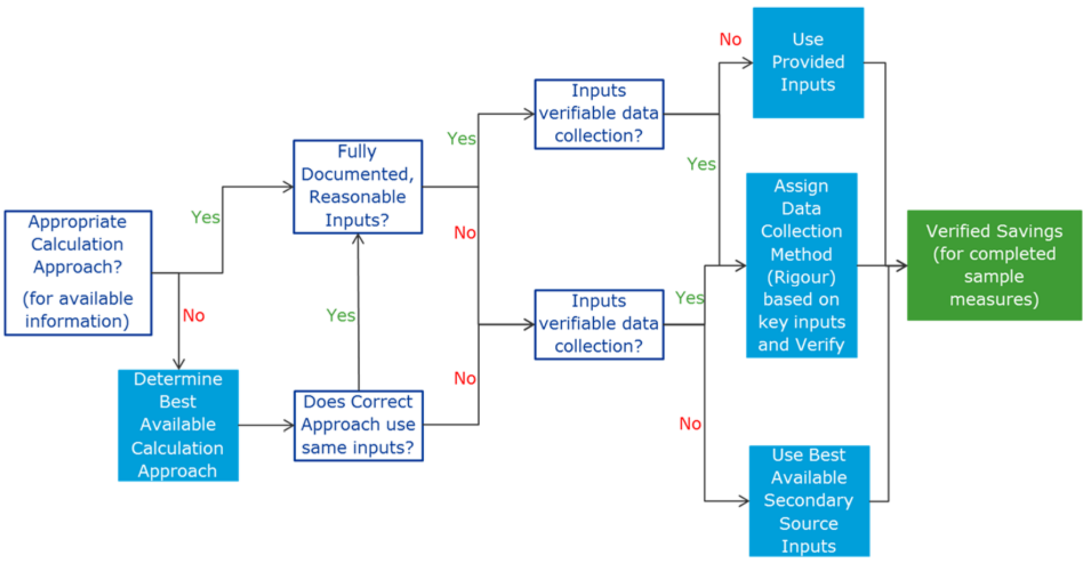
In the Life-Cycle Net Savings (LCNS) method used for this evaluation, the CPSV will also produce a verified savings estimate for accelerated measures using the pre-existing equipment as the baseline (VGS_E). Whether or not the measure is accelerated depends on the responses to the attribution survey and will be discussed later. The "versus existing" verified savings will be used in estimating net savings and will not be included in the verified gross savings. The LCNS methodology is further explained in Appendix B.

The CPSV will produce verified values for three required inputs in the Life-Cycle Net Savings (LCNS) attribution:

- **VGS_S** – Verified Gross Savings versus standard efficiency equipment on the market
- **VY_L** – Verified Estimated Useful Life of the equipment/action
- **VGS_E** – Verified Gross Savings versus existing equipment configuration at the time of installation/action: for a sub-set of measures that are accelerated

CPSV site reports will be completed by assigned evaluation engineers and reviewed by an experienced evaluation engineer at another partner firm. Each review will follow the same basic process shown in Figure 8-27.

Figure 8-27: CPSV high-level process



After the initial review and savings calculation, an engineer from a partner firm on the EC team (either DNV GL or Itron) will review the site report, approach, calculation, and verified savings. Following this review the verified savings, verified estimated useful life, reasons for deviation and other pertinent information will be compiled into a single dataset at the unit of analysis level for expansion and integration with the FR analysis.

CPSV rigour levels

The CPSV plan calls for two types of data collection: telephone-supported engineering review (TSER) and on-site. There are adjustments that might entail more or less work at each site. Table 7 details likely engineering effort levels for the standard, increased, and decreased levels. The levels of effort are averages. Some sites may require substantially more effort, while some sites may entail less effort.

Based on the tracking data we have identified the simplest projects as a level of stratification and will used TSER interviews to verify the projects at these sites. The more complex on-site sample will also have varying degrees of effort requirements in order to allow more effort at more complex sites.

Table 8: M&V Description for Proposed Engineering Effort Levels

Effort Level	Description
Telephone-supported engineering review (TSER)	Lower rigour projects. Application desk review, telephone interviews, possible revised engineering calculations; primarily for qualitative assessment.
Standard On-site	Simpler projects. Detailed application review, on-site verification, collection of data on key parameters, revised engineering calculations, billing data analysis, and possible spot measurements.
Higher Rigour On-site	Small, medium and large scale projects that may or may not require monitoring or metering. Detailed application review, on-site verification, collection of data on key parameters, revised engineering calculations, billing data analysis, and possible spot measurements / short term post monitoring.
Very High Rigour On-site	Largest and most complex projects. Detailed application review, on-site verification, collection of data on key parameters, billing/interval data analysis, calibrated simulation models, spot measurements, long-term post monitoring, pre-verification and short-term measurement. May require larger teams, including senior staff and multiple site visits.

Most site-specific impact evaluation efforts for Standard On-site points will fall into the category of lower rigor level of effort. However, there are exceptions and adjustments that might entail more or less work at each site. During the file review adjustments of this sort should be noted and the sites will be reviewed by the engineering team lead (Phani Pagadala) to determine which level of rigour is required. Up to 20 sites (primarily Large Volume) will receive higher rigour on-sites and up to two sites will receive very high rigour on-sites to establish the relative value of increased rigour levels in future evaluation.

Each site will be assigned a single point of contact (POC) for the purposes of communications with the customer, the utility and within CPSV itself. The POC will be a more senior engineering team member who is experienced in the energy efficiency field (preferably a registered professional engineer) and will be responsible for co-ordinating the work of their team, tracking progress on each project review, becoming intimately familiar with the documentation and technical requirements of the work to be performed, ensuring that quality control procedures are implemented, and reporting on project review progress and any issues to the engineering team lead (Phani Pagadala).

Higher rigour sites could involve the addition of elements such as:

- A fully specified regression analysis of consumption information from utility bills with inclusion/adjustment for changes and background variables over the time period of the analysis that could potentially be correlated with the gross energy savings being measured.
- Twelve (12) months post-retrofit consumption data are required.
- Twelve (12) months pre-retrofit consumption data are required, unless program design does not allow pre-retrofit billing data, such as in new construction. In these cases, well-matched control groups and post-retrofit consumption analysis is allowable.

- Sampling must be adequate (in general, a minimum of six data points will be required) for a valid regression-based estimate.
- Building energy simulation models that are calibrated as described in IPMVP Option D requirements. If appropriate, evaluators may alternatively use an engineering model with calibration.
- Retrofit isolation engineering models as described in IPMVP Option B requirements.

APPENDIX Q. CPSV DISCREPANCY DETAILS

This appendix includes additional information about the magnitude of and reasons for gross savings adjustments, by program. Sections are broken up into "Annual savings Adjustments," which refer to adjustments that do not relate to measure life, and "Measure Life Savings Adjustments" which relate only to measure life but do not affect annual savings. Attempts are made to identify the level of control the program has over each type of adjustment and provide context and opportunities for improvement. Table 8-122 and Table 8-123 show the "Reasons for Discrepancies" which are used throughout this appendix.

Table 8-122: Descriptions of Annual savings Adjustments

Reason for Discrepancy	Level of Program Control	Description	Explanation	Recommendation (where possible, do the following:)
Measured Usage	Low	Customer provided metered or measured data that differs from what the program used.	This usually stems from the evaluation having a longer metering period to work with than the ex ante engineering team.	Attempt to use a longer post-installation data collection period if possible.
Efficient Equipment Operating Conditions	Low	On-site conditions differed from that claimed by documentation.	These can reflect a change in the operation of the facility since the measure was installed, but also can be due to information that was either not communicated or communicated differently to program engineering staff.	Document any observations or assumptions made with emails, on-site forms, photos, and conversation notes. When evaluators don't have evidence of a value, they have to determine their own value.
Operating Hours	Low	Customer reported different operating hours from those reported in ex ante documentation, but no other operational changes.		
Change to Calculation Method	Medium	Evaluator used a different calculation method.	This stems from the lack of a live calculation tool or the choice to use a different tool (often because the ex ante tool is not able to accommodate all the information obtained on-site).	Maintain and provide live calculation tools with practical instructions on their use and supporting documentation for their methods and assumptions. Seek to avoid using calculation methods which use too many assumptions or rely on theoretical assumptions rather than metered data.
Baseline	Medium	Customer stated or the evaluator determined that a different baseline should be used.	This happens when the program does not clearly document their baseline sources, and a different site contact has different ideas about the baseline, or the evaluator that the baseline is not industry standard practice. In other cases, the appropriate code may be misidentified.	Follow the policy decisions made during EAC evaluation discussions. Document any observations or assumptions made with emails, on-site forms, photos, and conversation notes. Include documentation of permit dates (such as email from customer or copy of paperwork etc.).
Efficient Equipment Specifications	High	Equipment specifications differed from ex ante documentation.	This can occur when there was a misunderstanding of how the equipment operated or the meaning of a specification, such as input vs. output boiler efficiency.	Collect photographs, invoices, and cut sheets to document the sources of equipment specifications.
Data Entry Error	High	Tracking savings or calculation tool contained an error.	This most often reflects tracking savings not matching documentation, but can also be a mistake in recording some building characteristic.	Check tracking savings against documentation before finalizing, particularly for large projects.

Table 8-123: Descriptions of Measure Life Savings Adjustments

Reason for Discrepancy	Level of Program Control	Description	Explanation	Recommendation (where possible, do the following:)
RUL limitation	Medium	The EUL is limited by the RUL of the existing equipment.	Evaluation determined that the equipment in question will not be reused after the host equipment reaches its RUL.	Provide evidence that add-on equipment can be reused after host equipment is removed. Provide a program estimate of RUL.
No Savings	Medium	The existing equipment had reached the end of its useful life and was replaced with Industry Standard Practice equipment.	Sometimes the customer says that equipment replaced through the program had only a few months of useful life remaining, and that they considered the equipment installed to be "standard efficiency."	Document the source of post-ER baseline equipment, as well as a sourced estimate for RUL.
Reported Maintenance Schedule	Medium	Customer reported that they perform maintenance at a scheduled frequency.	If a customer does specific maintenance, for example, every three years, then a rebate for that maintenance activity cannot have a measure life longer than this.	Document customer maintenance practices.
Customer reported replacement schedule	Medium	Customer reported that they replace equipment on a set schedule.	Some facilities replace furnaces, boilers, and other equipment on a recurring schedule. The measure life or RUL cannot be longer than this.	Document customer replacement practices, or the reasons why the equipment in question is an exception.
Lack of Ex Ante Doc	High	Program did not include any evidence or reasoning behind the EUL selection.	In the absence of a clear OEB Measure Life Guide category or justification for another value, the evaluators determined measure life independently.	Provide justification for the measure life selected, especially when the category selected is unclear or one does not exist.
Average of Measures	High	Project included multiple measures with different measure lives.	When multiple measures are used in a single project, evaluation will combine the measure lives as a savings-weighted average or another appropriate value depending on the situation.	Use and document a savings-weighted average of measure lives, or other appropriate value.
Added post-ER period	High	Dual baseline project, with post-early replacement not claimed by program.	The program claimed only early replacement or post-early replacement savings, multiplying this value by the EUL.	Calculate dual baseline savings and document the reasons for selecting the chosen baselines.
Steam Trap	High	Adjustment made to steam traps EUL in the OEB Measure Life Guide.	The two utilities used a different EUL value for steam traps, which is a common installed measure. Evaluation performed research and selected a value to use across programs.	Use the evaluation-selected value, or provide steam-trap-specific (site, trap type, and application specific) evidence for another value.

The following sections provide results in detail for each program. All adjustments shown in this section are unweighted. Adjustments in tables are absolute values, and are the total of positive and negative adjustments. Values shown in figures are identified with regard to the magnitude of positive or negative adjustments (greater or less than 100%). Union's influence adjustments are removed from ex ante results, so the adjustments shown here do not include their removal.

Enbridge Commercial, Industrial and Multi-Family

Annual savings adjustments

The absolute value of total annual savings adjustments for the Enbridge Commercial, Industrial, and Multi-family programs are 1,793,030 m^3 of natural gas, or 6% of the total first year sample tracking savings of 30,679,909 m^3.

This section shows annual savings only, which is an attempt to isolate the effects of gross savings adjustments outside of measure life. Annual savings can occur during the early replacement or post-early replacement periods, depending on the situation. Ex-post annual savings are typically better comparable with the program's ex ante savings estimate than other first year metrics such as average annual savings, early replacement period savings, or post-early replacement period savings.

Table 8-124 shows the percent of total annual savings adjustments associated with each Reason for Adjustment. The table also indicates the level of control that the program has over that discrepancy through improved calculations or improved documentation, as discussed in Table 8-122. For example, "Measured Usage" represents 24% of first year discrepancies, and the program has a limited ("Low") ability to prevent this kind of adjustment. 92% of first year discrepancies fall into the "Low" category.

Table 8-124: Summary of annual savings adjustments (m^3 Natural Gas)

<table>
<tr><th>Reason For Adjustment</th><th>Percent of First Year Discrepancy</th><th>Level of Program Control</th><th>Percent of First Year Discrepancy</th></tr>
<tr><td>Measured Usage</td><td>24%</td><td rowspan="3">Low</td><td rowspan="3">92%</td></tr>
<tr><td>Efficient Equipment Operating Conditions</td><td>30%</td></tr>
<tr><td>Operating Hours</td><td>38%</td></tr>
<tr><td>Change to Calculation Method</td><td>0%</td><td rowspan="2">Medium</td><td rowspan="2">2%</td></tr>
<tr><td>Baseline</td><td>2%</td></tr>
<tr><td>Efficient Equipment Specifications</td><td>6%</td><td rowspan="2">High</td><td rowspan="2">6%</td></tr>
<tr><td>Data Entry Error</td><td>0%</td></tr>
<tr><td>Overall</td><td>100%</td><td></td><td>100%</td></tr>
</table>

Figure 8-28 distributes the annual savings adjustments by realization rate bin, showing the positive and negative impacts of each adjustment on first year program savings. For example, focusing on projects with 40-60% realization rates, about 2/3 of the savings adjustments resulted from Operating Hours changes and about 1/3 from Efficient Equipment Operating Conditions changes. Overall, about 15% of total annual savings adjustments result from projects in the 40-60% gross savings realization rate bin.

Figure 8-28: Annual savings Adjustments by Magnitude of Adjustment (m^3 Natural Gas)

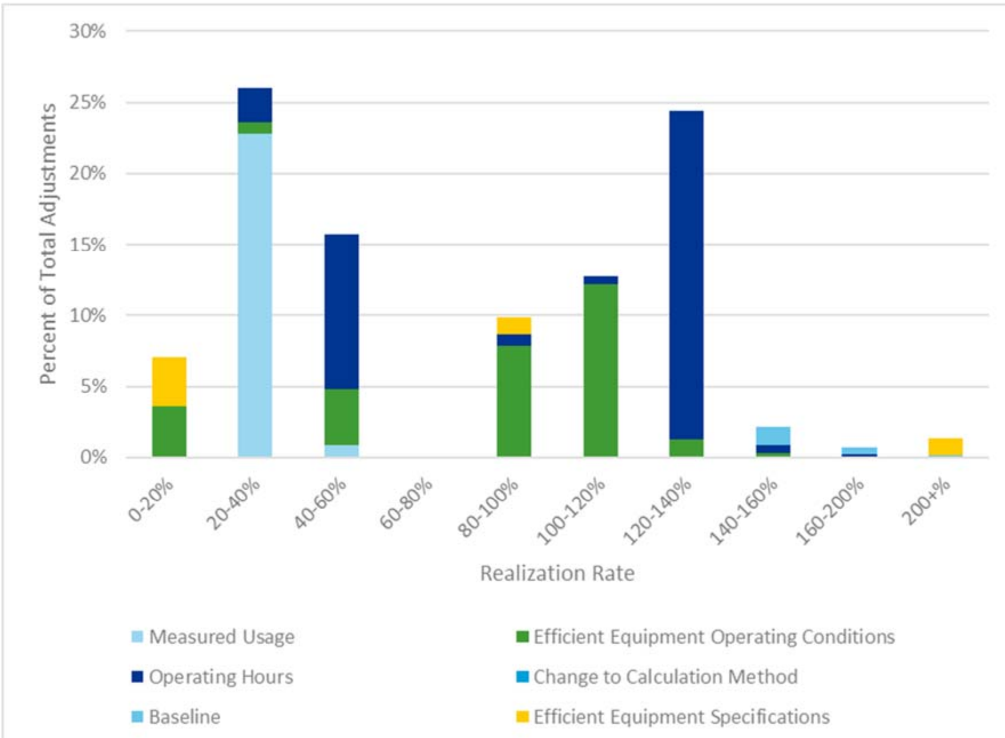
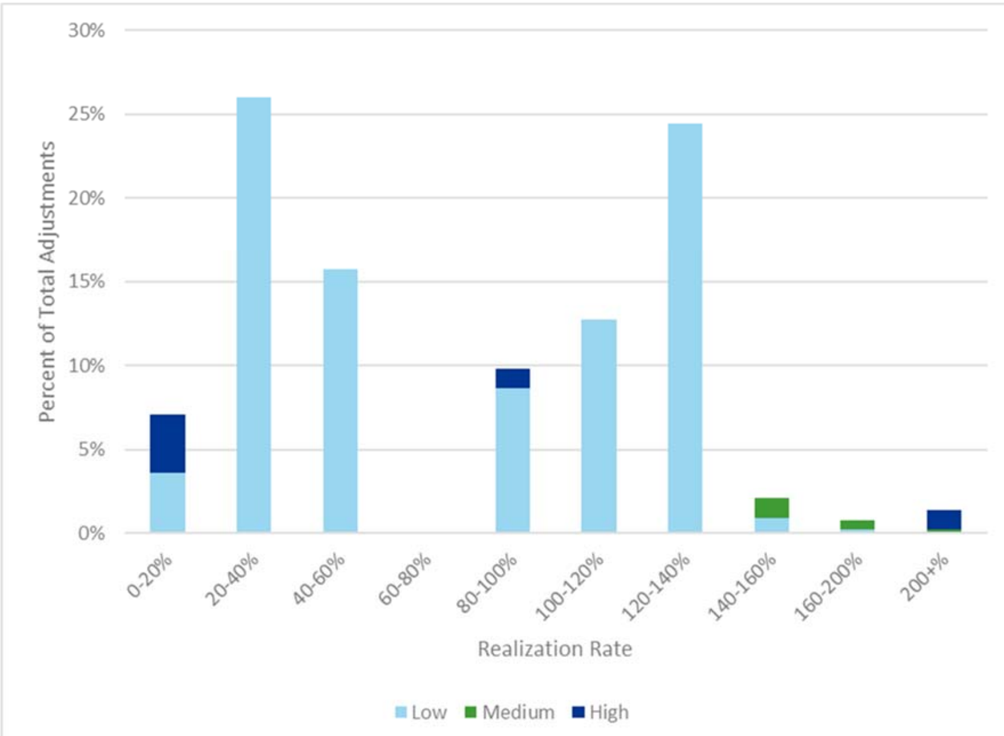


Figure 8-29 shows the level of program control over the adjustments shown in Figure 8-28. For example, the program has a "Low" level of control over all the adjustments which resulted in first year gross savings realization rates of 40-60%.

Figure 8-29: Program Control Over Annual savings Adjustments by Magnitude of Adjustment (m^3 Natural Gas)



Measure life adjustments

The absolute value of the total measure life-driven cumulative savings adjustments for Enbridge are 10,983,754 CCM of natural gas, or 2% of the total cumulative sample tracking savings of 471,326,160 CCM. These are cumulative lifetime savings[40] and should not be compared to annual savings adjustments.

Table 8-125 shows the percent of total measure life-driven adjustments associated with each specific Reason for Adjustment. The table also indicates the level of control that the program has over that discrepancy through improved calculations or improved documentation, as discussed in Table 8-123. For example, "RUL Limitation" represents 25% of measure life adjustments, and the program has a moderate ("Medium") ability to prevent this kind of adjustment. Thirty-five percent of measure life adjustments fall into the "Medium" category. The program likely has a high degree of control over almost two-thirds of the EUL adjustments, which indicates that better documentation of EULs could significantly reduce the risk of adjustments in the future.

Note that the measure life adjustments shown here are inexact. Because they result from changes to both RUL and EUL, there is no way to directly compare the impacts of measure life changes on savings in

[40] To provide comparable values, the cumulative savings adjustments are calculated as ex ante annual savings times ex post EUL minus ex ante annual savings times ex ante EUL.

isolation from other effects. This section is an attempt to isolate those effects to the extent possible, in order to provide useful information for program planning.

Table 8-125: Summary of Measure Life Driven of Annual savings Adjustments (CCM Natural Gas)

<table>
<tr><th>Reason For Adjustment</th><th>Percent of Measure Life Driven Adjustments</th><th>Level of Program Control</th><th>Percent of Measure Life Driven Adjustments</th></tr>
<tr><td>RUL limitation</td><td>25%</td><td rowspan="4">Medium</td><td rowspan="4">35%</td></tr>
<tr><td>No Savings</td><td>10%</td></tr>
<tr><td>Reported Maintenance Schedule</td><td>0%</td></tr>
<tr><td>Customer Reported Replacement Schedule</td><td>0%</td></tr>
<tr><td>Lack of Ex Ante Doc</td><td>48%</td><td rowspan="4">High</td><td rowspan="4">65%</td></tr>
<tr><td>Average of Measures</td><td>7%</td></tr>
<tr><td>Added post-ER period</td><td>2%</td></tr>
<tr><td>Steam Trap</td><td>8%</td></tr>
<tr><td>Overall</td><td>100%</td><td></td><td>100%</td></tr>
</table>

Figure 8-30 distributes the measure life adjustments by realization rate bin, showing the positive and negative impacts of each kind of adjustment on cumulative savings overall. For example, focusing on projects with 100-120% measure life driven adjustments, about 2/3 of the savings adjustments result from a Lack of Ex Ante Documentation, with the rest stemming from RUL Limitations, Average of Measures, and No Savings adjustments. Overall, about 72% of total measure life savings adjustments result from projects in the 100-120% adjustment bin. In other words, most EUL adjustments for this program resulted in small increases.

Figure 8-30: EUL Adjustments by Magnitude of Adjustment (CCM Natural Gas)

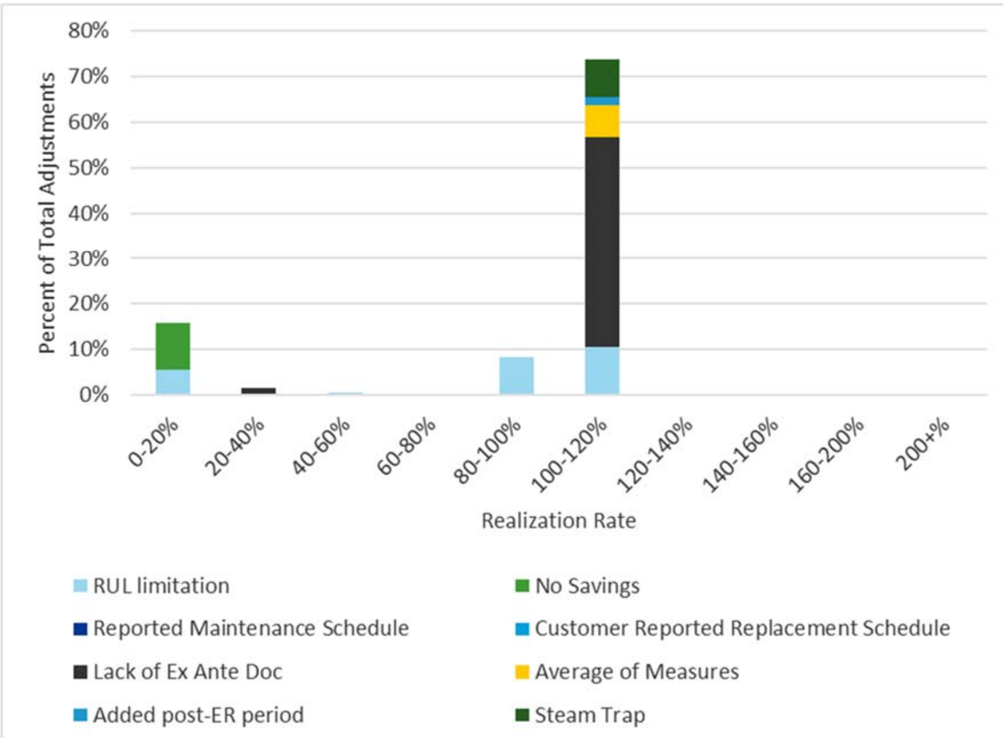
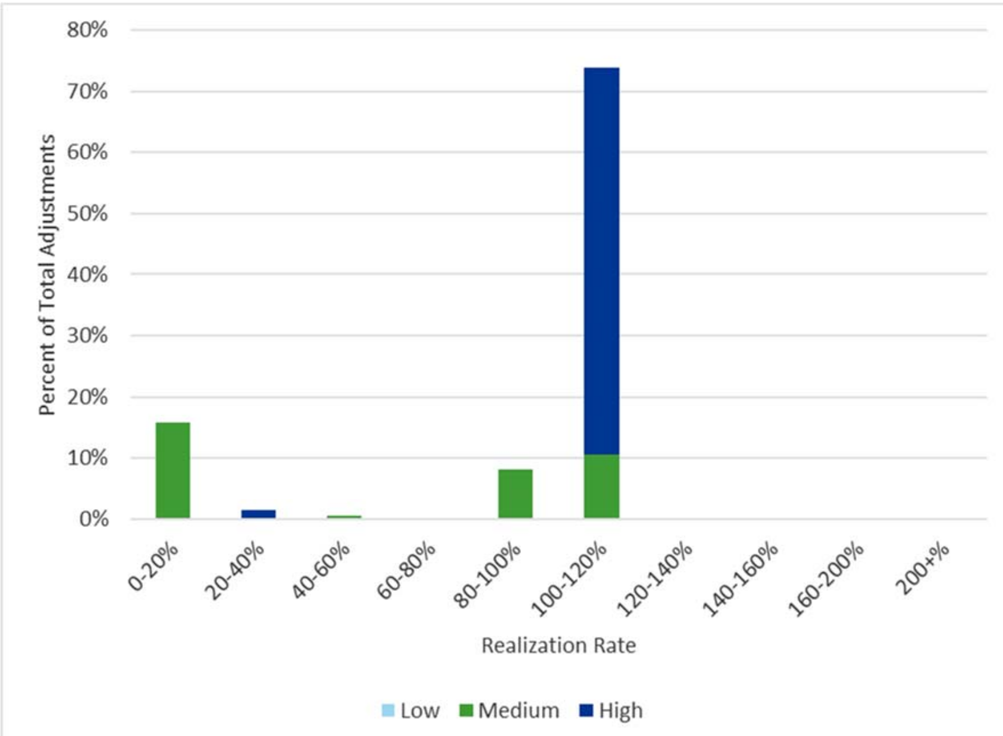


Figure 8-31 shows the level of program control over the adjustments shown in Figure 8-30. For example, the program has a "High" level of control over most reasons which resulted in adjustments of 100-120%.

Figure 8-31: Program Control Over Measure Life Driven Savings Adjustments by Magnitude of Adjustment (CCM Natural Gas)



Union Commercial, Industrial and Multi-Family

Annual savings adjustments

The total absolute value of the annual savings adjustments (engineering adjustment) for Union Custom Programs are 2,652,557 m^3 of natural gas, or 3% of the total first year sample tracking savings of 85,649,059 m^3. The engineering adjustment represents the differences in ex post and ex ante savings that are not a result of the influence correction. These changes are due to differences in calculation methods, EUL, calculation parameters, or other engineering-related adjustments.

Table 8-126 shows the percent of total annual savings adjustments associated with each Reason for Adjustment. The table also indicates the level of control that the program has over that discrepancy through improved calculations or improved documentation, as discussed in Table 8-122. For example, "Efficient Equipment Operating Conditions" represents 75% of first year discrepancies, and the program has a limited ("Low") ability to prevent this kind of adjustment. The table shows that 90% of adjustments to Union' Custom programs were issues that the program likely has a low ability to control.

Table 8-126: Summary of Annual savings Adjustments

Reason For Adjustment	Percent of First Year Discrepancy	Level of Program Control	Percent of First Year Discrepancy
Measured Usage	0%	Low	90%
Efficient Equipment Operating Conditions	75%		
Operating Hours	15%		
Change to Calculation Method	3%	Medium	4%
Baseline	1%		
Efficient Equipment Specifications	1%	High	6%
Data Entry Error	4%		
Overall	**100%**		**100%**

Figure 8-32 distributes the annual savings adjustments by realization rate bin, showing the positive and negative impacts of each adjustment on first year program savings. Overall, adjustments were mostly because of changes to Efficient Equipment Operating Conditions and Operating Hours.

Figure 8-32: Annual savings Adjustments by Magnitude of Adjustment (m^3 Natural Gas)

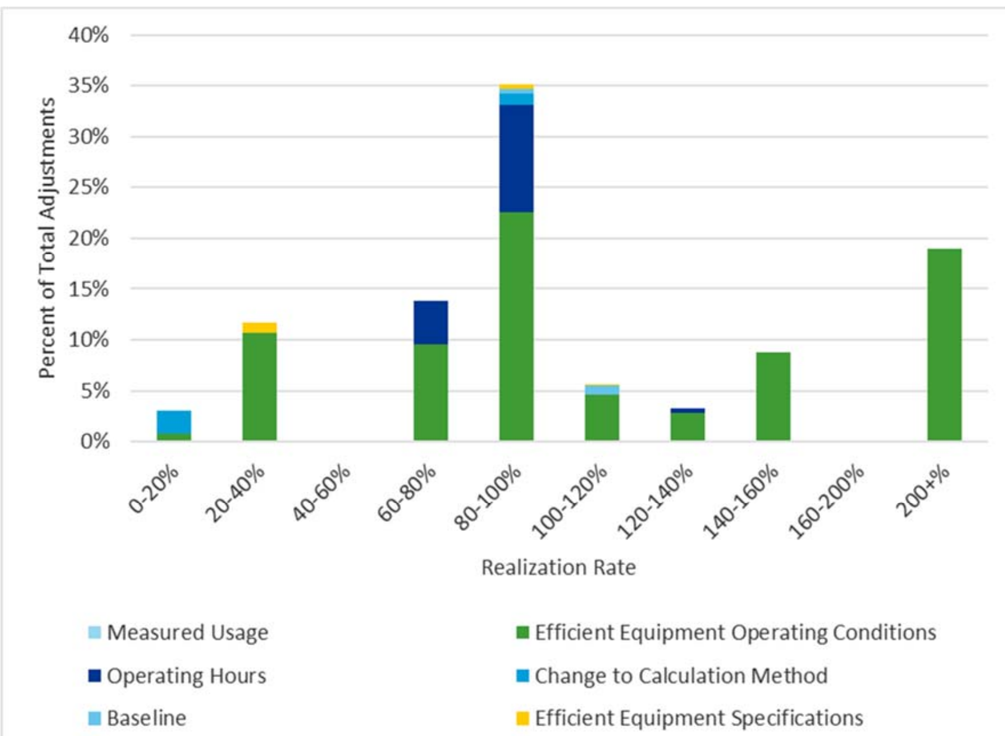
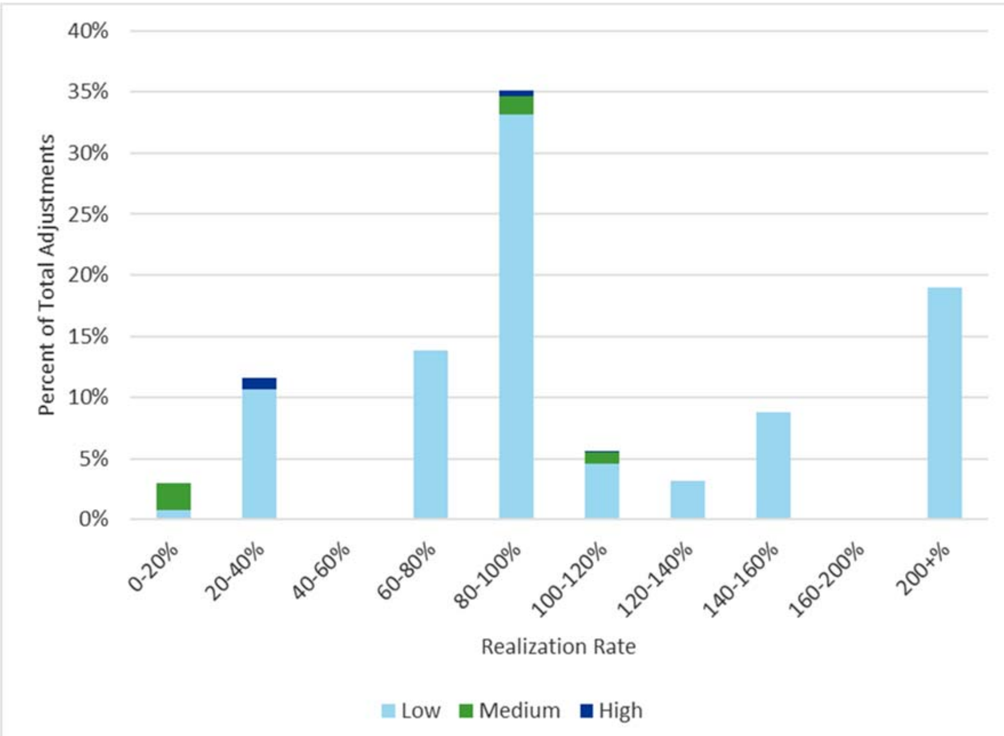


Figure 8-33 shows the level of program control over the adjustments shown in Figure 8-32. Almost all first-year savings discrepancies were in categories that the program has a low degree of control over.

Figure 8-33: Program Control Over Annual savings Adjustments by Magnitude of Adjustment (m^3 Natural Gas)



Measure life adjustments

Total absolute value measure life driven cumulative savings adjustments for Union Custom Programs are 31,801,957 CCM of natural gas, or 2% of the total cumulative sample tracking savings of 1,277,857,163 CCM. These are cumulative lifetime savings[41] and should not be compared to annual savings adjustments.

Table 8-127 shows the percent of total measure life-driven adjustments associated with each specific Reason for Adjustment. The table also indicates the level of control that the program has over that discrepancy through improved calculations or improved documentation, as discussed in Table 8-123. The table shows that 85% of EUL adjustments were due to categories that the program has a high degree of control over. However, this effect is likely overstated because weighting EUL adjustments by ex ante savings may overstate some changes. For example, many Union sites received significant EUL adjustments for early replacement projects that installed ISP technologies. Although the total EUL was greatly increased, the post-ER savings were zero. Using the ex post savings to weight those measures would likely result in a different distribution.

Note that measure life adjustments shown here are inexact. Because they result from changes to both RUL and EUL, there is no way to directly compare the impacts of measure life changes on savings in isolation

[41] To provide comparable values, the cumulative savings adjustments are calculated as ex ante annual savings times ex post EUL minus ex ante annual savings times ex ante EUL.

from other effects. This section is an attempt to isolate those effects to the extent possible, in order to provide useful information for program planning.

Table 8-127: Summary of Measure Life Driven of Annual savings Adjustments (CCM Natural Gas)

Reason For Adjustment	Percent of Measure Life Driven Adjustments	Level of Program Control	Percent of Measure Life Driven Adjustments
RUL limitation	15%	Medium	15%
No Savings	0%		
Reported Maintenance Schedule	0%		
Customer Reported Replacement Schedule	0%		
Lack of Ex Ante Doc	34%	High	85%
Average of Measures	0%		
Added post-ER period	49%		
Steam Trap	1%		
Overall	**100%**		**100.0%**

Figure 8-34 distributes the measure life adjustments by realization rate bin, showing the positive and negative impacts of each kind of adjustment on cumulative savings overall. The figure shows that most of the EUL adjustments were small and positive, while a few were strongly negative.

Figure 8-34: Measure Life Driven Savings Adjustments by Magnitude of Adjustment (CCM Natural Gas)

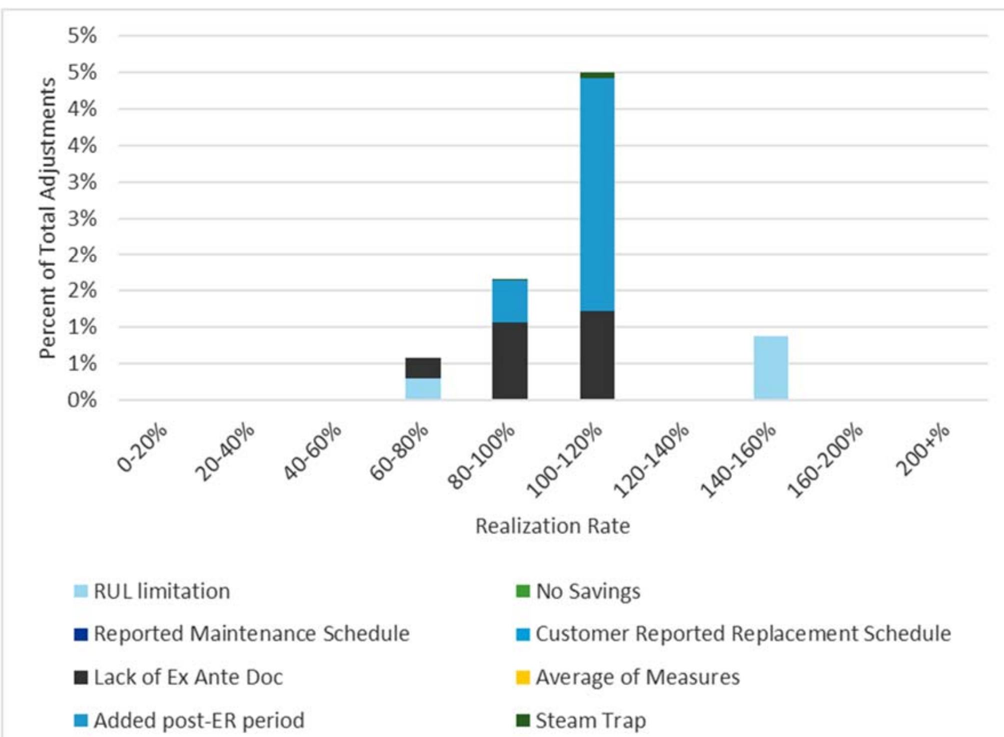
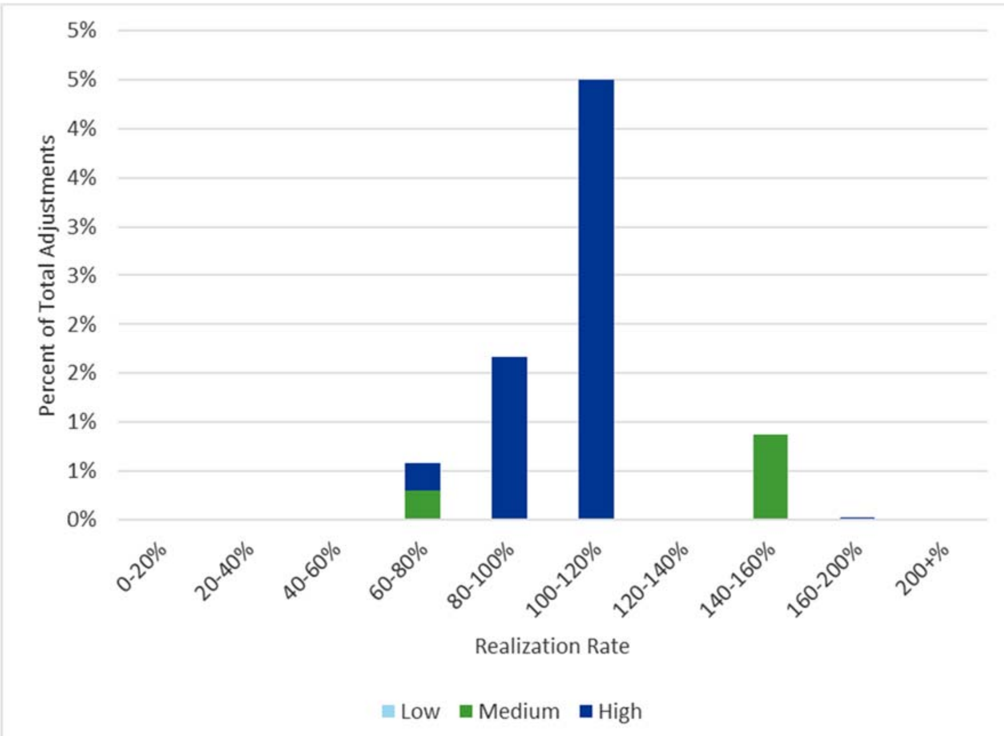


Figure 8-35 shows the level of program control over the adjustments shown in Figure 8-34. For example, the program has a "High" level of control over most reasons which resulted in adjustments of 100-120%.

Figure 8-35: Program Control Over Measure Life Driven Savings Adjustments by Magnitude of Adjustment (CCM Natural Gas)



Union Large Volume

Annual savings adjustments

Total absolute value annual savings adjustments (engineering adjustment) for Union Large Volume are 54,809,839 m^3 of natural gas, or 74% of the total first year sample tracking savings of 73,711,036 m^3. The engineering adjustment represents the differences in ex post and ex ante savings that are not a result of the influence correction.

Table 8-128 shows the percent of total annual savings adjustments associated with each Reason for Adjustment. The table also indicates the level of control that the program has over that discrepancy through improved calculations or improved documentation, as discussed in Table 8-122. For example, "Efficient Equipment Operating Conditions" represents 57% of first year discrepancies, and the program has a limited ("Low") ability to prevent this kind of adjustment. The table shows that discrepancies classified as data entry errors had a significant effect on adjustments. Seven sites had adjustments of this type, with three of them being caused by transfer of values from the project workbook to the tracking database. These are separate from the Influence Adjustments applied by Union to some projects, which are removed from ex ante savings and not considered here.

Table 8-128: Summary of Annual savings Adjustments

Reason For Adjustment	Percent of First Year Discrepancy	Level of Program Control	Percent of First Year Discrepancy
Measured Usage	5%	Low	66%
Efficient Equipment Operating Conditions	57%		
Operating Hours	4%		
Change to Calculation Method	0%	Medium	1%
Baseline	1%		
Efficient Equipment Specifications	0%	High	33%
Data Entry Error	33%		
Overall	**100%**		**100%**

Figure 8-36 distributes the annual savings adjustments by realization rate bin, showing the positive and negative impacts of each adjustment on first year program savings. The figure shows that most of the annual savings adjustments were large and positive.

Figure 8-36: Annual savings Adjustments by Magnitude of Adjustment (m^3 Natural Gas)

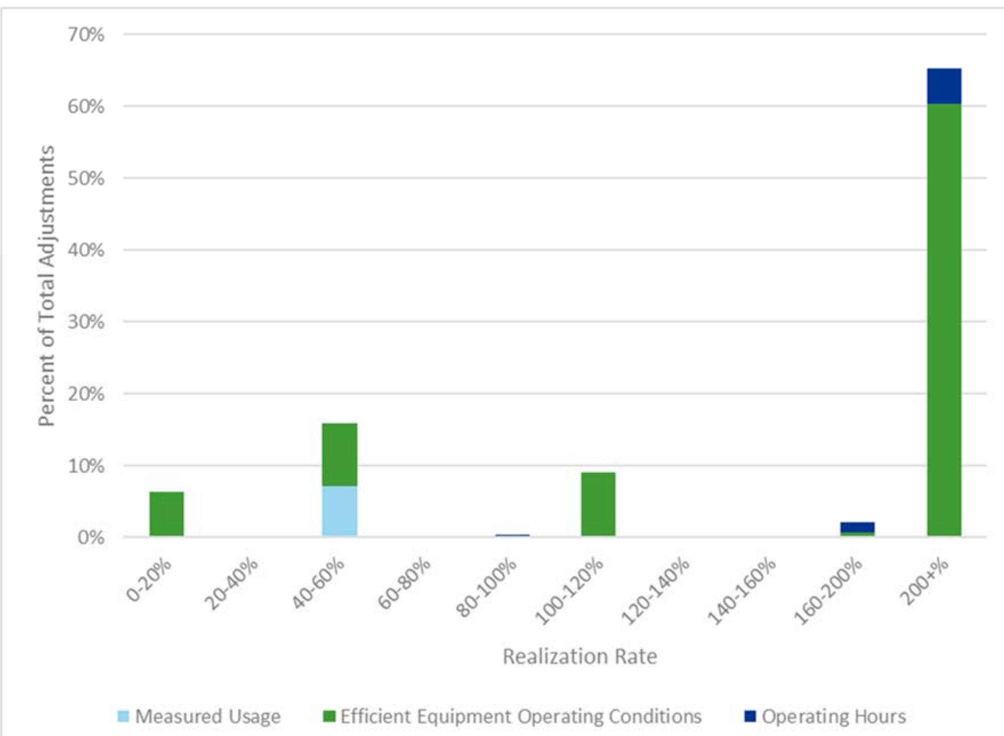
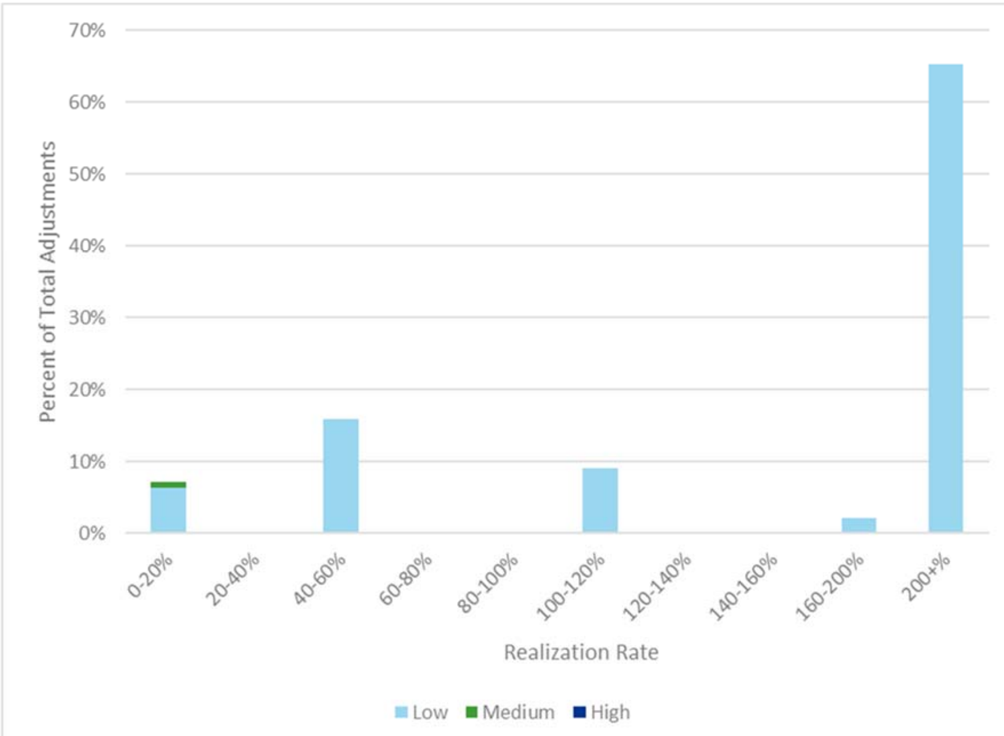


Figure 8-37 shows the level of program control over the adjustments shown in Figure 8-36. As with previous programs, almost all annual savings discrepancies are in areas the program has low control over.

Figure 8-37: Program Control Over Annual savings Adjustments by Magnitude of Adjustment (m^3 Natural Gas)



Measure life adjustments

Total measure life driven cumulative savings adjustments for Union Large Volume are 384,999,510 CCM of natural gas, or 45% of the total first year sample tracking savings of 856,320,533 CCM. These are cumulative lifetime savings[42] and should not be compared to annual savings adjustments.

Table 8-129 shows the percent of total measure life-driven adjustments associated with each specific Reason for Adjustment. The table also indicates the level of control that the program has over that discrepancy through improved calculations or improved documentation, as discussed in Table 8-123. The table shows that 65% of the adjustments made to measure life for the Large Volume program are in areas of high program control. However, this effect is likely overstated because weighting EUL adjustments by ex ante savings may overstate some changes. For example, many Union sites received significant EUL adjustments for early replacement projects that installed ISP technologies. Although the total EUL was greatly increased, the post-ER savings were zero. Using the ex post savings to weight those measures would likely result in a different distribution.

Note that measure life adjustments shown here are inexact. Because they result from changes to both RUL and EUL, there is no way to directly compare the impacts of measure life changes on savings in isolation

[42] To provide comparable values, the cumulative savings adjustments are calculated as ex ante annual savings times ex post EUL minus ex ante annual savings times ex ante EUL.

from other effects. This section is an attempt to isolate those effects to the extent possible, in order to provide useful information for program planning.

Table 8-129: Summary of measure-life-driven annual savings adjustments (CCM natural gas)

Reason for Adjustment	Percent of Measure Life Driven Adjustments	Level of Program Control	Percent of Measure Life Driven Adjustments
RUL limitation	10%	Medium	35%
No Savings	9%		
Reported Maintenance Schedule	<1%		
Customer Reported Replacement Schedule	16%		
Lack of Ex Ante Doc	10%	High	65%
Average of Measures	0%		
Added post-ER period	54%		
Steam Trap	<1%		
Overall	**100%**		**100%**

Figure 8-38 distributes the measure life adjustments by realization rate bin, showing the positive and negative impacts of each kind of adjustment on cumulative savings overall. The figure shows that most of the EUL adjustments were small and positive while a few were extremely positive or extremely negative.

Figure 8-38: Measure-life-driven savings adjustments by magnitude of adjustment (CCM natural gas)

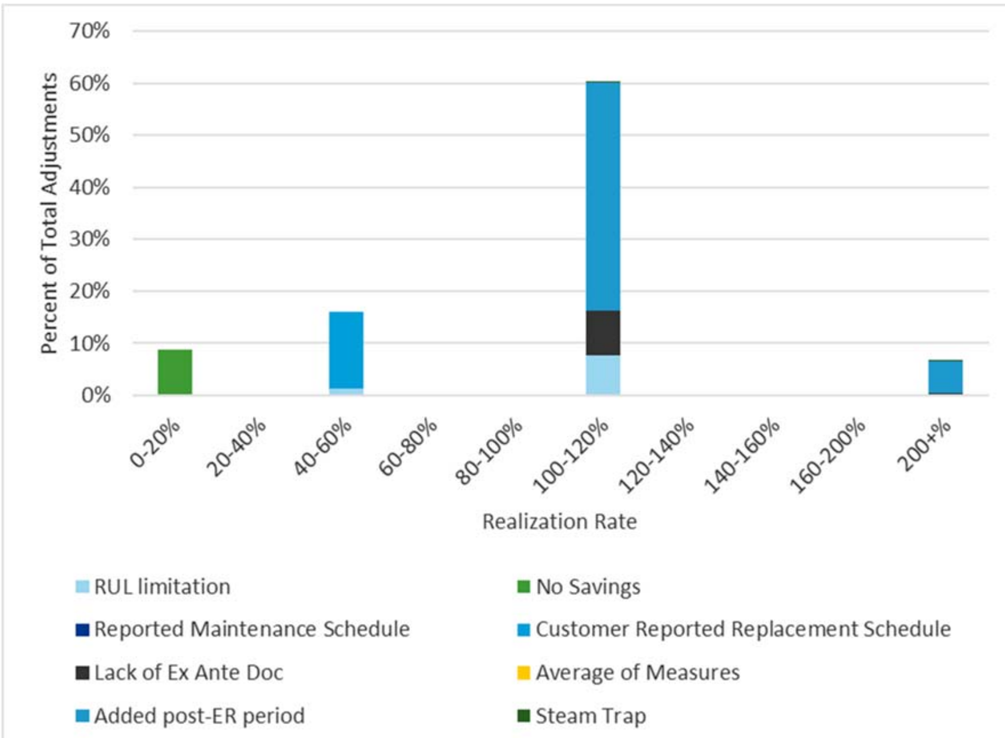
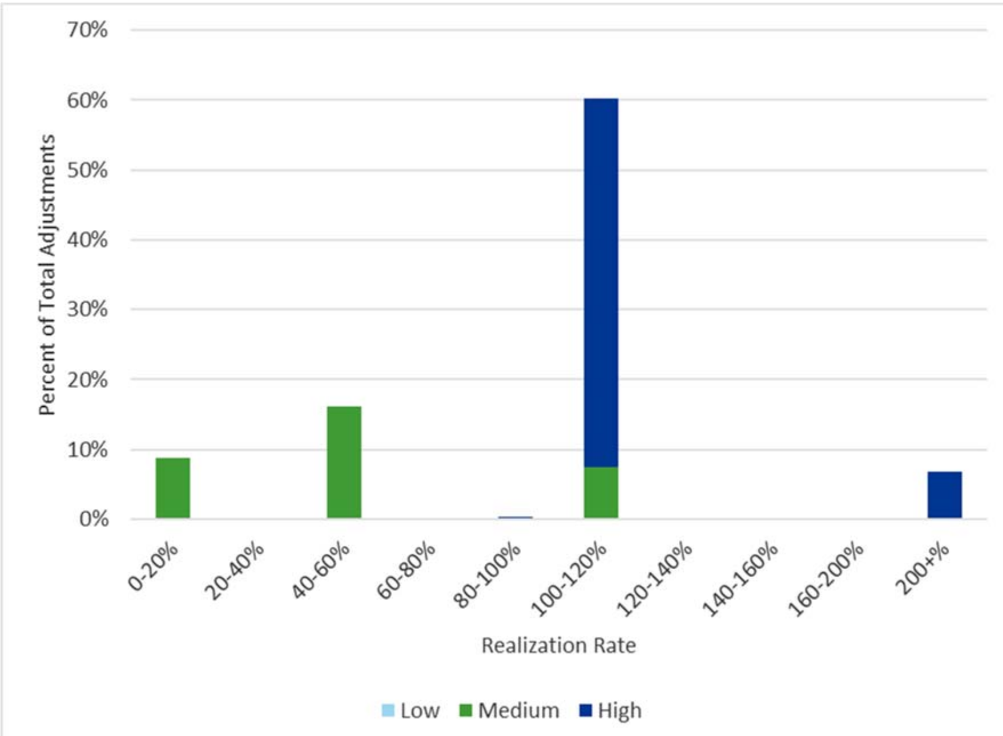


Figure 8-39 shows the level of program control over the adjustments shown in Figure 8-38. For example, the program has a "High" level of control over most reasons which resulted in adjustments of 100-120%.

Figure 8-39: Program control over measure-life-driven savings adjustments by magnitude of adjustment (CCM Natural Gas)



Union Gas Limited

Summary Responses to the 2015 Natural Gas Demand Side Management Annual Verification Recommendations

December 18, 2017

The Evaluation Contractor ("EC") submitted its 2015 Natural Gas Demand Side Management Annual Verification report to the Evaluation Advisory Committee ("EAC") on October 16, 2017. Its report included findings and recommendations addressed to Union, Enbridge and on future evaluation work. This summary document provides responses to EC recommendations that were addressed to Union.

Findings, recommendations and outcomes below are as reported in Section 5 of the EC's report and are broken into two main categories with associated sub-categories as follows:

2015 Annual Verification Recommendations
- Overall
- RunitRight savings recommendations
- Simulation modeling recommendations
- Cost-effectiveness recommendations
- Other

CPSV / NTG findings and recommendations
- Energy savings and program performance
- Verification processes
- Documentation and support
- Data management

1. 2015 Annual Verification Recommendations

This section presents finding, recommendations and responses for five sub-categories:

1. Overall
2. RunitRight savings recommendations
3. Simulation modeling recommendations
4. Cost-effectiveness recommendations
5. Other

1.1 Overall

Table 1, Overall[1]

#	Overall Annual Verification Recommendation	Applies to		
		Union	Enbridge	Evaluation
O1A	Consider investing in a relational program tracking database.	✓	✓	
O1B	Enbridge should include site-level information for all measures installed through the program.		✓	
O2A	Deliver tracking data in a single flat file.	✓	✓	
O2B	Consider investing in a relational program tracking database.	✓	✓	
O3A	Develop and maintain an electronic summary of the TRM.	✓	✓	✓
O3B	Track prescriptive savings using unique measure descriptions that map to electronic TRM.	✓	✓	✓

O1. Finding: The Enbridge tracking database does not currently include information that allows the evaluator to identify all the projects installed by a single customer. Without this information, the EC could not identify projects installed across customers to determine whether interactive effects may have reduced energy savings. Some prescriptive measures in the Enbridge data did not have site-level information at all, only a summary of the energy savings for that technology across all sites.

Recommendation A: Both utilities should strongly consider investing in relational program tracking databases. Relational program tracking databases and customer relationship management (CRM) systems allow for multiple measures and projects to be associated with a single customer and/or

[1] 2015 Natural Gas DSM Annual Verification Report Table 5.1

customer site. The incremental cost of implementation is low if it is part of the initial database design, populated as projects are started, and updated once they arecomplete.

Outcome: Reduced burden on utility staff and reduced evaluation costs. A relational database would streamline aggregation of program data for scorecards and make providing data simpler for annual savings evaluation and verification.

UNION RESPONSE: As detailed in its 2015-2020 DSM Plan, Union outlined the need for a DSM tracking and reporting system upgrade. The Board approved this request in its January 20th, 2016 Decision. This system upgrade is expected to be rolled out in 2018.

Recommendation B: Enbridge should include site-level information for every measure installed in the program.

Outcome: Confirmation that each installation is unique.

UNION RESPONSE: This recommendation was directed to Enbridge only.

O2. Finding: Both utilities invested significant effort in developing Excel-based tracking workbooks that summarized data and calculated DSMSI based on utility-reported results. Union's workbook included a feature that was designed to allow evaluators to enter adjustment factors in a single location and automatically update DSMSI and LRAM calculations. Neither workbook was well suited for evaluation efforts.

Recommendation A: Deliver to evaluators a single, flat file of tracking data.[2] Each record should have measure-level information which includes the information listed below.

- Program identification information, such as scorecard, and program name
- Customer identification information, such as a unique customer ID, rate class, and location
- Measure identification information, such as measure description, unique measure identification, measure group, measure life, free rider rate, and savings per unit for prescriptive measures
- Savings information, such as annual gross and net savings, cumulative gross and net savings, and non-gas savings
- Additional information as needed to allow the evaluator to verify LRAM and cost-effectiveness

The Union tracking data most closely followed this recommendation, but both utilities invested in workbook features that did not enhance evaluation efficiency.

[2] In this context, a flat file is a table with one record per line and no summary information.

Outcome: Reduced burden on program staff, more flexibility for evaluators.

UNION RESPONSE: All of the measure-level information indicated above was included in Union's tracking database.

Union's 2015 tracking database provided to the EC included live calculations that connected measure-level inputs to the calculation of energy savings, scorecard achievements, LRAM values and cost effectiveness values found in Union's draft Annual Report. This is consistent with Union's approach to the audits conducted during the 2012-2014 DSM Framework.

Union's tracking database has continually evolved over the course of all previous audits to the point where it has reached full transparency. Union's auditors and Audit Committees for the 2012-2014 audit expected Union's tracking database to have this level of full transparency. The EC's current recommendation to provide a single flat file without any summary information appears to be a step backwards in transparency and accountability. Given that this EC will remain in place for 2016, Union will accommodate its request. However, Union will continue to maintain an internal tracking database with all active calculations that can be provided to the EC upon request.

Recommendation B: See recommendation O1A. The utilities should consider investing in a new database.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

UNION RESPONSE: See Union's response to recommendation O1A.

O3. Finding: Neither Union nor Enbridge tracking databases currently use prescriptive measure descriptions that map directly to the approved energy savings spreadsheet (TRM). The EC often struggled to align tracking measures to the correct TRM measure, which resulted in repeated back-and- forth between evaluation and the utilities for clarification. During this process, the EC found that some Enbridge measures were assigned to the wrong sub-category by capacity or other size measure. The EC also found that some Enbridge measures were assigned outdated savings values from previously- approved TRMs.

Recommendation A: Develop and maintain an electronic summary of the TRM, such as an Excel file. Each measure (identified as a unique savings value) should have an assigned measure ID number, and new ID numbers should be assigned when a measure is updated with a new savings value. This allows for a historical record of the changes in the TRM and allows the evaluation to identify outdated values.

UNION RESPONSE: OEB Staff now coordinates the TRM update process.[3] This recommendation

[3] The online portion of the TRM has been transitioned to OEB Staff as outlined in the OEB's March 4 letter regarding the transition of Technical Evaluation Committee Activities.

should be directed to OEB Staff.

Recommendation B: Track prescriptive savings using unique measure descriptions that clearly map to the electronic TRM.

Outcome: Reduced burden on utility staff and reduced evaluation costs. Fewer errors in the tracking data.

UNION RESPONSE: In 2015, the EC found no errors in Union's tracking database related to prescriptive measures and TRM inputs. For 2016, Union agrees to provide the EC with a mapping that more clearly connects prescriptive measure descriptions in its tracking database to TRM measure descriptions.

1.2 RunitRight savings recommendations

Table 2, RunitRight Recommendations[4]

#	RunitRight Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation
RR1	Consider adding independent variables to the regression to account for school breaks.		✓	
RR2A	Consider including the date when each activity was implemented.		✓	
RR2B	Provide information on both the baseline and installed case.		✓	
RR2C	Increase the level of documentation when a single change results in a significant portion of savings.		✓	
RR3A	Consider including a basic description of all end-use equipment served by the gas meter.		✓	
RR3B	Consider using engineering calculations to estimate electricity savings.		✓	
RR3C	Consider reviewing the process for selecting the HDD reference temperature.		✓	

UNION RESPONSE to Recommendations RR1-RR3c: RunitRight is an Enbridge program. These recommendations were directed to Enbridge only.

[4] 2015 Natural Gas DSM Annual Verification Report Table 5.2

1.3 Simulation modeling recommendations

Table 3, Simulation Modeling Recommendations[5]

#	Simulation Modeling Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation
SM1	Provide simulation file and output to the evaluation team.	✓	✓	
SM2	Provide more explicit support for major measure installations.	✓	✓	
SM3	Consider reviewing and modifying program processes to avoid data entry or outdated simulation result errors.	✓	✓	
SM4	Consider funding a study to verify the models produced by the utility agents.			✓

SM1. Finding: Both utilities use building simulation modeling to estimate energy savings for their home retrofit programs, including Home Energy Conservation, Home Reno Rebate, Winterproofing, and the Home Weatherization Program. HOT2000 is the most common program used for those simulations, which is a program developed and released by NRCan for certified energy advisors. Because of the restrictions on the program, the evaluator could not consistently run the simulation files and produce the same result reported by the program.

Recommendation: Provide both the building simulation file and the program output to the evaluation team. By delivering both, the evaluation team would not have to follow up with the utility to obtain output for models that could not be run, but could still verify the output for models that can be run.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

UNION RESPONSE: In 2015, Union provided the EC with documentation as per the EC's original and subsequent follow-up requests. Union will continue to do so for the 2016 audit and will provide both the building simulation file and the program output to the evaluation team.

[5] 2015 Natural Gas DSM Annual Verification Report Table 5.3

SM2. Finding: Both utilities have market-rate scorecard metrics that rely on a definition of deep savings that is related to the number of “major” measures installed at a site. Both utilities also collect and deliver photographs to support many of the changes made at a home retrofit site. However, the evaluator could not consistently confirm the number or type of major measures installed based on the photographs or other documentation provided.

Recommendation: Consider providing more explicit support for each major measure to eliminate uncertainty around the number of deep savings program participants.

Outcome: Greater certainty around scorecard achievements.

UNION RESPONSE: Union endeavours to provide all available supporting information to the EC as requested. The type of supporting information gathered is consistent with what Natural Resources Canada (“NRCan”) requires certified Energy Advisors to collect for use of HOT2000 software.

Union requests that the EC provide more information on what additional support it would find useful. In certain cases, confirming measures after they have been installed is difficult. For example, upgraded wall insulation is sometimes covered up by paint or other material making a post-installation photo impossible. In such scenarios an invoice confirms that work was complete.

Union agrees to continue to work with the EC to ensure that it has all information available to facilitate the confirmation of measures installed in a home undergoing review.

SM3. Finding: The evaluator identified a number of inaccurate savings entries due to data entry errors or outdated Union home retrofit simulation results. Many of these errors could be avoided through changes in program processes.

Recommendation: Consider reviewing and modifying program processes to avoid similar errors in the future.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

UNION RESPONSE: Union’s program delivery model has certified Energy Advisors run HOT2000 in accordance with the requirements of Union's program. Energy Advisors are independent consultants and are not under contract with Union. In support of Union’s program, they do run model scenarios with inputs different than what is required by NRCan for use of its licensed HOT2000 software. For example, advisors would upgrade the in-situ furnace efficiency to reflect the Home Reno Rebate baseline requirement of a 90% efficient furnace.

Union operates under a culture of continuous improvement. Since 2015, efforts have been made to improve upon the process it uses to collect data from its Energy Advisors. Union will continue with similar efforts going forward.

SM4. Finding: The energy savings from the home retrofit programs rely exclusively on the simulations provided by the delivery agents. Those simulations likely rely on a number of assumptions or standard modeling practices which may or may not follow industry standards. A detailed review of the models was outside the scope of the annual audit.

Recommendation: Consider funding a study to verify the models produced by the utility agents to ensure they conform to standard industry practice.

Outcome: Greater certainty around savings estimates.

UNION RESPONSE: This recommendation was not directed to Union but for clarity, simulations are completed by Energy Advisors certified by NRCan for use of NRCan's HOT2000 modeling software. This certification trains advisors to use NRCan industry standard inputs and modeling practices. Simulation results are then provided to NRCan and are subject to NRCan's QA procedure.

Union considers having NRCan-certified Energy Advisors use NRCan standard inputs and modeling practices appropriate to ensure that industry standard practices are followed.

1.4 Cost-effectiveness recommendations

Table 4 Cost Effectiveness Recommendations[6]

#	Cost-effectiveness Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation
CE1	Allocate "sector"-level administrative costs and overhead to each individual program and report program-level cost-effectiveness results.	✓	✓	
CE2	Use a consistent real discount rate of 4% when using real streams of benefits and costs.	✓	✓	
CE3	Explore the possibility of better defining water avoided costs.	✓	✓	✓
CE4	Work towards better uniformity in methods and assumptions.	✓	✓	✓

[6] 2015 Natural Gas DSM Annual Verification Report Table 5.4

CE1. Finding: In some cases, the Union program costs were grouped together for several programs. To get program- or sector-level cost-effectiveness results, the EC prorated costs to programs based on natural gas savings.

Recommendation: Allocate “sector”-level administrative costs and overhead to each individual program and report program-level cost-effectiveness results.

Outcome: Greater certainty around program-level achievements.

UNION RESPONSE: Union agrees with the EC that program-level cost-effectiveness results should be reported but disagrees with the EC’s definition of a program.

As per the 2015-2020 DSM Guidelines, for a program to be deemed cost-effective, it must achieve a TRC-Plus screening threshold benefit/cost ratio of 1.0 or greater or 0.7 for Low-Income. Union’s 2015 programs are defined within its 2015-2020 DSM Plan as Residential, Commercial/Industrial, Low-Income and Large Volume. Union’s 2015 program costs were reported to the EC separately for each of these programs.

The EC’s reference to ‘programs’ actually refers to ‘offerings’ within these programs. One example of an offering is the Home Reno Rebate offering within the Residential program. The EC’s reference to ‘sector’ refers to programs as defined in Union’s 2015-2020 DSM Plan. Further, the EC’s approach to prorating program costs proportionally to offerings within it based on the offerings’ energy savings is not a realistic estimate of where expenditures occur. Cost effectiveness with costs prorated in this manner would be neither accurate nor informative with respect to program design.

Union will continue reporting its costs on a program-level basis consistent with the programs as defined within its 2015-2020 DSM Plan.

CE2. Finding: Enbridge uses a real discount rate of 4% and applies it to streams of current (nominal) values. However, the real discount rate should only be applied to real (inflation-adjusted) streams of benefits and costs. Nominal discount rates should be applied to streams of current (nominal) values.

Recommendation: Use a consistent real discount rate of 4% for both Enbridge and Union when using “real” (inflation-adjusted) streams of benefits and costs.

Outcome: More accurate cost-effectiveness results.

UNION RESPONSE: Union agrees with the EC’s findings. Union will convert the real 4% discount rate recommended by the Board into a nominal discount rate and apply it to its stream of nominal TRC-Plus benefits.

CE3. Finding: Water rates are currently used as a proxy for the water avoided costs. Water avoided costs should only include the marginal impact from reduced consumption. Using the full rate as the avoided cost may be appropriate in some jurisdictions with a completely variable rate structure. However, those with high fixed costs (which, in our experience, can represent 75% to 80% of water costs) should use a true avoided cost.

Recommendation: Explore the possibility of better defining water avoided costs.

Outcome: More accurate cost-effectiveness results.

UNION RESPONSE: Union agrees with the EC that water avoided costs should only include the marginal impact from reduced consumption. As part of the 2015 audit, the EC recommended a 75% reduction to Union's avoided water costs (which are based on average water retail costs across its service territory) as a means to better estimate avoided water costs. Union agrees to continue using the EC's approach for 2016.

CE4. Finding: The EC found major discrepancies in the way the utilities calculate cost-effectiveness. Some areas of discrepancies included the discount rate, the use of a non-energy benefit adder, the format of reporting results, and the allocation of administration and overhead costs by program. While there is always a balance to be found between uniform methods and the need to account for each specific utility's needs, greater uniformity could be achieved.

Recommendation: Work towards a better uniformity of cost-effectiveness methods and assumptions between the two gas utilities.

Outcome: More accurate and consistent cost-effectiveness results.

UNION RESPONSE: Union adhered to its Board-approved 2015 Plan for the following items noted by the EC:

- Discount Rate: For 2015 only, as outlined in its 2015-2020 Plan Ex A Tab 2 page 26: "Union will also discount the total avoided costs resulting over the life of each DSM measure by using its Weighted Average Cost of Capital ("WACC")." As per the Plan Ex A Tab 3 page 42, Union will adopt a 4% real discount rate starting with its 2016 programs. See also Union's resolution to EC Recommendation CE2.

- Non-energy benefit adder: For 2015 only, as outlined in its 2015-2020 Plan Ex A Tab 2 page 24: "Union will employ the Total Resource Cost ("TRC") test agreed upon in the EB-2011-0327 Settlement as the sole method of program cost effectiveness screening. The TRC test methodology and thresholds will remain consistent with those outlined in EB-2011-0327." This TRC methodology does not include the 15% non-energy benefit adder. As per its 2015-2020 Plan Ex A Tab 3 page 40, Union will be employing the Total Resource Cost-Plus ("TRC-

Plus") test as the primary cost-effectiveness test to screen its programs beginning in 2016. This includes use of a 15% non-energy benefit adder.

With the above changes, there will be improved uniformity in cost-effectiveness methods and assumptions between both utilities in 2016.

1.5 Other

Table 5, "Other" Recommendations[7]

#	Other Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation
OR1	When the C&I deep savings metric is used, deliver monthly billing data for each C&I participant.	✓		
OR2	Provide a detailed explanation for the DSMSI calculation.	✓	✓	

OR1. Finding: The Union scorecard includes a metric that relies on an understanding of the whole-building energy use for each C&I program participant. The program data included the total annual consumption at each site, normalized by a regional (north or south) estimate of heating degree days. The calculation appeared to assume that industrial sites were not weather-sensitive but commercial sites were.

Recommendation: When the C&I deep savings metric is used, deliver monthly billing data for each C&I participant to allow the EC to verify the annual consumption values and the weather sensitivity assumptions. Provide the supporting information (and calculation, if possible) for the normalized regional heating degree days.

Outcome: Greater certainty around scorecard achievements.

UNION RESPONSE: Union's 2016-2020 scorecards no longer have a C&I deep savings metric.

OR2. Finding: The evaluator was unable to locate a source document that supports the utilities' calculation of DSMSI. Given the importance of the shareholder incentive, it is appropriate to have a

[7] 2015 Natural Gas DSM Annual Verification Report Table 5.5

clearly defined and detailed explanation of how it is calculated.

Recommendation: Provide a detailed explanation for the DSMSI calculation for review by the EC and OEB.

Outcome: Greater certainty around shareholder incentives.

UNION RESPONSE: The source document that describes how the incentive is calculated can be found in EB-2015-0029 Ex A Tab 2 page 21. Union provided this explanation to the EC and EAC during the course of the 2015 audit and the EC made no suggestions or changes to Union's approach.

2. CPSV / NTG recommendations

This section is broken into four sub-categories:

1. Energy savings and program performance
2. Verification processes
3. Documentation and support
4. Data management

2.1 Energy savings and program performance

Table 6, Energy Savings and Program Performance[8]

#	Energy Savings and Program Performance Recommendation	Applies to		
		Union	Enbridge	Evaluation
ES1	The utilities should continue in their commitment to accuracy.	✓	✓	
ES2	Evaluate free-ridership for the programs annually and couple the free-ridership evaluation with process evaluation			✓
ES3	Error ratios from this report inform sample design for future evaluation.			✓
ES4	Align the program design with cumulative net goals	✓	✓	
ES5	Do not pay incentives until after installation is complete.	✓	✓	
ES6	Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.	✓	✓	
ES7	Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.	✓	✓	✓
ES8	Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.	✓	✓	
ES9	Consider establishing an official definition for EUL and implementing a study to define EULs for program measures	✓	✓	✓
ES10	Track metrics for how long it takes from the final installation verification to the posting of incentive payments.	✓	✓	
ES11	Increase transparency of "influence adjustments" and do not include in gross	✓		

[8] 2015 Natural Gas DSM Annual Verification Report Table 5.6

ES1. Finding: Both utilities exhibit a strong commitment to accurate energy savings estimates. Both utilities have made significant investments in developing calculation tools which model savings accurately. For example, Union's dock door seal calculator is well considered and designed, and Enbridge's Etools calculator is very thorough in attempting to model savings for key measures.

Both utilities chose to retain engineers with strong understandings of their customers' building and process systems. We had numerous opportunities to interact with these engineers on phone calls and site visits, and have grown to respect their knowledge and engagement with the types of systems that matter to their customers.

Both utilities showed a commitment to finding accurate savings. On several occasions, both on the phone and in writing, the evaluation team suggested a value that would have increased savings in a way that the program engineer did not think was valid. When this happened, neither utility was shy in suggesting that we may want to make a more conservative choice.

Recommendation: The utilities should continue in their commitment to accuracy.

Outcome: Accurate energy savings.

UNION RESPONSE: Union is committed to being a high performing organization dedicated to continuous improvement mechanisms in all aspects of its work. Union appreciates the recognition that our engineers are knowledgeable subject matter experts.

ES2. Finding: Free-ridership in the utilities' programs is high.

Recommendation: With high free-ridership and rapidly changing programs, consistent evaluation of free-ridership annually and free-ridership evaluation coupled with process evaluation will help identify specific ways for each program to manage and reduce free-ridership.

Outcome: Effective free-ridership management will allow the programs to increase their net savings significantly in future years.

UNION RESPONSE:

This recommendation was not directed to Union however, Union finds it necessary to make clear that it does not agree with the EC's findings. There are well documented concerns with the approach to NTG determination taken by the EC. The NTG study did not in many instances reflect industry best practice. Union notes there were significant concerns with the measurement of free-riders conducted by the EC on the 2015 program year custom offers. Most importantly, Union is concerned with the reliability of scoring that was determined based on feedback from customer representatives regarding projects completed up to 2 ½ years earlier. Beyond the ability to reach truly informed participants to the projects, the delayed research significantly exacerbated recall bias of survey participants. In addition, the limited research conducted to ascertain utility influence delivered through the utility's business partners; the focus in the survey instrument on the payment of incentives rather than assessment of the entire suite of services and values provided to customers; the posing of questions that did not ensure clarity of properly captured efficiency improvements relative to specific project utilized baselines to ensure there could be no double counting of adjustments; and, the dismissal of consideration of utility influence and long standing customer support prior to the current program year, all contributed to proposed free-rider values which are not reasonable, nor accurate, and in which there can be no confidence.

It is also worth address the unique nature of Union's Large Volume program. This program is a Direct Access program where customers access their own money for eligible projects. If they do not use their money, it becomes available to other customers. This program design is entirely incompatible with the application of a free rider rate. While Union can attempt to influence a customer by providing incentives and identifying/quantifying opportunities to save energy, the customer prioritizes projects depending on its own needs. If a project meets the eligibility criteria of the program, Union will not refuse a customer access to its own money.

ES3. Finding: Relative precision targets were exceeded for some programs and not met for others.

Recommendation: Error ratios from the results provided in this report should be used to inform sample design for future evaluation years.

Outcome: Better defined error ratios for the measures in the programs will allow more efficient sample design for future evaluations, improving precisions and reducing costs.

UNION RESPONSE: This recommendation was not directed to Union however, Union has commented extensively during the 2015 audit on the topics of error ratios, sample size and resulting uncertainties. Prior to the 2015 audit, CPSV sampling would have required 50-70 projects be verified. The 2015 auditor verified 191 projects. Despite this increase in sample size, the EC's sample design did not result in an enhancement to precision. Union will be advocating the reintroduction of the sampling methodology used prior to 2015 that was the result of a known industry expert hired by the TEC as an independent third party.

ES4. Finding: Attribution for the programs came primarily through acceleration rather than changes in efficiency or quantity/size. This is partly due to the measures that dominate the programs: controls, maintenance, and optimisation. These measures do not have varying efficiencies, so the programs are either affecting the number of units implemented or accelerating the measure. Acceleration is less valuable to programs that are seeking to meet cumulative net goals. Acceleration periods tend to be considerably shorter than the estimated useful life (EUL) of a measure and thus the partial attribution that results is low relative to cumulative gross savings.

Recommendation: To align the programs with cumulative net goals, the utilities should seek to:

- continue promoting long life measures and consider discontinuing promotion of short lived measures
- proactively upsell equipment purchases from standard to efficient products
- target hard to reach customers who have not participated in the past
- promote EE measures with low market penetration (such as heat reflector panels)
- motivate customers to increase the scope of their projects, some options include multi-measure bonuses or escalating incentive structures that pay more for doing more

Outcome 1: Focusing on proactive sales rather than reactive will help the net-to-gross (NTG) ratio.

Outcome 2: Effective free-ridership management will allow the program to increase net savings significantly in future years.

UNION RESPONSE: Union does focus its efforts on achieving cumulative gas savings but supports a wide range of eligible energy conservation projects. Union continually improves and changes the design and focus of its programs but does not agree with all of the EC's recommended suggestions.

ES5. Finding: A handful (<5) of respondents indicated that all or part of their incentivized project had not yet been installed over a year after the incentive was paid.

Recommendation: Do not pay incentives until after installation is complete.

Outcome: Cost-effectiveness of the program will increase as it avoids paying for savings that do not materialize.

UNION RESPONSE: Union does pay incentives only after projects are completed and commissioned. Union requested more information on which projects DNV is referring but was not given any additional information. Fewer than 5 instances across both utilities suggests this finding is an exception rather than the rule.

ES6. Finding: Some customers receive incentives from their electric provider and natural gas utility to complete the same EE measure. Both providers may claim the same changes in energy use, resulting in overlap when aggregated across fuels at the provincial level.

Recommendation: Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.

Outcome: More accurate energy and carbon savings estimates across the province.

UNION RESPONSE: Union was not made aware of any instances of double counting energy savings for projects that were reviewed through the course of the 2015 audit and doesn't understand the basis for which the EC reached its finding.

Union continues to work towards coordination of CDM and DSM programs as outlined in the 2015-2020 DSM Guidelines.

ES7. Finding: Some measures (e.g., geothermal heat pumps, combined heat and power, and those that save district heating energy) have difficult-to-define baseline technologies.

Recommendation: Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating/cooling measures.

Outcome: Less evaluation risk and a better alignment between province energy efficiency goals and program implementation.

UNION RESPONSE: Union continues to adhere to DSM policies and guiding principles as defined in the 2015-2020 DSM Framework and Guidelines.

ES8. Finding: Projects with very long and very short simple payback periods often have low NTG ratios. However, from a customer service standpoint, it may be difficult for utilities to deny incentives to customers unless they have pre-established rules to point to.

Recommendation: Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.

Outcome: The rule will give utilities a guideline to restrict the program to projects that are more likely to result in net savings. It will also allow the utilities to reject potentially poor projects without a large effect on customer satisfaction.

UNION RESPONSE: As set out in the Board's Decision and Order, Section 5.2.6 on Union's 2015-2020 Plan (EB-2015-0029), the OEB rejected the need to introduce a policy defining payback eligibility criteria for the Commercial and Industrial custom offer.

ES9. Finding: Members of the EAC and evaluation team have different understandings of the definition of some evaluation inputs.

Recommendation: Consider establishing an official definition for EUL and implementing a study to define EUL for all measures, especially steam traps, pipe leaks, steam leaks, condensate leaks, and pipe insulation.

Outcome: The study will improve the accuracy of lifetime savings estimates.

UNION RESPONSE: Union adheres to the EUL definition included in the glossary of terms developed as part of the Board approved TRM filed in December 2016. Union understands that OEB Staff has issued an RFP for a CI custom measure life review as part of the 2016 evaluation process.

ES10. Finding: A handful (<5) of sites reported unhappiness with delays in receiving their incentive payment (5 months).

Recommendation: Track metrics for how long it takes from the final installation verification to the posting of incentive payments. Consider holding program managers accountable to these metrics by considering them during performance reviews, building in performance bonuses if all payments are posted within one month, and/or implementing a penalty if it takes greater than three months to post any payments.

Outcome: Improved customer satisfaction.

UNION RESPONSE: Union pays incentives only after projects are completed and commissioned. This process is communicated with project participants. Union requested more information on which projects DNV is referring but was not given any additional information. Fewer than 5 instances across both utilities suggests this finding is an exception rather than the rule.

Union operates under a culture of continuous improvement but does not agree that the EC's recommendation is needed to address its finding on fewer than 5 sites across both utilities.

ES11. Finding: Influence adjustments were made to projects that adjusted the gross savings for "net" or program influence reasons. Accounting of which projects had these adjustments was not maintained by the program and the adjustments were included in different places in project calculation workbooks, making their identification challenging. In addition, the program NTG was also applied to these projects, effectively double discounting savings in scorecards.

Recommendation: If the utility chooses to continue making influence adjustments to the savings upon which it calculates savings, these adjustments should be made more transparent and not included in the reported gross savings for the program in scorecards. Instead the specific project influence adjustment should be included in the scorecard in place of the general program or domain level NTG factor.

Outcome: Reduced risk of double adjustments.

UNION RESPONSE: As an outcome of previous audits, Union began applying influence adjustments in 2015 to certain maintenance-related projects (largely steam leak and steam trap repair projects). Union applied the factor so that its claim accounted only for savings it had influenced that are incremental to a customer's standard maintenance practice. However, Union does agree with the EC that applying an influence adjustment in addition to a NTG factor effectively double discounts savings. Union no longer applied an influence adjustment factor starting in 2016.

Table 7, Energy Savings and Program Performance (Cont'd) [9]

#	Energy Savings and Program Performance Recommendation	Applies to		
		Union	Enbridge	Evaluation
	savings			
ES12	Conduct a process evaluation to improve Large Volume influence on customer projects	✓		
ES13	Consider approaches to market that leverage third-party vendors.	✓	✓	

ES12. Finding: Union's Large Volume program has a very high amount of free-ridership.

Recommendation: This evaluation did not include a process evaluation. Union should consider conducting a process evaluation focused on how to reduce the rate of free-ridership. Three options that the Union might consider are:

- Eliminate measure types with high free-ridership (Union indicated that most maintenance type measures were eliminated in 2016).
- Use an application process that includes a committee review that can reject free riders. This option is hard for utilities to manage as it can affect customer satisfaction negatively
- Clear payback criteria such as initial payback must be longer that X years and the incentive paid must reduce payback below Y years. This has the advantage of being a rule that account representatives can explain when talking to customers.
- Non-energy benefits of projects that large industrial customers gravitate to are often large compared to energy saving benefits, so simple payback criteria will not eliminate all free

[9] 2015 Natural Gas DSM Annual Verification Report Table 5.6

rider projects. Awareness of this issue should be promoted among the implementation team.

Outcome: Effective free-ridership management may allow the program to increase its net savings significantly in future years.

UNION RESPONSE: As per Union's resolution to recommendation ES2, the unique Direct Access design is entirely incompatible with the application of a free rider rate. Union disagrees with the EC that a process evaluation focused on how to reduce the rate of free-ridership should be conducted. This type of study will not address the fundamental incompatibility between the Large Volume program design and the application of a free rider rate.

ES13. Finding: Vendor attribution did not increase overall program attribution significantly. Of the vendors that customers cited as influences, few indicated that either program had much effect on the projects.

Recommendation: The utilities should consider approaches to market that leverage third-party vendors. A process evaluation that includes vendor interviews might uncover opportunities.

Outcome: Effective leveraging of vendors could both increase NTG ratios and increase program uptake.

UNION RESPONSE: Union's current approach to market for all of its DSM programs fully leverages third parties. For many years, Union has extensively engaged third party partners including vendors/contractors/engineers and distributors to promote Union DSM programs and support customers in the decision making process, propelling customers to implement energy efficiency improvements. Union believes the EC's finding suggests that the approach employed in their free rider study was flawed and did not effectively identify the significant and important role of the vendor/business partner community. For example, it is best practice of self-report NTG surveys to interview participants and vendors as soon as possible after project implementation. This helps reduce recall bias and helps ensure that interviews are conducted with a person that was actively involved in the original project. Union suspects that recall bias is particularly pronounced for vendors who might not recall the details of one specific project over the numerous projects for which it was involved over the two year gap between project implementation and the interview. Vendors will have also had staff turnaround within this two year gap and the EC did not provide information on whether the vendor staff member interviewed was actively involved in the original project.

2.2 Verification processes

Table 8, Verification Process Recommendations[10]

#	Verification Process Recommendation	Applies to		
		Union	Enbridge	Evaluation
VP1	Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.	✓	✓	
VP2	The verification and utility staff should agree to a code of conduct for each role during onsite visits.	✓	✓	✓

VP1. Finding: DNV GL was unable to obtain access to all the equipment at all the sites selected for verification. Both Enbridge and Union have several large projects with industrial companies, including food processing, refineries, and other industries. In many cases, the customer refused to provide SCADA data or similar trend data to allow a reasonable verification of the project. This means we were unable to do more than a reasonableness check on the savings.

A review of the Enbridge contract shows that the customer is not required to provide the information that is necessary for EM&V. The most relevant sections are:

- Item 6 states: Payment of the Incentive Payment is subject to the completion of a satisfactory site inspection of the improvements, including the installed equipment by an authorized representative of Enbridge.

- Item 9 states: Upon request within eighteen months of the commissioning date of the Project, and with reasonable notice, the Customer agrees to provide authorized representatives of Enbridge with access to the Project, and with required information or data relating to the project for the purposes of the Application and these General Terms and Conditions.

Neither of these are sufficient for EM&V.

Recommendation: Modify contracts to require participants to agree to comply with EM&V as well as utility representatives as part of the requirements for participation in the program.

[10] 2015 Natural Gas DSM Annual Verification Report Table 5.7

Outcome: Reduced evaluation costs and risks. Participant non-compliance requires evaluators to request documentation for a large backup sample, and to survey and/or visit additional sites to obtain sufficient data for the evaluation. The process of contacting a site and getting a refusal costs time and money, as does the substitution of an additional site to make up for the unobtained data. In some cases, there might not be additional sites to sample, in which case the evaluation estimates will have lower precision than they would with full compliance.

UNION RESPONSE: Union encourages its customers to participate with verification activities. Prior to 2015, Union did not find the need to include a requirement for EM&V into requirements for project participation; 100% of participants selected for verification agreed to participate and to a degree that satisfied the verifiers' ability to defend its findings.

In some cases, the EC's opinion on what constitutes a reasonable verification is misaligned with what should be expected in practice. Union raised cases with the EC where customers complained about the length of time and level of involvement needed to participate with 2015 on-site verification activities. Participants have commented to Union that they do not have the level of resources available to accommodate these types of requests. No similar participant complaints were made for verifications prior to 2015. The extent of participant involvement required for 2015 verification should not be considered reasonable.

The EC notes that in some cases, verifiers were unable to obtain access to all the equipment or participants did not provide all requested data. Criteria including safety concerns, perceived reasonableness of the request, customer privacy and time lag from measure installation can prevent access to certain equipment. An average of two years has passed between projects implemented in 2015 and verification activities conducted in 2017. Due to this time lag, it can be expected that some data may be overly burdensome for the customer to extract or might no longer be available at all.

VP2. Finding: Verification engineers and verification forms caused confusion with site contacts and the length of visits also led to a handful of customer complaints. Utility staff at a handful of sites responded to questions in place of participating customers and in one case interfered with data collection.

Recommendation: The verification and utility staff should agree to a code of conduct for each role. The teams should receive clear direction as to the dos and don'ts of all parties involved in site visits, including both verification engineers and utility staff should they attend the visit. Open lines of communication between the site team and utility staff should be maintained to reduce misunderstandings and ensure that the teams are on the same page as to each other's role.

In general, the following should be part of standard verification practices:

- Ensure site engineer reviews final site report for accuracy post-audit.
- Align data collection forms with site report structure to reduce communication and transcription errors.
- Ensure data appropriate to determining EUL is collected while on-site (i.e., make EUL determination a primary, rather than secondary focus).
- Request specific documentation or data from systems prior to site visit (allowing for adequate time for site contact to obtain).

Outcome: Improved data collection and customer satisfaction.

UNION RESPONSE: Union agrees that a verification code of conduct for EC, verification and utility staff should be established.

Union also agrees with the EC's suggested inclusions in the code of conduct and proposes that other items be included to help address Union concerns as well as participant concerns communicated to Union over the course of the 2015 verification. These concerns, which were presented and discussed with the EC and OEB Staff, include:

- Verifiers booked site visits with as little as one day's notice to both customers and Union.
- Customers noted that having Union Account Managers attend on-sites should be mandatory and not optional.
- Union Account Managers that attended on-site visits observed that verifiers sometimes oversimplified customer responses to questions.
- Verifiers appeared unprepared for some on-site verifications.

Union raised these concerns with both the EC and Board Staff and the EC has committed to improvements for the 2016 verification process. In turn, Union has addressed the concerns raised by the EC related to responding to questions in place of participating customers. Upon receiving this feedback from the EC, Union communicated verification expectations internally and no further complaints against Union were received.

2.3 Documentation and support

Table 9, Documentation and Support Recommendations[11]

#	Documentation and Support Recommendation	Applies to: Union	Applies to: Enbridge	Applies to: Evaluation
DS1	Take steps to improve documentation: • Include explicit sources for all inputs and assumptions in the project documentation. • Store background studies and information sources with the project files and make them available to evaluators. • Provide evaluators full access to customer data. • Provide pre- and post-installation photos, where available. • Document and provide internal M&V documents where available. • Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification	✓	✓	
DS2	Ensure that incremental costs are supported by invoices or other documentation	✓	✓	
DS3	Increase the amount of documentation and source material for projects that have greater energy savings.	✓	✓	

[11] 2015 Natural Gas DSM Annual Verification Report Table 5.8

DS4 A	Digitize and file project documentation for all projects as they are completed and paid during project closeout.	✓	✓	
DS4 B	Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.			✓
DS5	Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner.	✓		
DS6	Use a consistent summary workbook.		✓	

DS1. Finding: Project documentation for some projects lacked sufficient details to allow evaluators to reproduce the calculations made by program staff or third-party vendors. Specific issues included:

- Project data or details missing
- Insufficient measure-level details to fully describe what was installed
- Descriptions that were difficult to understand
- Use of black box tools
- Hardcoded information in calculation spreadsheets
- Energy intensity changes presented without providing the data to justify it
- Undocumented assumptions
- Sources referenced but not included or available, such as feasibility studies and historical analysis of energy use that was left out of the project documentation
- Scanned documents that were unreadable
- Input adjustments that approximate other effects, but are not explained
- Insufficient access to customer data (by customers) for confidentiality reasons.
- Modelling files that could not be opened
- Adjustments to savings estimates for safety or influence that were not clearly marked, sourced, or carried out in a consistent fashion
- Etools files not provided for many industrial boiler & boiler add-on projects

Recommendation: Several steps could be taken to improve data quality:

- Include explicit sources for all inputs and assumptions in the project documentation.
- Store background studies and information sources with the project files and make them available to evaluators.
- Provide evaluators full access to customer data.

- Provide pre- and post-installation photos, where available.
- Document and provide internal M&V documents where available.
- Institute a checklist as part of project closeout to ensure all relevant project documentation is assembled as ready for verification

Outcome: Properly explaining and sourcing the savings calculation method and assumptions allows the evaluating engineer to more easily identify what needs to be verified. It also makes it easier to determine whether the methods and assumptions are reasonable and use ex ante assumptions rather than seek documented values elsewhere.

UNION RESPONSE: Union continually strives to improve the comprehensiveness of custom project documentation and generally works to ensure full and detailed inputs and supporting evidence is clearly outlined for each project. Nonetheless, Union will examine these recommendations moving forward. Given the timing of the receipt of the 2015 Annual Verification Recommendations in Q3 of 2017, incorporation of any such recommendations will be made in the 2018 program year at the earliest.

DS2. Finding: Invoices were not always included with documentation, and we saw a handful (<5) of cases where utility program staff were overclaiming incremental costs. This did not appear to be systemic, but higher incremental costs enable payment of a larger incentive.

Recommendation: Ensure that incremental costs are supported by invoices or other documentation, especially for add-on and optimization measures where the total cost and incremental cost are likely to be the same. Equipment replacement measures may require an additional standard efficiency quote to produce incremental cost.

Outcome: Incremental cost is an important component of simple payback, which is often used to judge the economic benefit of energy efficiency projects. It is also an input to some benefit-cost tests.

UNION RESPONSE: Union does ensure that incremental costs are supported by invoices or other documentation. In some cases, project costs are bundled within invoices for larger work being completed in tandem at a customer site. In others, projects are implemented using internal customer resources and no formal invoice is generated. In such cases, Union uses best available information to estimate incremental costs and these estimates are subject to verification.

Union requested more information on which projects DNV is referring but was not given any additional information. Fewer than 5 instances across both utilities suggests this finding is an exception rather than the rule.

DS3. Finding: Larger projects appeared to fall under the same documentation standards as smaller projects.

Recommendation: Increase the amount of documentation and source material for projects that have greater energy savings.

Outcome: Projects that are better documented tend to have more accurate savings estimates and receive fewer evaluation adjustments than those that are less documented. Large projects have a greater effect on overall savings adjustment factors. Therefore, large projects with better documentation are more likely to result in adjustment factors closer to 100%.

UNION RESPONSE: Union disagrees with the EC's recommendation. Union strives to ensure its project documentation captures all relevant information regardless of project size.

DS4. Finding: Enbridge did not maintain complete digital project files prior to the evaluation request. Union appeared to have digital documentation that was not completely assembled prior to evaluation.

Recommendation A: Digitize and file project documentation for all projects as they are completed and paid during project closeout. PDF and Excel files associated with a project should be stored in a way that allows them to be easily found and associated with a specific project and/or customer. The best practice is to include a document repository as part of the program tracking system with a separate folder for each project.

UNION RESPONSE: As detailed in its 2015-2020 DSM Plan, Union outlined the need for a DSM tracking and reporting system upgrade. The Board approved this request in its January 20th, 2016 Decision. This system upgrade is expected to be rolled out in 2018.

Recommendation B: Until the utilities can implement an effective digital document storage process, the evaluation should allow more time for the utilities to assemble and deliver the documentation.

Outcome: In our experience, DSM programs that store complete and well-organized digital records experience less evaluation risk. In other words, their gross savings adjustments are closer to 100%. This happens for three reasons:

- Digitization facilitates internal review of project documentation, providing additional opportunities to identify missing information and errors
- Assembly during project closeout improves the comprehensiveness of the documentation because less time has elapsed than if it was assembled for evaluation, so less information is lost or forgotten

- Easy retrieval makes it more likely that the complete file is sent to the evaluation team, reducing the information gap between implementation and evaluation.

UNION RESPONSE: This recommendation was not directed to Union.

DS5. Finding: Union custom projects utilized a project application summary workbook that summarizes the key project inputs, calculations, and most details. In general, this is a good approach that facilitates internal review and evaluation. One challenge was that different projects used the workbook in different ways:

- The notes section was sometimes used to identify and highlight specific unique approaches and features in projects, but not always.
- Calculations internal to the summary page were consistent for most projects, but not all (additional factors were sometimes added).
- Sub-methods critical to the calculation were contained in hidden sheets.
- Safety and influence adjustments were inserted in different locations and not always explained.

Recommendation: Consider providing more training or adding quality control steps to ensure the summary workbook front page is completed and stored in a consistent manner. Identify a common approach for common measures and, if necessary, document deviations and the reasons for the deviations in a clearly labelled field on the summary sheet.

Outcome: A consistent summary workbook aids both internal and external quality assurance, quality control, and measurement and verification.

UNION RESPONSE: Union agrees that its project application summary ("PAS") workbooks work well to summarize key project inputs and calculations, and that different projects might use the workbooks in different ways. Complete uniformity within PAS workbooks across hundreds of custom project is difficult. Union will explore this recommendation as part of its continuous improvement of custom project documentation.

DS6. Finding: The Enbridge Etools is used as both a calculation tool and as a communication tool with customers. While it appears to serve the needs of the program, this form of communication is difficult for the evaluation efforts.

- Etools does not easily allow for assumptions to be sourced within the record.
- Some Etools selections may be site-specific and some may be defaults; the calculator does not distinguish.
- Energy savings that are calculated outside of Etools are hard-entered in Etools but not always sourced.

Recommendation: Use a consistent summary workbook.

Outcome: A consistent summary workbook aids both internal and external quality assurance, quality control, and measurement and verification.

UNION RESPONSE: This recommendation was directed to Enbridge only.

2.4 Data management

Table 10, Data Management Recommendations[12]

#	Data Management Recommendation	Applies to		
		Union	Enbridge	Evaluation
DM1 A	Track contacts associated with projects in the program tracking database.	✓	✓	
DM1 B	Strongly consider investing in relational program tracking databases.	✓	✓	
DM1 C	Include structure for improved data integrity in the evaluator request for contact information for the 2016 and 2017 savings verification and evaluation.			✓
DM2 A	Consider offering bonus incentives early in the year to combat the "hockey stick" phenomenon where a large percent of projects get closed in the fourth quarter of the year (which results in rushed QC for data).	✓	✓	
DM3	Track and provide to evaluators dates for key milestones in the project.	✓	✓	
DM4	Maintain a customer identifier in the database to clearly identify related sites.	✓	✓	

[12] 2015 Natural Gas DSM Annual Verification Report Table 5.9

DM5	Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking extracts provided to evaluators.	✓	✓	

DM1. Finding: Neither Union nor Enbridge currently track participating customer or participating vendor contact information in their program tracking database. Providing the information to the evaluation put significant burden on utility staff. When contact information was provided, there were significant data integrity issues including contacts listed in the wrong places, partial addresses, and incorrect or missing phone numbers and email addresses.

Recommendation A: Track contacts associated with projects in the program tracking database. At a minimum, the program tracking database should include:

- Project site address
- Customer mailing address
- Primary customer contact name
- Primary customer contact phone
- Primary customer contact email
- Primary customer contact mailing address
- Addresses are best tracked as multiple fields including:
- Street address line 1 o Street address line 2 o City
- Province
- Postal code

Phone number fields should include data validation to enforce a consistent format and avoid missing or extra digit errors. Phone extensions should be tracked in a field separate from the ten-digit phone number and be restricted to numeric data only.

The best practice is to maintain contacts in a table separate from specific project or customer data. This allows for a single contact to be connected to multiple accounts and/or projects as necessary without creating duplication. This structure also makes it easier to associate multiple contacts with a single project.

Vendor contact information should also be tracked in the database, in the same table as the participating customer contact information. With a relational database, the contact ID from the table can be added to a project record in the role consistent with the contact's participation (such as vendor, decision maker, or technical expert) with a separate table that allows a single vendor contact to be associated with multiple projects.

Outcome A: Reduced burden on utility staff to seek contact information for projects, whether for internal or evaluation use. Reduced evaluation costs and improved sample design expectations.

UNION RESPONSE: As detailed in its 2015-2020 DSM Plan, Union outlined the need for a DSM tracking and reporting system upgrade. The Board approved this request in its January 20th, 2016 Decision. This system upgrade is expected to be rolled out in 2018.

Recommendation B: The utilities should strongly consider investing in relational program tracking databases. Relational program tracking databases and customer relationship management (CRM) systems allow for multiple contacts to be associated with a single account and/or project. This allows programs to easily clarify aspects of projects during implementation and to provide accurate, timely, and usable contact information to evaluators and verifiers. The incremental cost of implementation is low if it is part of the initial database design, populated as projects are started, and updated once they are complete.

Outcome B: Reduced burden on utility staff and reduced evaluation costs. A relational database would streamline aggregation of program data for scorecards and make providing data simpler for annual savings evaluation and verification.

UNION RESPONSE: As detailed in its 2015-2020 DSM Plan, Union outlined the need for a DSM tracking and reporting system upgrade. The Board approved this request in its January 20th, 2016 Decision. This system upgrade is expected to be rolled out in 2018.

Recommendation C: For 2016 (and perhaps 2017), we do not anticipate that contact information will have been entered into the program tracking databases. When the evaluation requests contact information for the 2016 and 2017 savings verification and evaluation, the contact request spreadsheet will be updated to provide additional fields to enforce data integrity (e.g., specific fields for a parsed address and company name for the technical and decision-making contacts).

Outcome C: Reduced evaluation costs due to less data cleaning and research to fill missing information. Improved data collection with less returned advance letters and more accurate connection between projects and contacts.

UNION RESPONSE: This recommendation was not directed to Union.

DM2. Finding: Both utilities have indicated that inputting and/or extracting data necessary for annual reporting and evaluation requires significant effort.

Recommendation A: Consider offering bonus incentives early in the year to combat the “hockey stick” phenomenon where a large percent of projects get closed in the fourth quarter of the year.

Outcome: Reduced burden on program staff, more consistency in meeting annual filing deadlines.

UNION RESPONSE: Union disagrees that offering bonus incentives early in the year to combat the “hockey stick” phenomenon would address the EC’s finding. The EC’s finding was caused more by the change in process, specific data requirements, project files needed for the NTG Study and the request for CPSV documentation for more than double the number of projects compared to previous years. Even with these changes, Union met, or was within a week of meeting each of the EC’s deadlines for providing data necessary for annual reporting and evaluation efforts.

Recommendation B: See recommendation DM1B. The utilities should consider investing in a new database.

Outcome: Reduced burden on utility staff and reduced evaluation costs.

UNION RESPONSE: See Union’s response to DM1B.

DM3. Finding: The extracts from the utility program tracking database do not include dates for key project milestones. Enbridge’s data did not include any dates and Union’s included only the “installation date.”

Recommendation: Track and provide to evaluators dates for key milestones in the project. Dates for project start, installation, and those that define the program year provide useful context for interviewers that is not always easy to find in project documentation

Outcome: Improved data collection through more informed interviewers and reduced evaluation costs through less need to search for dates in documentation.

UNION RESPONSE: Union has an on-going relationship with its CI and Large Volume customers. Through this relationship, some projects get proposed, prioritized, deferred and changed over time. Not all projects will have a definitive start date. As per the EC’s finding, Union does track an installation date. This date is important as it denotes the date after which installation and commissioning are complete and Union pays out a customer incentive. The program year is defined by the calendar year.

DM4. Finding: Customers with multiple sites are not tracked in the program tracking database. A few property management groups had many sites selected in the sample, but it was not clear from project tracking or the provided contact information that the sites were related. Property management firms were the most significant but not the only customer type where this was true.

Recommendation: Maintain a customer identifier in the database to clearly identify related sites. This is easiest to deploy in a relational database see recommendation DM1B.

Outcome: Reduced evaluation costs and reduced customer burden. In some cases, a failure to identify related sites can result in multiple calls to the same customer, which a customer identifier would avoid. In addition, tracking related sites could improve program implementation by increasing awareness of connected opportunities.

UNION RESPONSE: Union projects are labeled with both a customer ID and project ID. Project IDs are project-specific. Customer IDs remain the same for all sites associated with an individual customer account with the exception of a few cases such as sites across a school board or large property management groups. See Union's response to DM1B.

DM5. Finding: EUL and cumulative gross savings were not provided in the standard program tracking database extracts. The evaluation team backed out the missing information from the fields provided.

Recommendation: Include EUL (also remaining useful life for dual baselines), NTG, and each of the key savings types (i.e., annual and cumulative, gross and net) in the program tracking database.

Outcome: Improved data integrity results in less evaluation risk and more accurate savings totals. Providing each of the key savings types and their components allows evaluation to confirm that the savings provided are internally consistent.

UNION RESPONSE: Union's tracking database provided to DNV included all of these categories. Union requested the EC clarify this finding but was not given any additional information.