BOARD STAFF INTERROGATORY #1

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 3

Preamble:

Enbridge states: The retroactive application of the NTG ratios from the NTG Study is inappropriate and contrary to the Board's earlier Direction and is both inappropriate and inconsistent with best practices. *Emphasis added*

Questions:

Please specify on what basis Enbridge Gas claims that the retroactive application of net-to-gross (NTG) ratios is "inconsistent with best practices." Specifically, please cite the jurisdictions which do not leverage best-available information when developing final estimates of efficiency program impacts and performance incentives as well as whether or not these jurisdictions' decision to not use best-available information has been sanctioned by their regulator.

RESPONSE

It is Enbridge's opinion that it is best practice for results to be assessed in line with the same inputs used to establish targets.

In the Board's 2015 to 2020 DSM Framework, the Board directed that "the gas utilities should roll-forward their 2014 DSM plans, including all programs and parameters (i.e., budget, targets, incentive structure) into 2015."[1] The Board further outlined, "in order to effectively estimate the amount of energy savings achieved through the delivery and implementation of DSM programs, the gas utilities rely on a set of approved engineering assumptions that represent the best available information regarding various characteristics of an energy efficient technology (e.g., life cycle, energy usage level, gas savings, etc.).[2]

The Board further stated in its Decision & Order that it "approves Union and Enbridge's proposed 2015 metrics and targets for all scorecards. The OEB believes that it would

[1] EB-2014-0134, Report of the Board, DSM Framework for Natural Gas Distributors (2015-2020) p. 34.
[2] EB-2014-0134, Report of the Board, DSM Framework for Natural Gas Distributors (2015-2020) p. 31.

Witnesses: D. Bullock
D. Johnson

be **inappropriate** [emphasis added] at this time to make a change to the 2015 targets with the year completed."[3] It is important to note that Enbridge's 2015 targets and scorecards were developed using the input assumptions and NTG factors that were used to determine 2014 DSM program results. This is in line with Enbridge's understanding that 2015 targets should be set using best available information and subsequently that updated net-to-gross determinations should be applied prospectively to targets and results of future DSM program years.

Enbridge did not undertake research or analysis to ascertain general DSM policy approaches regarding best available information and/or whether such approaches are sanctioned by regulators. The Navigant report however did look at leading jurisdictions to identify current approaches to NTG estimation. 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. Massachusetts, Illinois and California are also considered leading states with respect to evaluation and the American Council for an Energy Efficient Economy's ("ACEEE") State Energy Efficiency Scorecard rates Massachusetts #1, California #2, and Illinois at #11.

Further, in the Summary of Findings, Navigant states the following:[4]

> **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.

[3] EB-2015-0049, Decision and Order, Ontario Energy Board, page 63.
[4] EB-2017-0324, Application and Evidence, Exhibit B, Tab 6, Schedule 1, page 4 of 40

BOARD STAFF INTERROGATORY #2

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 4

Preamble:

Enbridge states: In accordance with Section 11.0 of the Guidelines and for comparative purposes, Enbridge provides the DSM values based on the EC's recommended amounts and Enbridge's application as seen in Table 2 below:

2015 DSM Achieved Savings, Shareholder Incentive, and Lost Revenue	**Enbridge Pre-Audit**	**Audit Opinion of EC**	**Enbridge Application**
Shareholder Incentive	$10,318,594	$6,207,339	$10,077,965
Lost Revenue	$28,800	$16,405	$28,976
DSMVA	$825,460	$825,460 (not reviewed)	$825,460

Questions:

a) Please describe the various drivers of the variance (e.g., the use of differing NTG ratios, per unit savings assumptions, etc.) between the shareholder incentive calculated by Enbridge Gas ($10,077,695) and that calculated by the EC ($6,207,339).
b) Please describe the various drivers of the variance (e.g., the use of differing NTG ratios, per unit savings assumptions, etc.) between the lost revenue calculated by Enbridge Gas ($28,976) and that calculated by the EC ($16,405).
c) On a program-by-program basis, please demonstrate the dollar value of each variance driver in a) and b) as well as the process used by Enbridge Gas to calculate the value.
d) Within Table 2, Enbridge Gas indicates that the "Audit Opinion of EC" is that the value of Enbridge Gas' DSMVA is $825,460 (not reviewed). Please clarify whether or not the EC provided an opinion on the value of Enbridge Gas' DSMVA.
e) Please indicate whether the NTG ratios Enbridge Gas used to calculate its shareholder incentive and lost revenue include spillover.
f) Enbridge Gas indicates its current NTG assumptions are based on the results of a previous study.

Witnesses: D. Bullock
D. Johnson

i. Please provide a copy of this study.

   1. If not included in the study report, please provide documentation showing details of the methodology used to develop the NTG estimate (e.g., the final scope of work)

ii. Please indicate the date this study was completed.

iii. Please provide copies of the calculation workbooks used to determine the NTG values in this study.

iv. Since the completion of that study, what efforts has Enbridge Gas undertaken in order to understand how effectively their DSM programs have been delivered to market?

v. What studies or other research has Enbridge Gas initiated since that study in order to ensure DSM programs achieve the high levels of performance and continually deliver ratepayer value?

   1. If applicable, how has Enbridge Gas reflected the findings, insights or lessons learned from these studies into their program design and delivery strategies?
   2. If such studies have not been completed, why not?

g) If not for the 2015 program year, when does Enbridge Gas believe the results of NTG study completed by DNV GL should be used to calculate program performance?

RESPONSE

Please note that Enbridge filed updated evidence with the Board on March 26, 2018. As a result of a minor mathematical error identified in the calculation of LRAM, the LRAM was corrected to $28,216 vs. $28,976 in the December 19, 2017 application, a difference of ($760). The edits contained therein affect the table referenced by Board Staff in the preamble above. For certainty, for the purposes of correctly addressing this IR response, Enbridge will be referring to the updated evidence which reflects the corrected LRAM of $28,216.

In addition, please note, Board Staff has a minor typo on a value they have included in the table outlined in the preamble with respect to the Shareholder Incentive. The table referenced in Enbridge's evidence[1] specifies $10,077,695 for the Shareholder Incentive in Enbridge's application. The table in the preamble provided by Board Staff has incorrectly shown the value of $10,077,965.

[1] EB-2017-0324, Application and Evidence, Exhibit A, Tab 1, Schedule 3, page 4

Witnesses: D. Bullock
D. Johnson

a) & b)
In undertaking this comparison it appears that although the EC fully verified Enbridge's performance with regard to the Low Income (Part 3) Building Performance Metric (i.e., 100% verified), which uses a percentage achievement value, the EC completed their calculation using a rounded percent score with fewer decimal places than the actual percentage achievement value used in Enbridge's calculation. As such there is a rounding difference of $44.

Otherwise Enbridge confirms that the only difference between the Shareholder Incentive and Lost Revenue values under the "Audit Opinion of EC" and "Enbridge Application" columns outlined below is that the Enbridge Application applied different (previous) custom measure NTG assumptions than those applied by the EC.

c) The shareholder incentive is calculated at the scorecard level, not the program level. As a result, please see the table below in response to this interrogatory for the dollar value of the shareholder incentive of each scorecard, based on the audit opinion of the EC and the Enbridge Application.

As explained above, the variance between the EC's audit opinion and Enbridge's application is wholly attributable to applying different custom NTG assumptions. Please note, however, the $44 variance in the Low Income program is a rounding error and was explained in parts a) and b) above.

2015 DSM Program	**EC's Audit Opinion Shareholder Incentive***	**Enbridge's Application Shareholder Incentive****	**Variance***
Resource Acquisition	$ 2,612,431	$ 6,482,744	$ 3,870,313
Low Income	$ 1,483,748	$ 1,483,792	$ 44
Market Transformation	$ 2,111,159	$ 2,111,159	$ -

* Totals may not add up due to rounding
** EB-2017-0324, Application and Evidence, Exhibit B, Tab 1, Schedule 1, page 107, Table 9.6

The following table provides the LRAM for each program scorecard, comparing the value reflected in the audit opinion of the EC and the LRAM outlined in the Enbridge Application.

Witnesses: D. Bullock
D. Johnson

2015 DSM Program	EC's Audit Opinion Lost Revenue*	Enbridge's Application Lost Revenue**	Variance
Resource Acquisition	$ 16,405	$ 28,216	$ 11,811
Low Income	$ -	$ -	$ -
Market Transformation	$ -	$ -	$ -

* EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, December 20, 2017, page i
** EB-2017-0324, Application and Evidence, Exhibit B, Tab 1, Schedule 1, page 104, Table 8.0

In order to calculate both the shareholder incentive and lost revenue amounts outlined in Enbridge's evidence, Enbridge used the EC's audit opinion, and recalculated the amounts by replacing the NTG assumptions proposed by the EC with the previous NTG assumptions.

d) The EC did not provide an opinion on Enbridge's DSMVA.

e) Enbridge does not have a current spillover estimate and has not applied a spillover value in its determination of CCM, DSMI or LRAM outlined in this application. Enbridge has similarly not applied a spillover value in determination of results in prior years. Based on the NTG Study scope of work, Enbridge understood that the spillover value would be contained in the recent NTG Study. Instead the NTG Study only included an adjustment for free-ridership.

f) For clarity, Enbridge stated that its current commercial / industrial custom program NTG assumptions were based on audited outcomes of the 2014 audit process. Nowhere in evidence did Enbridge state "its current NTG assumptions are based on the results of a previous study." as suggested in the question.

   i. A copy of this Summit Blue study has been included as an attachment in response to SEC Interrogatory #52, found at Exhibit I.EGDI.SEC.52.
      1. Methodology details are included in the study.

   ii. The study was completed on October 31, 2008.

   iii. Enbridge is unable to locate and therefore unable to produce worksheet calculations used to determine NTG values determined in the study. This is not surprising given the date that they were produced and that Enbridge personnel involved at the time have since retired or moved on from the DSM group.

Witnesses: D. Bullock
D. Johnson

iv. Since the completion of the study, Enbridge has undertaken a number of activities over the years to gain input and feedback in an effort to enhance program offerings.

These include, but are not limited to, focus groups, surveys, market assessments and stakeholder consultations. Many of these have focused on the Commercial and Industrial area and have included a broad range of stakeholders including customers, channel partners as well as Intervenors.

These activities are additional to the consistent interaction Enbridge ESCs have with customers through the delivery of the custom programs, which provides a continuous source of feedback for program improvements.

v. Beginning with the earlier Evaluation & Audit Committee established following the DSM Generic proceeding of 2006, and then transitioning to the Technical Evaluation Committee (“TEC”) beginning in 2012, evaluation priorities have been established in consultation with these committees through a stakeholder engagement process. (For the 2015-2020 framework evaluation responsibility and oversight has moved to the OEB with advisory input from the EAC). These committees established evaluation priorities which resulted in the following studies and activities (Findings and lessons learned from these studies are considered and adopted in evolving program design and delivery):

2008

- TAPS PROGRAM VERIFICATION STUDY
- NOVITHERM HEAT REFLECTORS VERIFICATION STUDY
- MULTI-RESIDENTIAL SHOWERHEAD PROGRAM VERIFICATION STUDY
- COMMERCIAL SECTOR CUSTOM PROJECTS VERIFICATION
- INDUSTRIAL SECTOR CUSTOM PROJECTS VERIFICATION
- ENERGUIDE AWARENESS SURVEY OF THE ENERGUIDE LABEL
- HOME PERFORMANCE CONTRACTOR MARKET TRANSFORMATION PROGRAM STUDY
- BOILER MARKET TRANSFORMATION PROGRAM 2008: CONTRACTOR, ENGINEER & CUSTOMER AWARENESS RESEARCH

- BUSINESS PARTNER MARKET TRANSFORMATION PROGRAM: PERCENTAGE INCREASE IN DESIGN INCORPORATION PLANS
- BUSINESS PARTNER MARKET TRANSFORMATION PROGRAM: TECHNOLOGY AWARENESS
- EXAMINING THE IMPACT OF LOW FLOW SHOWERHEADS ON WATER HEATER CONSUMPTION
- NATURAL GAS ENERGY EFFICIENCY POTENTIAL: UPDATE 2008
- RESIDENTIAL MEASURE FREE RIDERSHIP AND INSIDE SPILLOVER STUDY
- RESOURCE SAVINGS VALUES IN SELECTED RESIDENTIAL DSM PRESCRIPTIVE PROGRAMS
- COMMERCIAL/INDUSTRIAL CUSTOM PROJECTS ATTRIBUTION STUDY
- MEASURE LIFE FOR RETRO-COMMISSIONING AND CONTINUOUS COMMISSIONING PROJECTS
- PRESCRIPTIVE DESTRATIFICATION FAN PROGRAM STUDY
- PRESCRIPTIVE COMMERCIAL BOILER PROGRAM STUDY
- COLD WEATHER DESTRATIFICATION HUNTER DOUGLAS MONITORING RESULTS
- PRESCRIPTIVE BOILER SCHOOL PROGRAM RESEARCH

2009

- TAPS PARTNERS PROGRAM 2009 FOLLOW-UP STUDY
- TAPS PARTNERS PROGRAM 2009 LOW INCOME ANALYSIS
- SHOWERHEAD AND AERATOR AUDIT STUDY MULTI-RESIDENTIAL RENTAL BUILDINGS STUDY
- VERIFICATION STUDY OF COMMERCIAL CUSTOM PROJECTS
- VERIFICATION STUDY OF INDUSTRIAL CUSTOM PROJECTS
- ENERGUIDE FOR NATURAL GAS FIREPLACES
- HOME PERFORMANCE CONTRACTOR MARKET TRANSFORMATION PROGRAM: 2009
- DRAIN WATER HEAT RECOVERY SYSTEM MARKET TRANSFORMATION PROGRAM 2009 BUILDER KNOWLEDGE RESEARCH
- ANALYSIS OF LOW INCOME WEATHERIZATION PROGRAM RESULTS
- ANALYSIS OF SHOWERHEAD FLOW RATES RESIDENTIAL SECTOR EXAMINING THE IMPACT OF LOW FLOW SHOWERHEADS ON WATER HEATER CONSUMPTION

- PRESCRIPTIVE DESTRATIFICATION FAN PROGRAM PRESCRIPTIVE SAVINGS ANALYSIS
- PRESCRIPTIVE COMMERCIAL BOILER PROGRAM PRESCRIPTIVE SAVINGS ANALYSIS
- SAS ANALYSIS: ESTIMATING THE IMPACT OF LOW-FLOW SHOWERHEADS
- MEASURE LIFE FOR RETRO-COMMISSIONING AND CONTINUOUS COMMISSIONING PROJECTS REPORT

2010

- TAPS PARTNERS PROGRAM 2019 FOLLOW UP STUDY
- TAPS PARTNERS PROGRAM 2010 LOW INCOME ANALYSIS
- SHOWERHEAD VERIFICATION AMONG RENTAL BUILDINGS RESEARCH REPORT
- VERIFICATION STUDY OF COMMERCIAL CUSTOM PROJECTS
- VERIFICATION STUDY OF INDUSTRIAL CUSTOM PROJECTS COMMERCIAL HYDRONIC BOILER BASELINE STUDY
- STEAM TRAP MEASURE LIFE RESEARCH

2011

- TAPS 2011 FOLLOW UP STUDIES
- TAPS PARTNER PROGRAM – DIRECT INSTALL FOLLOW UP STUDY
- TAPS PROGRAM – DIRECT MAIL AND BILL INSERT FOLLOW UP STUDY
- TAPS PARTNERS PROGRAM 2011 LOW INCOME STUDY
- SHOWERHEAD VERIFICATION AMONG RENTAL BUILDINGS RESEARCH REPORT
- VERIFICATION STUDY OF COMMERCIAL CUSTOM PROJECTS
- VERIFICATION STUDY OF INDUSTRIAL CUSTOM PROJECTS
- VERIFICATION STUDY OF PRE-RINSE SPRAY VALVES
- ON-DEMAND WATER HEATER RETROFIT PROJECT
- LI PART 9 WEATHERIZATION PROCESS EVALUTION

2012

- TAPS AND ESK PROGRAM 2012 VERIFICATION
- COMMERCIAL CUSTOM PROJECT SAVINGS VERIFICATION STUDY
- INDUSTRIAL CUSTOM PROJECT SAVINGS VERIFICATION STUDY
- 2012 MULTI-RESIDENTIAL LOW INCOME SHOWERHEAD VERIFICATION
- SAMPLING METHODOLOGY FOR CUSTOM C&I PROGRAMS (NAVIGANT)

2013

- COMMERCIAL CUSTOM PROJECT SAVINGS VERIFICATION STUDY
- INDUSTRIAL CUSTOM PROJECT SAVINGS VERIFICATION STUDY
- COMMERCIAL/INDUSTRIAL FREE RIDER JURISDICTIONAL SCAN
- TECHNICAL REFERENCE MANUAL
- RESIDENTIAL MARKET SURVEY
- LARGE VOLUME CUSTOMER SATISFACTION SURVEY
- GAS VENDOR RELATIONSHIP & SATISFACTION RESEARCH STUDY

2014

- DSM ACHEIVABLE POTENTIAL STUDY
- COMMERCIAL/LOW INCOME CUSTOM PROJECT SAVINGS VERIFICATION STUDY (CPSV) SUMMARY
- INDUSTRIAL CUSTOM PROJECT SAVINGS VERIFICATION STUDY (CPSV) SUMMARY
- TECHNICAL REFERENCE MANUAL
- CUSTOM C/I NTG STUDY INITIATION
- RIR POST INSTALLATION STUDY
- COMMERCIAL DSM CUSTOMER SATISFACTION SURVEY
- TORONTO COMMUNITY HOUSING ENERGY EFFICIENCY SURVEY
- SMALL COMMERCIAL TRENDS RESEARCH STUDY

<u>2015</u>

- STOCKPILE MOISTURE REDUCTION STUDY
- COMMERCIAL/LOW INCOME CUSTOM PROJECT SAVINGS VERIFICATION STUDY (CPSV) SUMMARY
- INDUSTRIAL CUSTOM PROJECT SAVINGS VERIFICATION STUDY (CPSV) SUMMARY
- COMMERCIAL BOILER BASELINE STUDY RFP
- ETOOLS VERIFICATION STUDY

g) This application specifically addresses the Company's request for approval of the Clearance of DSM Deferral and Variance Accounts in respect of its 2015 program year. As such, the application and evidence focuses on Enbridge's position and understanding that the Board's direction did not contemplate the retroactive application of the NTG Study for the calculation of program performance in 2015.

With regard to when the NTG Study should be used, the Company refers to the Board's Decision and Order of January 20, 2016, "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." [2]

It is apparent that at the time of the Board's Decision it expected that the NTG Study would soon be completed, "In 2016, the free rider rates will be updated based on the results of the net-to-gross study and the annual evaluation process." [3] At the time, the Board had likely not contemplated the delays realized in the execution and completion of the NTG study (with the 2015 Final Annual Results reported in October 2017, and revised on December 20, 2017) and the resulting impact these delays would have on the confidence placed in the determination of the NTG Study outcomes and the subsequent complications this delay would have with respect to target setting.

As such, the Company is of the view that the determination of how the study should be used is a matter for Board deliberation in the mid-term review, where impacts on targets and scorecards can be appropriately considered and reassessed relative to the timelines of the 2015 and 2016 evaluation processes and in the context of the Board's earlier Decision.

[2] EB-2015-0029/0049, Decision and Order, January 20, 2016, page 21
[3] Ibid.

Witnesses: D. Bullock
D. Johnson

Notwithstanding the foregoing, in accordance with positions outlined in evidence, Enbridge requests that the Board direct Board Staff to work with the EAC to finalize the NTG Study by requiring the EC to: (i) update the NTG study findings to include secondary attribution and spillover results; (ii) undertake a sensitivity analysis on the results for further review; and, (iii) act as a facilitator in respect of the determination of an appropriate NTG value through a collaborative, transparent, negotiated stakeholdering process in line with best practices in other leading jurisdictions.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #3

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 5, p. 5

Preamble: Enbridge States

Enbridge states: Fifth, Enbridge uncovered a number of errors made by the EC throughout the verification process, including in the evaluator's individual project level savings verifications, as well as in the EC's application of adjustments to arrive at verified 2015 DSM program results…

Questions:

a) Please confirm that all errors identified by Enbridge Gas were corrected by the EC and the final 2015 evaluation report included at Exhibit B, Tab 5, Schedule 2 of Enbridge Gas' application reflects these corrections.
b) Please indicate during what process Enbridge Gas identified the errors. E.g., did Enbridge Gas identify the errors during the EAC review process the EC facilitated in order to gain stakeholder feedback on preliminary findings?

RESPONSE

a) Not confirmed. The report included in Enbridge's evidence in Exhibit B, Tab 5, Schedule 2 was the EC's NTG / CPSV Scope of Work, dated December 14, 2016, not the "final 2015 evaluation report." The final report had not been provided by the EC at the time Enbridge filed this Clearance of Deferral Accounts application on December 19, 2017.

b) Enbridge first identified and reported the errors, which significantly decreased Enbridge's results, to the EC and Board Staff in an email dated November 20, 2017. This was after the EAC review process period in which the EC received feedback on preliminary findings. The draft NTG / CPSV report was provided to the EAC on May 24, 2017. Enbridge provided comments on the draft report on June 14, 2017 to coincide with the review period.

Witnesses: D. Bullock
D. Johnson

Of note, sometime after the review period, there were two spreadsheets provided by the EC which outlined the CPSV data used by the EC to calculate the various adjustment ratios. The EC provided these spreadsheets to Enbridge on the same day that the first “final” Custom Savings Verification and Free-ridership Evaluation was shared (this report was later updated on October 12, 2017). Enbridge used these spreadsheets, to identify the errors, however since Enbridge did not have access to these spreadsheets during the designated review process, it did not have the opportunity to identify the errors during this time.

It was during the process of applying the EC’s final results into the Enbridge tool for the purposes of preparing the 2015 Clearance application that Enbridge uncovered the errors. Though Enbridge had initially requested that the EC use the Enbridge tool, in line with auditors in prior audit years, the EC created their own tool to apply its various audit adjustments. As a result, Enbridge was required to analyze the various components in the EC’s tools, extract the required information and apply the EC’s adjustment values into Enbridge tracking tool in order to generate all the tables included in the Company’s final 2015 Annual Report. This was a lengthy and complicated process. In depth analysis of “preliminary findings” would not necessarily have uncovered the errors.

During the feedback / comment period, Enbridge did not anticipate it would need to “audit the auditor’s” results. No other party, to Enbridge’s knowledge, undertook a detailed analysis of the EC’s calculations nor was this anticipated given the expectation that, appropriately managed, any error by the contractor would have been identified during the designated review process. It is Enbridge’s opinion that any error should be reported and rectified, no matter whether the error was identified during the designated review process or not.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #4

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 8

Preamble:

Enbridge states: As stated in the Board's August 21, 2015 letter, the EAC was to provide input and advice throughout the process, including the evaluation and audit of DSM results and the development of the Evaluation, Measurement & Verification Plan to be drafted by the EC.

Questions:

a) Per the OEB's August 21, 2015 letter, prior to the EC finalizing the evaluation, measurement & verification plan, Enbridge and Union Gas were "responsible for developing an initial evaluation plan that will inform the evaluation of programs…" Please provide all initial evaluation plans Enbridge Gas developed and provided to the EC related to their 2015 DSM programs.
b) Prior to the 2015-2020 evaluation period, did Enbridge Gas produce an overall DSM portfolio evaluation plan in order to identify key evaluation priorities and guide the annual evaluation process? If so, who reviewed/approved these plans?
    i. If applicable, please provide an example of an overall DSM portfolio evaluation plan developed by Enbridge Gas prior to the 2015-2020 period.
    ii. Please describe how this evaluation plan was used to establish annual evaluation priorities prior to the 2015-2020 period.

RESPONSE

a) Evaluation plans for 2016 to 2020 were included in the Company's Multi-Year Demand Side Management Plan, filed April 1, 2015.[1] Since 2015 was a roll-over year, following the Board's direction, specific evaluation plans were not developed for the 2015 program year.

   The 2015-2020 DSM Plan was approved by the OEB on January 20, 2016 (with a Revised Decision on February 24, 2016).

[1] EB-2015-0049, Multi-Year Demand Side Management Plan, Exhibit B, Tab 2, Schedule 2.

Witnesses: D. Bullock
D. Johnson

b) Enbridge outlined evaluation plans for the previous 2012 to 2014 program years as part of Enbridge's 2012-2014 Demand Side Management Plan, filed on November 4, 2011.[2] This application was approved by the OEB on February 9, 2012.

i. Examples of the evaluation plans can be found in Enbridge's 2012-2014 Demand Side Management Plan, Exhibit B, Tab 1, Schedule 5.
ii. Prior to the 2015 to 2020 period, annual evaluation priorities were established by the Technical Evaluation Committee and in response to annual audit findings.

[2] EB-2011-0295, 2012 to 2014 Demand Side Management Plan, Exhibit B, Tab 1, Schedule 5.

BOARD STAFF INTERROGATORY #5

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 9

Preamble:

Enbridge states: The Board's letter dated March 4, 2016 outlined the transition of the, then current, ongoing DSM evaluation activities from the TEC to the EAC.

Questions:

a) Per the OEB's March 4, 2016 letter, Enbridge Gas and Union Gas, with the endorsement of the TEC, procured DNV GL to complete a net-to-gross study for custom commercial and industrial projects. When the OEB released its March 4, 2016 letter; more than two years following when Enbridge Gas and Union Gas initiated the procurement process, the study's work plan had not as of yet been completed.

   i. Please provide the timeline for this project. Specifically, please identify:

      - The date the RFP was posted;
      - The date DNV GL (formerly KEMA) was selected as the successful proponent of the procurement;
      - The date DNV GL was contracted to complete the project;
      - The date of the first meeting between DNV GL and the TEC;
      - The date the first draft of the work plan was completed;
      - The date the final work plan was completed;
      - The date DNV GL began implementing the final work plan; and,
      - A description of the final project deliverable provided to Enbridge Gas, Union Gas and the TEC by DNV GL as well as the date it was provided (i.e., the last deliverable before the project was transitioned to the OEB).

   ii. Please provide any documentation related to methodological discussions that were undertaken before the study was transitioned to the OEB.

   iii. Please provide the draft work plan that was to be presented to the TEC on March 10, 2016.

Witnesses: D. Bullock
D. Johnson

iv. Please describe the original timing for when the TEC expected the net-to-gross study to be completed.
v. Enbridge Gas states that the TEC resolved that net-to-gross ratios developed through the study were "to be used on a go-forward basis." Please indicate the first year the TEC expected that updated net-to-gross ratios would be applied to Enbridge Gas' DSM results.
vi. Please describe the reasons for the significant delays and specifically why it took an extended period of time to complete the first stage of the project.

b) Per the OEB's March 4, 2016 letter, as part of OEBs Decision issued in 2015, Enbridge and Union Gas were "directed to complete a Boiler Baseline Study in 2015, with the findings incorporated in the evaluation of 2014 results."

i. Please provide a status update on the Boiler Baseline study.
ii. The OEB's March 4, 2016 letter states "This study was the result of OEB decisions for both Enbridge and Union Gas and therefore the utilities are expected to complete it." Please confirm that Union Gas and Enbridge have always retained responsibility for completing the boiler baseline study.
iii. Please provide an expected timeline for completion of the study.
iv. Please describe the magnitude of impact the study may have on Enbridge's DSM results for years 2014, 2015, 2016, 2017 and 2018.
v. Given the OEB's direction that the results of the Boiler Baseline Study are to be retroactively applied to 2014 results, please describe why Enbridge believes the retroactive application of 2015 NTG study results to 2015 results may be inappropriate.

<u>RESPONSE</u>

a)

i)
- The RFP for the NTG Study was posted on November 1, 2013;
- DNV Kema (now DNV GL) was selected by the TEC as the successful proponent on February 17, 2014;
- The NTG Study contract was executed with DNV on May 5, 2015;
- The first meeting of DNV and the TEC was March 10, 2014;
- The date of the work plan developed under the oversight of the TEC March 2, 2016;
- After the study was transitioned to the OEB as outlined in the Board's letter of March 4, 2016 regarding transition of TEC activities to the OEB, the scope of work was revised to include the annual CPSV, a draft scope

of work was provided to the EAC on October 8, 2016 and the final scope of work was dated December 14, 2016;

- DNV did not begin implementation of the final work plan until after the study was transitioned to the OEB as outlined in the Board's letter of March 4, 2016 regarding transition of TEC activities to the OEB. The first request for custom project data to support the sample verification was made to the utility on November 8, 2016; and,
- The TEC (including the utilities and Board Staff) were provided with the March 2, 2016 NTG Study Scope of Work at the March 10, 2016 TEC meeting as referenced in the Board's March 4th letter regarding transition activities.

ii) Discussions pertaining to the NTG study methodology and approach undertaken before the study was transitioned to the OEB are documented in a number of TEC quarterly reports that are available on the OEB website:

- TEC Q3, 2015 Report, Section 3 (https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/Q3%202015%20TEC%20Report_March%20TEC.pdf)
- TEC Q1, 2015 Report, Section 3 (https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202015%20Q1%20Report.pdf)
- TEC Q4, 2014, Section 2 (https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202014%20Q4%20Report.pdf)
- TEC Q2, 2014, Section 1 (https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202014%20Q2%20Report.pdf)
- TEC Q1, 2014, Section 2 (https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202014%20Q1%20Report.pdf)

In addition attached the this IR response is an email provided by DNV dated June 9, 2015 capturing parking lot issues discussed and resolved with the TEC (a copy of the memo is attached to this IR response as Attachment 1).

Witnesses: D. Bullock
D. Johnson

iii) The work plan dated March 2, 2016, presented to the TEC and Board Staff at a TEC meeting on March 10, 2016 was included in Enbridge's evidence at Exhibit B, Tab 5, Schedule 1.

iv) As identified on page 32 of the March 2, 2016 Scope of Work, the schedule outlined that the project would be completed by November 16, 2016.

v) As outlined in evidence and reflected in the TEC Q1 2014 Quarterly Report, the TEC and DNV agreed that the primary objective of this project is to develop a transparent, reputable study that produces strong, credible, and defensible NTG ratios to be used on a go forward-basis. This objective was reflected in the Scope of Work. "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."[1] Further the NTG RFP outlined that the selected proponent was expected to provide guidance on the development of a strategy for the application of free-ridership and spillover data collected on previous program participation to forward looking DSM program activity.

vi) Much of the discussion which precipitated the completed NTG Study Scope of Work dated March 2, 2016 is captured in the attached DNV Memo and is summarized in the following topic groupings:

- Contact/input from program staff regarding specific projects;
- Determinations of attribution due to financial incentives and other services;
- Effort regarding self-direct customers;
- The use of a dual baseline NTG calculation;
- Time period over which influence would be assessed; and,
- Addressing spillover with large industrial customers

Enbridge understands that efforts during the April, May, June and July meetings focused on arriving at agreements on most of these topics.

In July 2014, the TEC agreed that with anticipation that the OEB would be providing a new DSM Framework shortly it would be prudent to get clarity on the key policy framework before continuing with the NTG Study and the

[1] EB-2017-0324, Application and Evidence, Exhibit B, Tab 5, Schedule 1, Page 5 of 48

TEC halted the project until the new DSM Framework was made available.

Following the release of the new DSM Framework in December 2014, the TEC resumed focus on the Study and worked to reach agreement on the remaining methodological issues. Following the TEC meetings in July 2015, and October 2015, the remaining items were addressed with agreed approaches. Board Staff was in attendance at TEC meetings in the fall of 2015 and the group began to address the proposed transition of TEC projects to the new governance structure. On March 10, 2016 DNV provided their scope of work (date March 2, 2016) to the TEC (including Board Staff). This was the final deliverable on the project prior to Board Staff assuming oversight of the NTG study.

b)

i) & ii)

It should be noted that while the preamble to this question is accurately stated, the Board also noted at the end of the same paragraph of the same March 4, 2016 letter that the TEC developed a scope of work and issued a RFP for the Boiler Baseline Study in October 2015 and received proposals from consultants but that the: "TEC has not proceeded with the evaluation of the proposals as it is awaiting further instructions from the OEB". As then outlined in the Transition Plan portion of the Board's March 4, 2016 letter, Enbridge and Union Gas were directed to complete the Boiler Baseline Study. The letter specified that once proposals had been evaluated and a consultant selected, input on the study would be provided to the utilities by the EAC and OEB Staff. A Boiler Baseline Committee (sub-committee) including members from the EAC and Board Staff was convened and in the fall of 2016 following selection of ICF as the consultant the committee reviewed and refined the scope of work, a contract was executed with ICF in March, 2017 and the study commenced shortly after. As a result of challenges faced identifying sites that met the study criteria as well as customers willing to participate, ICF prepared a memo in October, 2017 that outlined some of the specific challenges they were having as well as presenting options to consider, including a request for additional funding, in an effort to complete the study, (a copy of this memo is attached to this IR response as attachment 2).

Both Enbridge and Union Gas met with the boiler baseline sub-committee in December, 2017. The sub-committee agreed to a revised approach incorporating payment of increased incentives; however they decided it was not appropriate to provide additional funds for the project as costs were fixed in accordance with the original proposal. The utilities conveyed the sub-committees recommendations in December 2017 and met with ICF in January 2018 to come to a resolution.

ICF is now proceeding with gauging the success of higher incentives for participation in the study. In March 2017 ICF provided a memo outlining their go forward approach (a copy of this email is attached to this IR response as Attachment 3). The sub-committee agreed that execution of the revised plan will be monitored closely to determine if the new approach delivers results. If there is limited incremental success, the utilities will meet with the boiler baseline sub-committee to discuss recommended next steps. As outlined in the enhanced ICF plan, there is a risk ICF will be unable to collect data on the required number of sites to successfully complete the study.

iii) The recent memo from ICF indicates the study is expected to be completed by the end of July, 2018.

iv) Until the study has been successfully completed, it would be speculative to estimate the magnitude of the impact on DSM savings. That said, boilers represent 12% of Enbridge's total CCM results on an m^3 basis in 2016.

v) First, it should be recognized that the reference to the Board requiring the results of the 2015 Boiler Baseline Study being applied to 2014 results arose in the context of the decision in respect of the Clearance Application for 2013 DSM deferral and variance accounts (EB-2014-0277). It is also important to note that both of the 2013 and 2014 DSM Plans operated under an entirely different DSM Framework. 2015 of course is the subject of the subsequent 2015-2020 Framework approved in EB-2014-0134.

As well, the Company does not believe that it is reasonable or appropriate to apply adjustments retroactively given that the Boiler Baseline Study is not yet complete. As outlined in the 2015 to 2020 Framework, "the gas utilities should roll-forward their 2014 DSM plans, including all programs and parameters (i.e., budget, targets, incentive structure) into 2015." 2015 targets were set based on a set of input assumptions including boiler baseline assumptions. In the case of boiler projects, the same baseline assumption is used in both custom and prescriptive calculations. The baseline does not change from custom project to custom project and is

Witnesses: D. Bullock
D. Johnson

consistently applied across the measure.

Similarly as stated in evidence it is not appropriate nor in line with the Board's decision to apply NTG study results retroactively to 2015.

The Board's Decision and Order clearly states, "The OEB does not expect the gas utilities to rely on a predetermined free ridership rate for the duration of the **2017** to **2020** [*emphasis added*] 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."[2]

Additionally, since 2015 budgets and targets were established in line with the Board's direction to roll over 2014 budgets and targets, it is inappropriate to retroactively apply adjustments to a program year derived from a different set of input assumptions, including NTG values. Enbridge believes this is unreasonable and inconsistent with the spirit of the Board's instructions as part of the Multi-Year DSM Framework. In its 2015 to 2020 DSM Plan Decision, the Board confirmed this interpretation by stating that: "input assumptions and net-to-gross adjustment factors are finalized for a given year based on the previous year's final DSM audit."[3]

[2] EB-2015-0049 Decision and Order, January 20, 2016, p. 21
[3] EB-2015-0049, revised Decision and Order, February 24, 2016, p. 3

Witnesses: D. Bullock
D. Johnson

DNV·GL

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

Date: June 9, 2015

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.
        - o The TEC is not in a position to provide endorsement on this point at this time. Discussion with DNV is required.
    - TEC Take:
        - o 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.
    - 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):
    - **TEC Action Item:** TEC to discuss guidelines for framing[1] questions and usage of information from program in probes. Decision required prior to survey instrument development.
    - Open questions on usage of
        - framing questions to remind customer of decision making process
        - program-supplied information in framing question-related probes
    - Rationale for questions and scoring to be provided with survey instruments once drafted.
    - 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:
        - 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.

[1] Framing questions are those that remind the customer of the decision-making process and are not used in the attribution scoring.

    - 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):
    - 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.
   - <u>TEC Take</u>:
     - 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 rebated 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. (We call this the measurement the "Primary Attribution" below.) The effect on the current

project of prior and indirect program experience will be captured in a secondary, less rigorous question sequence. (We call this effect "Secondary Attribution.").

- Operationally, DNV GL proposes to capture two types of attribution that would complement one another. See examples in Figure 1.
    - Primary attribution will consider all program activities that bear directly on the current study project.
    - Secondary attribution will quantify the programs' effect on company prior EE activity or practices that influenced the project.
        - Research questions for secondary attribution might include
            - Does your company have policies or practices regarding projects like project X?
            - How long have these practices existed?
            - How likely would your company be to have these practices by now without the program?
            - How likely would you have been to do project X without these practices?

Figure 1: Example O&M Participant Attribution

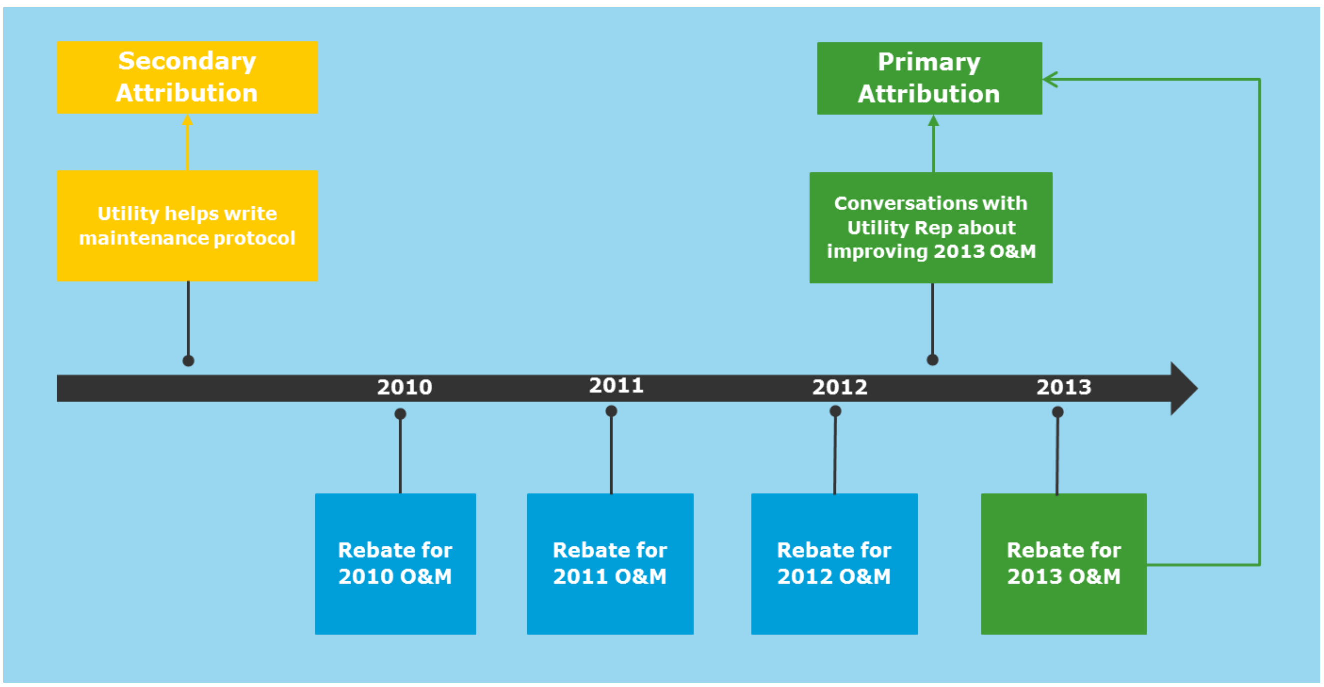
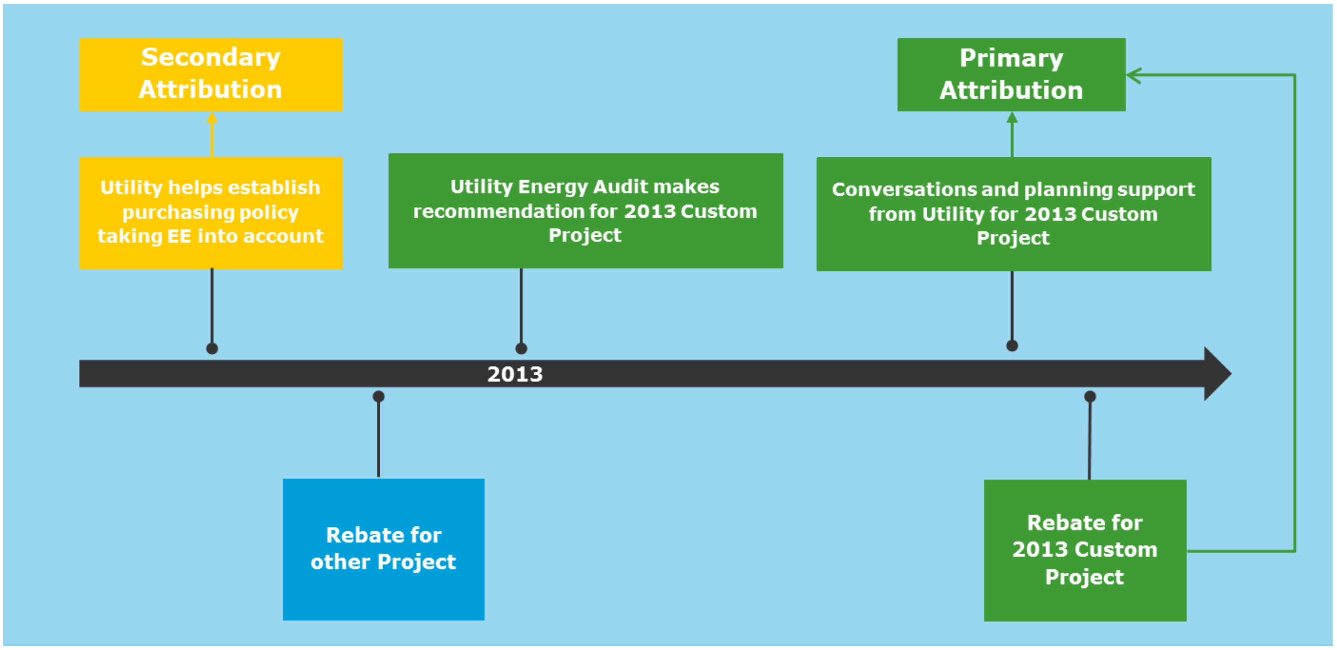


Figure 2: Example Custom Project Participant Attribution



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.

MEMORANDUM

To: John DeVenz and Deborah Bullock, Enbridge
Muhammad Saleem and Leslie Kulperger, Union Gas

From: John Dikeos and Nick Ebbs, ICF

Date: October 23, 2017

Re: Hydronic Boiler System Baseline Study: Status Update

This memo provides an update regarding the Hydronic Boiler Baseline Study that ICF is carrying out on behalf of Enbridge Gas Distribution ("Enbridge") and Union Gas Limited ("Union Gas") at the direction of the Ontario Energy Board. The objective of this assignment is to collect market data on standard efficiency hydronic boilers typically sold in retrofit applications in Ontario in order to develop baseline boiler assumptions. This will allow Enbridge and Union Gas to more accurately estimate the savings that are resulting from high efficiency and condensing boiler retrofit installations. ICF's revised proposal to carry out this scope of work is dated October 14, 2016 and the project kickoff meeting occurred on February 2, 2017.

Project Resources

Bob Bach of Energy Profiles Ltd., a former HVAC contractor and a noted boiler equipment expert, was acting as a subcontractor to ICF on this project. On May 11, 2017, Mr. Bach informed ICF that he was no longer able to participate any further in this project. His role on the Boiler Baseline study was centered on providing boiler-related expertise, including:

- **Study approach:** Input to the final work plan and boiler baseline approach assessment.
- **Boiler sales data:** Assistance with boiler sales data collection through the Canadian Institute of Plumbing and Heating (CIPH).
- **Market actor consultations:** Support related to identifying market actors for the market characterization consultations.
- **Training material development:** Leading the development of training material for on-site auditors to improve their knowledge of boilers and the associated features being focused on in this study.
- **Training delivery:** Supporting the delivery of training material to on-site auditors, including assistance with identifying an appropriate site for the on-site portion of the training.
- **Reporting:** Inputs to the study reporting, including insights into the boiler market and reviews of draft deliverables.

ICF sought out additional boiler expertise in order to replace the role Mr. Bach was intended to play for the project. This included identifying and engaging boiler experts to assist with development and delivery of training material for our on-site auditors and the identification of an appropriate site for the on-site portion of the training. The following boiler experts were identified to support these activities:

- Phillip Paterson**, Partner and Operation Supervisor/Foreman, PSL Mechanical Heating and Air Conditioning Inc.:** Mr. Paterson has been working with large commercial boilers for over 10 years. Over the years, he has worked with building owners and property managers to maintain, service and upgrade their mechanical systems. Mr. Paterson assisted with the preparation of training material and carrying out the on-site training.
- John Goshulak**, Vice President Sales and Marketing, Weil-McLain Canada:** Mr. Goshulak is a professional engineer with over 25 years in the HVAC business, including a wealth of experience with hydronic boilers. He recently supported ICF with a technology assessment study, where he agreed to participate in a market actor consultation, and he was also referred to ICF to support this project by Mr. Bach. Mr. Goshulak assisted ICF in identifying an appropriate site for the on-site training and in coordinating the site visit.

Although his role has changed, Mr. Bach agreed to stay on the project in a limited capacity in an advisor role. As such, he will provide feedback on draft reporting, fulfilling the final role noted in the list above.

Utility Customer Data

Enbridge and Union provided customer data for a subset of their commercial customers. This included the following information:

- NAICS or SIC code
- Business name
- Facility address
- Contact information
- Annual gas consumption

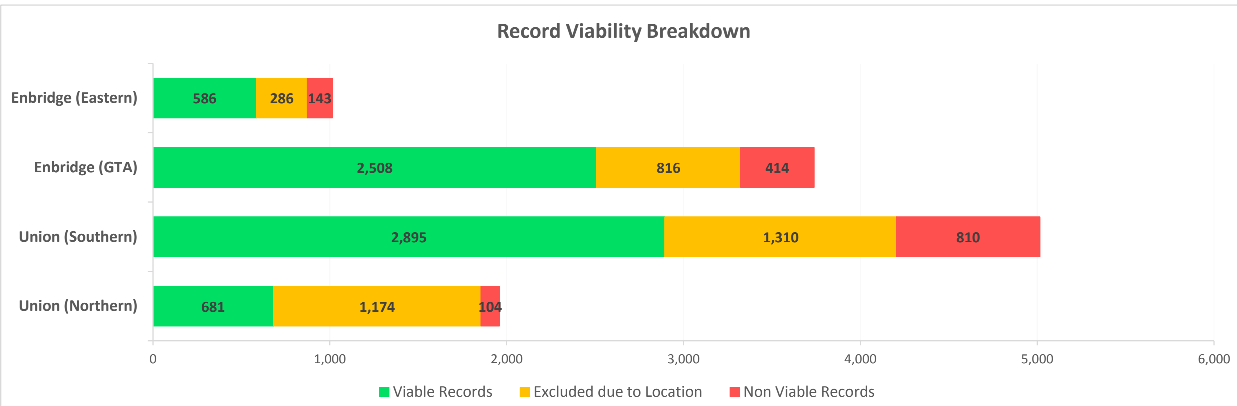
The following criteria were used to identify the subset of records within the utilities' records that had a high probability of yielding eligible boilers:

- **NAICS/SIC code:** All commercial and institutional sub-sectors were included, consistent with the definition of Commercial used for the utilities' retrofit incentive programs.
- **Boiler incentive program participation:** Exclude accounts that have participated in boiler incentive programs in the last few years (2013-2016).
- **Building types:** Including all commercial and institutional accounts, excluding restaurants, warehouses, non-food retail facilities (except large malls), and food retail facilities, since these building types are unlikely to have boilers.
- **Account start date:** Accounts created between 2005 and 2013 excluded since they are unlikely to have changed their boilers. It was subsequently decided to remove this filter as the account created date does not seem to be accurately reflected for most accounts.
- **Account Status:** Only including active accounts.

- **Minimum consumption:** Minimum annual gas consumption threshold originally set at 800 GJ (21,000 m^3). Later reduced to 640 GJ (17,000 m^3) to ensure that smaller eligible facilities aren't being excluded.
- **Location:** It was determined that it was simpler for ICF to filter out records that didn't fall within the geographical coverage area, so the utilities did not screen for this parameter. The original statement of work called for sites located in Toronto, Ottawa, Sudbury, and London to be included. This area was subsequently expanded, as described in the Site Identification section of this document.

Exhibit 1 summarizes the dataset that resulted from the screening criteria noted above. The results are broken down by utility service territory. The green bars represent records that were used for this study. The yellow bars represent records that were excluded because the locations fell outside of the geographical area selected for this study. The red bars represent records that were not considered viable for this study, mostly because there was no contact information (e.g. phone number) associated with the record.

Exhibit 1: Utility Customer Records Summary by Region



Site Identification

As summarized in Exhibit 2, ICF has contacted approximately 6,630 facilities with an overall call success rate of 0.44% (0.74% for site visit bookings in Enbridge's service territory and 0.15% in Union's service territory). This has resulted in 23 site assessment bookings of candidate facilities in Enbridge's service territory and 5 site assessment bookings in Union's service territory.[1]

[1] Referred to as candidate facilities since the number of site assessment bookings does not reflect the number of successful site visits. This is discussed further in the Site Assessments section.

Exhibit 2: Site Identification Metrics

Facilities Contacted	
Total Contacted Facilities	**6,327**
Enbridge	3,094
Union	3,233
Total Uncontacted Facilities	**343**
Enbridge	0
Union	343
Total Number of Facilities	**6,670**

Call Success Rate	
Total Number of Site Visits (Scheduled)	28
Total Number of Facilities Contacted	6,327
Success Rate	**0.44%**

Pending Site Visits	
Total Site Visits Scheduled	**28**
Enbridge	21
Union	7
Total Site Visits Completed	**28**
Total Successful Site Visits	**5**
Total Pending Site Visits	**0**
Success Rate	**18%**

ICF originally estimated a 2% success rate for the site identification stage. The lower success rate for site assessment bookings can be attributed to many factors, including:

- Data quality issues with the utilities' customer records (e.g. invalid phone numbers).
- Challenges filtering customers based on their account start date.
- Difficulties with separating out new construction facilities from the customer records.
- Most of the calls were made during the summer vacation and back to school periods, when it was more challenging to get in touch with facility contacts.
- It was more challenging than anticipated to speak directly with facility managers or other staff knowledgeable of the boiler equipment.

At the current rate of progress, ICF is concerned that there will be an insufficient number of utility records to meet the initial target of 140 site assessments. In fact, the current success rate suggests that the number of site assessment booking will be well below this number. In order to increase the success rate and overall number bookings for site assessments, ICF investigated the following possible adjustments to the eligibility criteria and survey approach:

- Extending boiler age
- Expanding geographical coverage
- Alternative leads for site assessments, including an analysis of previously contacted sites to identify sites that may result in an assessment if contacted again
- CRM analysis and re-calling previously contacted sites
- Increased site visit participant incentives

Each of these items are discussed in the following sub-sections.

Extending Boiler Age

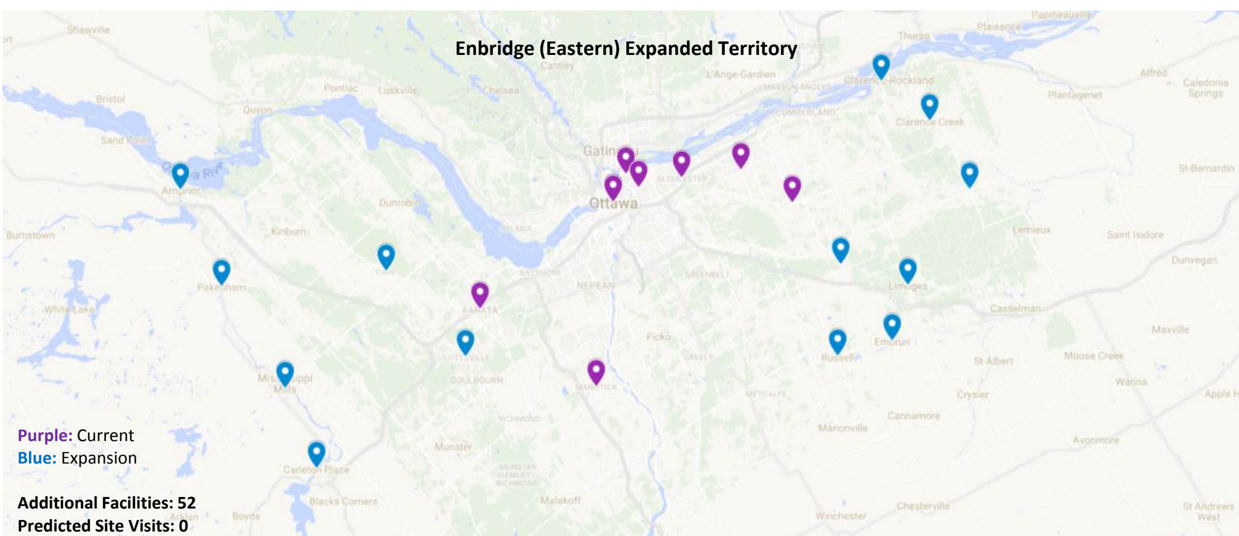
The initial criteria for boiler age included boilers installations from January 2014. ICF investigated whether it was feasible to push back this timeline without compromising the quality of the data. It was noted that the previous minimum energy performance standards for boilers, which were superseded by changes effective Jan. 1, 2017, came into effect on July 1, 2013.[2] As such, to increase the population of eligible potential participants, ICF suggested that the eligibility criteria for boiler age be pushed back to this date. This change was determined to be reasonable by the utilities and has already been implemented by ICF.

Expanding Geographical Coverage

In the original scope of work, to minimize logistical issues and ensure that the site visits were carried out in a cost-effective way, ICF proposed that the site visits be focused on a limited number of large urban centres in each of the utilities' jurisdictions. Initially, ICF employed a 45 minute driving distance surrounding Ottawa (Enbridge Eastern region), Toronto (Enbridge Central region), Sudbury (Union Northern region), and London (Union Southern region). In order to increase the number of eligible records that our call center can contact, ICF has already expanded the number of cities so that North Bay is being considered for Union's Northern Region and cities surrounding Ontario's Golden Horseshoe region (i.e. Oakville, Burlington, and Hamilton) are being considered as part of Union's Southern region.

ICF assessed the impacts of expanding geographical coverage to nearby areas or adding additional population centers. The results of this analysis for each of the utility regions are summarized in the exhibits below, which suggest that expanding the geographical coverage would result in a total of 2,467 additional records for the site identification process. Assuming similar call and site assessment success rates, our analysis suggests that expanding the radius around representative cities will result in 16 additional site assessment bookings and the impact on travel time per site visit will be modest. Based on the current site assessment success rate, this result in an additional 2-3 site visits that result in usable data.

Exhibit 3: Impact of Expanding Geographical Coverage in Enbridge Eastern Service Territory



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[2] O. Reg. 404/12: Energy and Water Efficiency - Appliances and Products, under Green Energy Act, 2009, S.O. 2009, c. 12, Sched. A, available at: https://www.ontario.ca/laws/regulation/120404

Exhibit 4: Impact of Expanding Geographical Coverage in Enbridge Central (GTA) Service Territory

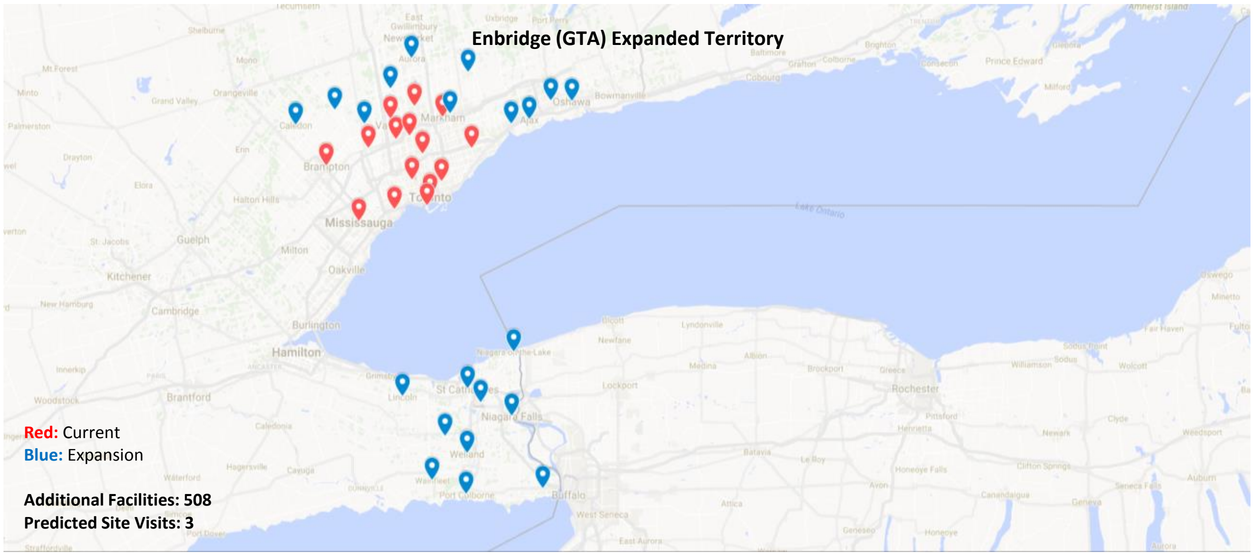


Exhibit 5: Impact of Expanding Geographical Coverage in Union Southern Service Territory

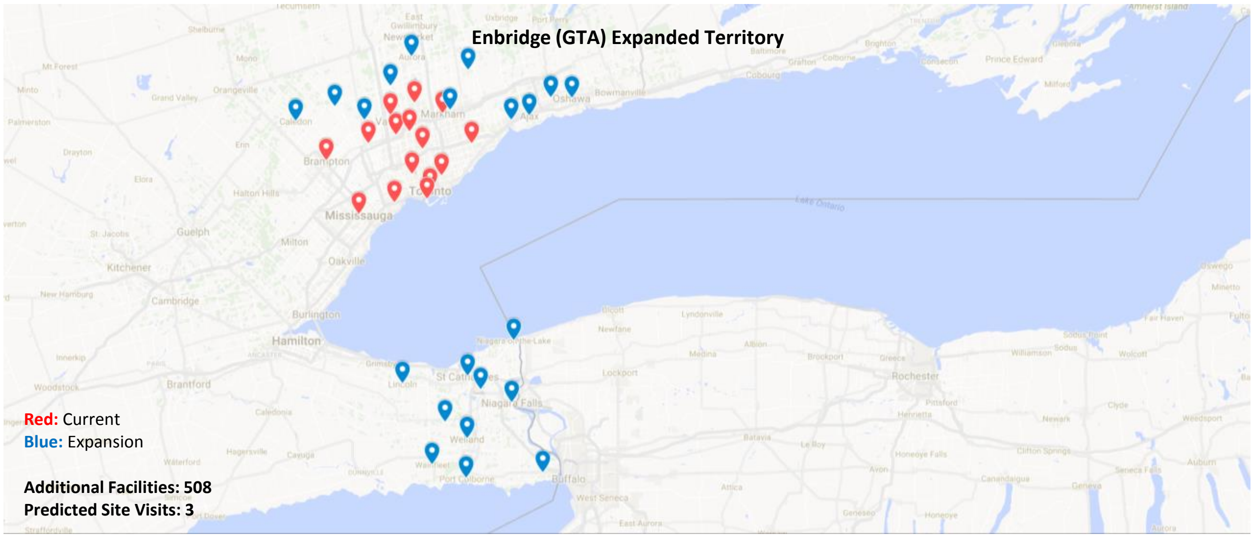
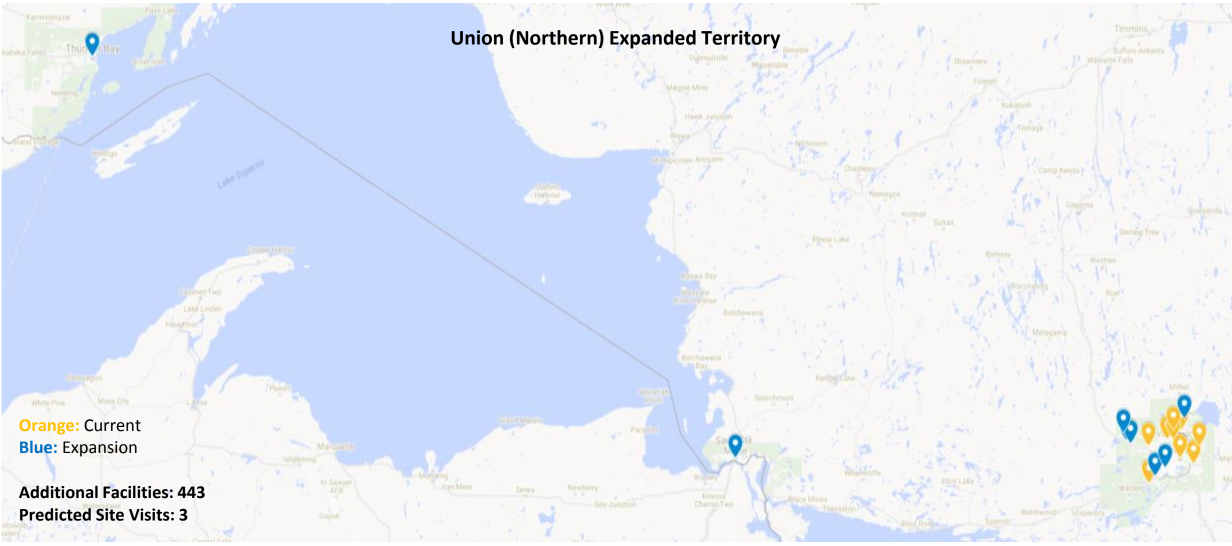


Exhibit 6: Impact of Expanding Geographical Coverage in Union Northern Service Territory



In addition, ICF assessed the impacts of expanding to all customer records provided by Enbridge and Union. However, expanding to all customer records provided by Enbridge and Union will only result in an estimated 21 additional site assessments based on our experience to date (of which 5 are expected to be successful) and will have a very large impact on travel time and costs. As such, ICF recommends that the radius around representative cities be expanded but that facilities outside these regions not be contacted.

Alternative Leads for Site Assessments:
Contacting other sources beyond customers could result in leads for potential site assessments. ICF is currently working with the utilities to identify if there are appropriate alternative leads for the site assessments from the following sources:

- Boiler contractors and engineering consultants who would know of eligible installations and could provide contact information for facilities.
- Portfolio managers with multiple facilities who may be aware of sites not previously contacted.
- Utility records pertaining to "lost" boiler projects may point towards un-incented boiler retrofits. For example, a utility customer may have begun discussions with Enbridge or Union regarding a boiler retrofit, but ultimately proceeded without completing the application process for the program and receiving incentive funding.

Providing these other sources with an incentive for providing successful leads might further encourage participation in the study and also provide a reasonable reimbursement for their effort. An initial estimate of an incentive amount that is both compelling and commensurate with the level of effort is $200 per eligible qualified lead. Additional funding would be required for this expenditure. Assuming that the eligible qualified leads for this approach would range from 30 to 65 sites and including a 10% general and administrative (G&A) fee for the disbursement of the funds, an incremental budget of $6,600 to $14,300 would be required.

Employing alternative leads to identify potential contacts for site assessments is a promising approach since it will rely on "warm leads" (i.e. sites that have completed boiler retrofits in the required timeframe). It's also possible that all of the required sites could be identified through this approach.

CRM Analysis and Re-calling Previously Contacted Sites
ICF could analyse our contact center database to determine where calls are failing and how the process can be improved. In addition, certain sites that were contacted without success may still result in site assessments (e.g. facility contacts may have been away on summer vacation). ICF could further analyse the record set to identify these facilities.

This approach would result in additional site visits but, based on ICF's experience to date, the level of effort per identified site is likely to be quite high.

Increased Site Visit Participant Incentives
Based on the target of 140 site visits, ICF is currently offering a $20 gift card to half of the participants and a raffle to win a grand prize. ICF has identified to the utilities that there is a lack of motivation for facilities to participate in the site visit assessments and suggested that participation may improve if the incentive is increased. Based on the updated target of 70 site assessments, as discussed below, ICF recommends that the incentive to participants be increased to $100 for all participants. Including a 10% G&A fee for fund disbursement, this approach will require incremental funding of $4,620.

Some form of recognition or alternate incentive, such as a thank you letter from the utility or the offer of a free facility energy audit, may also help to boost participation. ICF is working with the utilities to investigate these options as well.

Site Assessments

As summarized in Exhibit 7, to date ICF has scheduled 28 site visits of candidate facilities, of which all 28 have been completed. However, only 5 of the completed site visits have resulted in useful data for the purpose of the study.

Exhibit 7: Site Assessment Metrics

Site Assessment Summary	
Total Site Visits Scheduled	**28**
Enbridge	23
Union	5
Total Site Visits Completed	**28**
Total Successful Site Visits	**5**
Total Pending Site Visits	**0**
Success Rate	**18%**

Findings that have contributed to the poor success rate of the site assessments include:

- **Boilers not meeting the project eligibility criteria:** In many cases, boilers have not met the project eligibility criteria (e.g. boiler too old, capacity too small, new construction application). ICF believes that this is a result of speaking to facility contacts who are not knowledgeable about their building's HVAC equipment as part of the phone screening. Many people who self-reported that they were knowledgeable about the systems reported incorrect information (e.g. incorrectly stating the boiler capacity or boiler age). Because the identity of the facility manager was not known in advance, call centre agents had to rely on the contact's assessment of whether or not they could provide the required information. This was further exacerbated by complications with following up in situations where eligibility criteria was in doubt, as noted below.

- **Confirmation of eligibility criteria:** Challenges associated with confirming site visit bookings and/or confirming that sites meet the project eligibility criteria using follow-up calls. Since site visit participants don't stand to benefit from the visits, the initial follow-up phone calls resulted in a high number of site visit cancellations. Consequently, ICF made the decision not to follow up by phone to confirm site visit times or to follow up in cases where the eligibility of the boiler was in doubt, as was originally planned, and would normally be routine procedure for site visits. This has increased the number of site visits being undertaken, but results in a lower success rate for collected data as more sites of questionable value are included in the site assessment list.
- **Site contact availability:** In some cases, site contacts have not been available or contactable at the time of the site assessment, despite repeated attempts to make contact once on site.

ICF has made improvements to the call center scripts in order to improve the site visit success rate, but many of the parameters cannot be controlled for.

Adjustments to Sample Size

Given the challenges faced in gaining customer agreement to participate and identify eligible boiler installations, ICF proposed the possibility of reducing the current sample size. Based on a preliminary review of appropriate precision and confidence intervals, the original statement of work called for a sample of 70 hydronic boilers larger than 300 MBH used for space heating applications and 70 boilers below 300 MBH for central DHW (domestic hot water) applications. When the scope was adjusted, at the recommendation of the boiler study sub-committee, to remove DHW boilers from the study, the decision was made to increase the sample size of larger than 300 MBH boilers to 140.

Based on the estimated number of baseline boilers sold in Ontario, ICF evaluated the effects of different sample sizes on precision and confidence level. The results were provided to the utilities and are summarized in the exhibit below.

The total eligible population was estimated based on the following inputs:

- **Boiler sales:** 26,870 units larger than 300 MBH shipped across Canada for the period January 2013 to December 2016, according to CIPH. This is a reasonable proxy for the number of boilers shipped across Canada since mid-2016.
- **Ontario market share:** Estimated to be 60% of all boilers sold in Canada, considering that Ontario represents 40% of the Canadian population, and there is a relatively low penetration of natural gas in Quebec and the Maritimes.
- **Retrofit market share:** Estimated to be 66%, based on a typical boiler life of 25 years (4% of boilers being replaced in a typical year) and new construction adding approximately 2% to the commercial floor area in a typical year.
- **Incentive program participation:** Estimated to be 3,017 units for the period January 2013 to December 2016, based on Enbridge and Union program participation data.
- **Baseline boiler population:** The population of eligible boilers can be estimated by multiplying the estimated boiler shipments across Canada (26,870) by the Ontario market share (60%), subtracting the incentive program participation (3,107), and multiplying by the retrofit market share (66%). This yields an estimated population of approximately 8,650 baseline boilers.

Exhibit 8: Boiler Sample Sizes Related to Differing Precision and Confidence Intervals

Scenario	Precision	Confidence	Size
1	8%	95%	140
2	10%	90%	67
3	20%	90%	17
4	10%	80%	41
5	20%	80%	11

Approaches Considered and Rejected

The following approaches to capturing the target data set were considered and rejected for the reasons outlined below:

- **Expanding geographical coverage:** ICF investigated the impacts of expanding the geographical coverage for the site identification and site assessments to nearby areas and adding additional population centers. Based on an analysis of the records provided by the utilities, this would result in an estimated 1,806 additional records for the site identification process.
- **CRM analysis and re-calling previously contacted sites:** ICF also considered carrying out detailed analysis of its CRM and re-contacting previously contacted facilities that failed to participate, but may be eligible.

The above approaches are not recommended because of their high cost and the fact that they are not expected to yield sufficient target sights by themselves.

Recommended Next Steps

ICF recommends the following approaches:

- **Adjustments to sample size:** ICF's analysis on the effects of different sample sizes on precision and confidence level suggests that a lower number of successful site assessments may yield an acceptable dataset from the perspective of statistical significance. Based on this analysis, it is recommended that the target sample size be changed to 70 boilers, consistent with the original sample size proposed at the beginning of the project.
- **Alternative leads for site assessments:** ICF recommends pursuing alternate leads to identify candidate facilities for the site assessments including:
    - Continuing to work with the utilities to identify and contact utility account managers, facility and energy managers, boiler contractors, and "lost" boiler projects. In particular, ICF believes that reaching out to boiler contractors has the highest chance of success.
    - Providing other sources with an incentive of $200 per eligible qualified lead. This would require an incremental budget of $14,300.
    - Working with the utilities to investigate other forms of recognition or alternate incentive, such as a thank you letter from the utility or the offer of a free facility energy audit.
- **Increased site visit participant incentives:** It is recommended that the incentive to qualified site visit participants be increased to $100 per site. This would require an incremental budget of $4,620.

Project Budget

The original project budget is presented below, along with budget spent to date and budget remaining as of October 20, 2017:

Task	Original budget	Spent to date ($)	Spent to date (%)	Budget Remaining ($)
TOTAL	**$144,260**	**$125,224**	**87%**	**$19,036**
Ongoing Project Management Tasks	$14,055	$18,682	133%	-$4,627
1.0 Inception (Kickoff, Methodology, etc.)	$5,820	$6,479	111%	-$659
2.1 Sales Data Collection	$1,445	$1,255	87%	$190
2.2 Consultations with Market Actors	$9,320	$7,204	77%	$2,116
2.3 Facility ID and Pre-Screening	$36,390	$52,679	145%	-$16,289
2.4 On-Site Data Collection	$42,000	$25,936	62%	$16,064
3.1 Market Characterization	$4,110	$3,293	80%	$817
3.2 Boiler Baseline Determination	$6,500	$1,500	23%	$6,500
3.3 Draft Reporting	$4,980	$2,396	48%	$2,584
3.4 Final Deliverables	$2,960	$0	0%	$2,960
Expenses (Enhanced Data Collection)	$3,080	$0	0%	$3,080
Expenses (CIPH Shipment Data)	$1,000	$1,000	100%	$0
Expenses (ISNetworld Subscription)	$3,100	$3,100	100%	$0
Expenses (On-Site Data Collection)	$9,500	$1,700	18%	$7,800

As summarized in the table above, ICF has expended $125,224 or 87% of the project budget to date. Of this amount, $36,065 has been invoiced to Enbridge and Union.

The following items have required more effort than ICF allocated in our original budget:

- **Ongoing Project Management Tasks:** This project has required a substantial amount of project management time, based on a larger amount of client interaction than was originally envisioned and effort to address issues with the proposed approach.
- **Task 2.3 Facility ID and Pre-Screening:** The lower than anticipated success rate required with site identification resulted in more revisions to the process and script than was originally anticipated. The level of effort required to make contact with the appropriate person who could answer the eligibility criteria questions was also higher than anticipated, both in terms of number of calls made and time per call. It was anticipated that two points of contact would typically be required, with an initial call to the number associated with the account, and then a follow up call with the person responsible for maintenance. In practice, it was necessary to be transferred to several people in most cases before communicating with the appropriate person. The calls also took longer as the program requirements were discussed, and there was more hesitation and suspicion on the part of participants than anticipated.
- **2.4 On-Site Data Collection:** Data collection took more effort than anticipated primarily due to the high failure rate of site assessments, i.e. the assessments not resulting in usable data for the study. This was due to either a failure to gain access to the boiler or the boiler not meeting the eligibility criteria. Site visits were also scheduled more sporadically than originally anticipated, resulting in increased travel time per site assessment, and greater travel costs. Site assessments also took longer than expected

due to several participants not being ready when the site auditor arrived, leading to delays onsite. The inability to more thoroughly pre-screen sites, as noted previously, also contributed to this.

ICF has estimated that the following additional budget will be required to implement the recommended next steps, in addition to the remaining budget of $19,036:

TASK DESCRIPTION	TASK TOTALS
SUB-TOTAL	
Project Management	**$12,500**
Ongoing Project Management Tasks	$12,500
Task Area 2: Market and Sales Data Collection	**$61,740**
Alternative leads: ID Sites	$15,330
Alternative leads: Contact Sites	$15,330
2.4 On-Site Data Collection	$31,080
SUB-TOTAL	**$74,240**
Enhanced Data Collection	$4,620
Contractor Incentives (Qualified Leads)	$14,300
Expenses (On-Site Data Collection)	$4,750
TOTAL	**$97,910**

The additional budget estimate is based on refined estimates for the level of effort required to identify sites and conduct site assessments based on the learnings from the project delivery to date. Some high-level insights on the budget line items noted above include:

- **Project management:** Additional project management effort to account for the expanded project timeframe and more interactions with the clients to ensure the project is progressing well.
- **Alternative leads (ID Sites):** This task is related to consultations with market actors, such as contractors, to identify “warm lead” candidate facilities that have recently replaced their boilers.
- **Alternative leads (Contact Sites):** This task includes level of effort from ICF’s engineers and contact center to contact candidate facilities and follow-up to verify that they meet the eligibility criteria. ICF is proposing a more rigorous approach to site screening prior to visiting sites, which will result in a significantly higher success rate for the site visits and less overall effort for the on-site data collection.
- **On-Site Data Collection:** The updated incremental budget for the on-site data collection assumes 4 site visits for day, allowing for more travel time between sites and for sufficient time to comprehensively catalogue the information on each boiler. Based on a more rigorous approach to site screening prior to site visits, ICF has also assumed a 75% success rate for site visits going forward.

The changes made in the proposed approach represent ICF's best efforts to incorporate all of the lessons during the delivery of the project to date, including valuable insights and recommendations from the utilities.

Project Schedule

Unforeseen circumstances have resulted in delays to the overall project timeframe. For example, Mr. Bach's departure from the project caused a delay of approximately 4 weeks in the start of the site visits since he had been tasked with leading the development of the site auditor training material shortly before his departure. Most impactful however, challenges with identifying eligible facilities for the site assessments have resulted in significant delays.

There is some uncertainty on the impact of the further delays since ICF will have to implement alternate approaches to identifying eligible facilities for the site assessments. ICF anticipates that the project completion, which was originally scheduled for late October 2017, will be delayed by an estimated 4-6 months. Despite these delays, ICF is committed to satisfying the overall project goal of characterizing baseline boilers in Ontario at an acceptable level of statistical significance.

MEMORANDUM

To:	John DeVenz and Deborah Bullock, Enbridge Leslie Kulperger, Union Gas
From:	John Dikeos and Nick Ebbs, ICF
Date:	March 21, 2018
Re:	Hydronic Boiler System Baseline Study: Enhanced Approach

Background

ICF's original approach for identifying facilities with eligible boilers for the purposes of the Hydronic Boiler Baseline Study yielded limited success; despite contacting over 6,600 facilities, we were only able to book 28 site visits and only 5 of the completed site visits resulted in useful data for the purpose of the study (i.e. only 5 sites had boilers that met the eligibility criteria).

The memo outlines ICF's proposed enhanced approach, including an updated schedule and draft email templates for our consultations with boiler contractors. Due to the challenges ICF has encountered with this project thus far, it is important to note that ICF is proposing a staged "exploratory" approach where progression to subsequent phases is contingent on success in earlier phases. Additional challenges may merit discussions with Enbridge and Union Gas staff on alternate approaches and/or whether it is worthwhile to proceed to subsequent phases. It should be noted that, even with the enhanced approach, there is a risk the project will be unable to meet the study criteria and will be deemed unsuccessful.

Enhanced Approach

Based on the alternate approaches that ICF investigated, as outlined in ICF's memo dated Oct. 23, 2017, and the feedback that has been provided by Enbridge and Union Gas, ICF is proposing to move forward with implementing the following alternate approach for this study:

- **Adjustments to sample size:** ICF's analysis on the effects of different sample sizes on precision and confidence level suggests that a lower number of successful site assessments is expected to yield an acceptable dataset from the perspective of statistical significance. Enbridge and Union Gas have agreed to revise the target sample size to 70 boilers, as this sample size is consistent with the original scope of work, as well as being consistent with industry standards for the statistical significance of surveys.

- **Alternative leads for site assessments:** ICF will pursue alternative leads to identify candidate facilities for the site assessments (i.e. to identify “warm leads”). We will work to identify boiler contractors, property management groups, and “lost” utility boiler projects.[1] However, ICF will focus primarily on reaching out to boiler contractors since we believe that this approach has the highest chance of success.
- **Incentives:** We will offer incentives to both site visit participants (i.e. $200 per site) and boiler contractors or other market actors that provide eligible qualified leads (i.e. $200 per eligible qualified lead) for a total of 5 eligible qualified leads per boiler contractor to ensure the study is not biased.
- **Calls to candidate facilities:** Pending the success of our approach to identify “warm lead” candidate facilities, we will leverage our in-house contact center to complete calls to these facilities. Based on lessons learned from this project and similar recent projects, ICF has improved its contact center staff training for these types of engagements and has a better overall process in place. We are confident that this will help improve the overall success rate of our calls to candidate facilities. Where it’s deemed to be beneficial and cost-effective, our consultants will be involved in training contact center staff and completing a portion of the calls to candidate facilities.
- **Pre-site visit confirmation of eligibility criteria:** To improve the success rate of our site visits, ICF will implement a more rigorous pre-screening approach for the pre-site visit confirmation of eligibility criteria. For instance, calls to confirm eligibility criteria will be completed by our consultants to ensure that we are able to properly gauge facility contacts’ knowledge of their boiler systems. ICF will also attempt to confirm site visit bookings in advance of sending staff to any sites. This was not possible using the original “cold call” approach, as the site contacts were easily discouraged from participating if contacted too frequently.

Furthermore, ICF is proposing a multi-pronged approach to confirm that boiler installations were not influenced by gas incentive programs:

1. **Boiler contractors:** First, this will be listed as one of the criteria for the facilities being identified by the boiler contractors
    - If the boiler contractors are unsure, they may provide ICF with some leads that include DSM participants but these will be weeded out in subsequent steps
2. **Utilities:** Next, the draft list of facilities will be provided to Union and Enbridge so that the Gas Utilities can cross-reference with their participant databases
3. **Facility managers:** Lastly, ICF will confirm with facility managers as part of the screening process and during site visits that their boiler retrofits weren’t influenced by gas incentive programs

[1] “Lost” boiler projects are utility customers that may have begun discussions with Enbridge or Union regarding a boiler retrofit, but ultimately proceeded without completing the application process for the program and receiving incentive funding. Such projects will be carefully vetted to ensure that they can reasonably be considered to have not been influenced by utility DSM initiatives.

Updated Schedule

A draft schedule for executing the enhanced approach is outlined in the table below. Subsequent stages are dependent on the success of previous stages. For example, ICF will move to carrying out calls to candidate facilities if a critical mass of “warm” leads is generated by the alternative leads for site assessments.

		Mar-23-18	Mar-30-18	Apr-06-18	Apr-13-18	Apr-20-18	Apr-27-18	May-04-18	May-11-18	May-18-18	May-25-18	Jun-01-18	Jun-08-18	Jun-15-18	Jun-22-18	Jun-29-18	Jul-06-18	Jul-13-18	Jul-20-18
Task	**Approx. Timeframe**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Stage 0: Compile list of alternative leads (primarily boiler contractors)	3 weeks																		
Stage 1: Alternative leads for site assessments (i.e. generate “warm” leads)	6 weeks																		
Stage 2: Calls to candidate facilities	5 weeks																		
Stage 3: Site visits	5 weeks																		
Stage 4: Draft reporting	3 weeks																		

Boiler Contractor Email Template: First Contact

Subject: $200 Incentive Offer to Support Boiler Baseline Study

Hi xxxxx,

On behalf of Enbridge and Union Gas, we are offering a **$200 referral incentive** for each lead that helps us identify a recent boiler installation that meets our eligibility criteria. You can claim these referral incentives by helping us identify a few eligible sites that we could visit from the list of clients you have worked with recently. Your **customers will also receive a $200 incentive** for each successful site visit.

These incentives are being offered as part of a research study to collect market data on recent hydronic boiler installations in Ontario. As part of this effort, we are identifying recent boiler installations and carrying out on-site data collection of boilers that meet our eligibility criteria. Your assistance in identifying eligible sites would be much appreciated and will also be useful in helping the Enbridge and Union Gas improve their future incentive programs.

If you are interested in providing site information to us and to coordinate next steps, please contact me at xxxxx.xxxxx@icf.com or by phone at xxx-xxx-xxxx.

Regards,
xxxxx

Boiler Contractor Email Template: Established Contact

Subject: $200 Incentive Offer to Support Boiler Baseline Study

Hi xxxxx,

Thanks for your interest in participating in the study we are working on to collect market data on recent hydronic boiler installations in Ontario. As I noted, we appreciate your support to help us identify a few eligible sites that we could visit from clients you have worked with. This would entail a brief visit by one of our staff to take a look at the boiler, and to record information on the thermal efficiency and other boiler features.

We are looking to identify facilities that have installed one or more boilers that meet the following criteria:

- Must be a space heating hot water boiler
- Must have a capacity greater than 300 MBH
- Must have been installed after June 30, 2013
- Must have replaced existing boilers (i.e. not new construction)
- Boiler installations did not receive an incentive from Enbridge or Union

As a reminder, we are offering a **$200 referral incentive for each successful site lead** (up to a maximum of 5 sites) that you are able to provide to us. Your customers will also receive a $200 incentive for a successful site visit.

Thanks again for your interest in assisting with this study and please let me know if you have any questions.

Regards,
xxxxx

BOARD STAFF INTERROGATORY #6

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 10

Preamble:

Enbridge states: The EC was selected with no EAC or utility input or consultation.

Questions:

a) In the August 21, 2015 letter from the OEB to DSM stakeholders, as referenced at Exhibit A, Tab 1, Page 7 of 48 of Enbridge's application, the OEB states that the role of OEB is to include, amongst other responsibilities, "…selecting a third party Evaluation Contractor (the EC)." Please describe how OEB Staff's selection of DNV GL (the EC) without EAC or utility input was not appropriate.
b) Please confirm whether or not all members of the EAC were invited to provide input on the RFP's Scope of Work used to procure the EC to evaluate the 2015 program year.
c) Please confirm whether or not all members of the EAC were invited to provide input on the Scopes of Work used to procure other supporting evaluation contractors for the 2016 and 2017 program years.
d) Please confirm whether or not Enbridge is aware that a non-utility member of the EAC participated in the latest round of EM&V procurements related soliciting evaluation contractors for 2016 and 2017 program years.

RESPONSE

a) Enbridge's preamble above did not state that OEB Staff's selection of DNV was not appropriate. It stated, factually, that the EC ("DNV") was selected with no EAC or utility input or consultation. However, acknowledging that the August 21, 2015 letter from the Board outlining the 2015 to 2020 DSM Evaluation Process outlines that the OEB's role includes selecting a third party Evaluation Contractor; the letter further specifies that the role of the EAC is to "provide input and advice to the OEB on the evaluation and audit of DSM results."[1]

As such, Enbridge is of the view that the review and consideration of consultant/contractor proposals (in respect to the overall Evaluation Contractor or any other evaluator / verifier) for the execution of evaluation activities, including consideration of budgets and assessment of appropriate selection criteria, are determinations that, among all evaluation and audit activities, are appropriately determined with input and advice from the EAC (including the utilities as representatives on the committee).

b) Confirmed.

c) Enbridge confirms that EAC representatives were invited to provide input on the Scopes of Work used to procure other supporting evaluation contractors for the 2016 and 2017 program years. The EAC was not however privy to specific details in the RFPs. In addition, the EAC generally was not provided with any information on the proposals received or the criteria or process undertaken to select winning proponents.

d) Enbridge confirms that a single non-utility member of the EAC participated in the latest round of EM&V procurements at the specific invitation to that representative from Board Staff and at the exclusion of the remainder of the EAC. Enbridge sees no guidance in the Board's letter outlining the roles of the parties in the new governance structure that supports differentiated or preferential inclusion of one member of the EAC over the others.

[1] EB-2015-0245, Letter from the Board, 2015-2020 DSM Evaluation Process of Program Results, August 21, 2015, page 2.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #7

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 10

Preamble:

Enbridge states: The 2015 EM&V process took approximately 18 months.

Questions:

a) Related to the 2015 EM&V process, please indicate when OEB staff provided Enbridge with the non-disclosure agreement (NDA) for signature for Enbridge to release data required for evaluation activities, and when Enbridge returned the signed document to OEB staff and DNV GL.
b) Please indicate the length of time Enbridge required to fulfill all data requests made by the EC to facilitate the evaluation of Enbridge's DSM programs. Please specify the date that the last set of data was provided to the EC.
c) Please indicate whether or not Enbridge was provided with an opportunity to review/provide input on all major deliverables of the evaluation project. If yes, please indicate, in total, the amount of days Enbridge was provided for this review.
d) Please provide Enbridge Gas' 2012, 2013, 2014 Auditor's Reports and Audit Committee Reports.
e) Please describe the extent to which the auditor selected by the Audit Committee performed primary research as well as other robust evaluation studies in order to inform the results demonstrated in the 2012, 2013, 2014 Auditor's Reports.

RESPONSE

a) Enbridge was not provided with a NDA for signature by Board Staff. Enbridge was however provided with a Confidentiality Declaration & Undertaking, along with all members of the EAC. In a communication from Board Staff on February 13, 2017, an updated version of this document was provided to all EAC members for signature. Enbridge returned an executed copy on February 15, 2017.

b) Enbridge received the Commercial/Industrial CPSV/NTG data request on October 28, 2016 and provided its first set of CPSV/NTG Bin 1 data on November 17, 2016.

Witnesses: D. Bullock
D. Johnson

Enbridge received the final data request from the EC on July 14, 2017 relating to the Home Labelling market transformation program and responded on July 20, 2017.

c) Enbridge confirms that, along with the balance of the EAC, the Company was afforded the opportunity to review and provide input on the following major deliverables related to the 2015 evaluation process (Enbridge assumes this list aligns with Board Staff understanding of “major deliverables”):

- EM&V Plan/Scope of Work
- NTG Survey Instrument/Participant IDI Method Memo
- Vendor Survey (1 week)
- 2015 CPSV/NTG Scope of Work
- Draft 2015 CPSV/NTG (F/R) Results Report
- Final 2015 CPSV/NTG (F/R) Results Report (No comment period)
- Draft 2015 DSM Annual Verification Report
- Final 2015 DSM Annual Verification Report (No comment period)
- Draft Spillover Report
- Final Spillover Report (not yet received, no comment period)

Enbridge has not taken the time to definitively confirm how many days were provided for review of these deliverables but recollects generally the EAC was provided with 2 weeks (approx. 10 business days to provide comments) for each deliverable.

d) The 2012, 2013 & 2014 Auditor Reports and Audit Committee Summary Reports can be found in each year’s respective DSM Clearance of Deferral and Variance Account Applications as follows:

Witnesses: D. Bullock
D. Johnson

Year	Case Number	Document	Reference – Auditor Report	Reference – Audit Committee Summary Report
2012	EB-2013-0352	Revised Application for 2012 Demand Side Management (“DSM”) Clearance of Variance Accounts	Exhibit B, Tab 2, Schedule 1	Exhibit B, Tab 3, Schedule 1
2013	EB-2014-0277	Application for 2013 Demand Side Management (“DSM”) Clearance of Variance Accounts and Request for Confidentiality	Exhibit B, Tab 2, Schedule 1	Exhibit B, Tab 3, Schedule 1
2014	EB-2015-0267	Application for 2014 Demand Side Management (“DSM”) Clearance of Variance Accounts and Request for Confidentiality	Exhibit B, Tab 2, Schedule 1	Exhibit B, Tab 3, Schedule 1

e) As outlined by the OEB in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346):

> The third party Auditor… should be asked to:
> - provide an audit opinion on the DSMVA, LRAM and incentive amounts proposed by the natural gas utilities and any amendment thereto;
> - verify the financial results in the Draft Evaluation Report to the extent necessary to express an audit opinion;
> - review the reasonableness of any input assumptions material to the provision of that audit opinion; and,
> - recommend any forward-looking evaluation work to be considered.
>
> The independent third party Auditor is expected to take such actions by way of investigation, verification or otherwise as are necessary for the Auditor to form its opinion.

To meet this objective for each program year, the Audit Committee and the TEC developed an audit Terms of Reference. These Terms of Reference formed the Audit Request for Proposal annually. As was the case with the 2015 audit year, for the 2012 to 2014 framework, the audit Terms of Reference (scope of work) also included the additional objective of recommending future evaluation research opportunities to enhance the assumptions as well as recommendations to improve input assumptions, verification procedures, and the overall audit process.

Witnesses: D. Bullock
D. Johnson

Given that Enbridge's custom projects represented a significant percentage of its total net CCM (for example approximately 70% post-CPSV in 2014), the significant focus of the overall audit effort in each year was devoted to reviewing the commercial/industrial custom projects.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #8

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 12

Preamble:

Enbridge states: As further discussed below, the outcomes of the NTG study should not be applied to 2015 program results for purposes of determining the Company's shareholder incentive.

Questions:

a) As stated at Exhibit A, Tab 1, Schedule 3, p. 9 of Enbridge's application, the TEC, which included Enbridge, had agreed to a scope of work for the NTG study in April 2014. Please discuss the extent to which the study's scope – and specifically the methodology used to generate the NTG estimate – agreed to by Enbridge in April 2014 differs from the study completed by DNV GL in 2017.
b) Please provide the comments Enbridge made on the applicability and appropriateness of the self-report methodology during development of the study's scope of work.
c) Please indicate if the study filed in response to IR #2 used a self-report methodology.

RESPONSE

a) For clarity, the question outlined above does not correctly state Enbridge's language in the referenced evidence. DNV had not outlined a scope of work by April 2014. More accurately, the evidence highlighted that at that time the TEC and DNV agreed that the evaluation objective of the NTG Study would be stated as, "the primary objective of this project is to develop a transparent, reputable study that produces strong, credible, and defensible NTG ratios to be used on a go forward basis."[1] The scope of work for the NTG study dated March 2, 2016 was not delivered to the TEC until March 10, 2016 immediately after which the OEB assumed oversight of the project.

[1] TEC Quarterly Reports, 2014, Q1.
https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202014%20Q1%20Report.pdf

b) The self-report methodology, specifically the timing of projects and when influence occurred was a topic of discussion at the Ontario Gas NTG Evaluation Kickoff Meetings, and at the Technical Advisory Group meetings. Below is a table highlighting the type of discussions since 2013 with respect to the applicability of the self-report methodology during the development of the study's scope of work.

	Meeting type	Date	Discussion
1	Technical Evaluation Committee	Thursday May 30, 2013	Prior to the call, the Utilities presented the TEC members with a list of issues and observations from the 2008 Custom Attribution Study. This list was developed based on dialogue with internal utility staff members who helped facilitate the 2008 study. It included issues related to: • Timing of study field work and the scheduling of interviews which proved to be challenging for the study contractor. • Time lags between when the custom project was completed and when the attribution study was initiated (i.e. the 2008 study examined projects that were initiated in 2006 or earlier)….. Initial feedback from TEC members was that a more open-ended approach to the survey might produce more reliable results. With a greater focus on trying to better understand the influencing factors contributing to gas efficiency investments, study results would not only make free ridership more reliable, but help uncover more accurate and valid participant spillover information. 1. Timing Issues: The committee began its discussions with the advantages and disadvantage of transactional surveys (survey focused on the satisfaction and experience related to a transaction) vs. customer survey (survey focused on satisfaction of a particular product or service). The committee agreed that transactional surveys might be more appropriate for capturing free ridership where more recent program participants need to be considered, but noted that certain customers may warrant different treatment (such as scheduling of in person interviews as opposed to electronic surveys). It was also noted that the Utilities have established relationships with customers and its not just about asking them what action they took…..A number of comments were made related to an appropriate timeframe for the study. It was noted that today, real-time survey techniques are more frequently being used and that immediate responses are likely to provide more accurate results for free ridership values, whereas spillover would need to be surveyed on a different time frame and using a different sampling population.

2	Technical Evaluation Committee Meeting	Wednesday, July 16, 2014	The TEC discussed the two unresolved Parking Lot items as a group and also during a call with the Consultant: *Parking Lot Item #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 years should be taken into account by the study in determining NTG?"* The Committee discussed the differences in capturing long sales cycle program effects versus capturing "in program" spillover effects (projects rebated in current year that were free riders based on current year program effects, but attributable to prior program participation). The design and delivery structure of the utilities' Commercial and Industrial Custom Programs was considered in determining whether these effects should be captured in the free ridership or spillover portion of the study. The TEC agreed that both long sales cycle program effects and "in program" spillover effects should be captured in some form but the distinction and labeling of the savings from these effects is an item that remains unresolved. Current guidelines lack clarity and with the imminent new framework for Natural Gas Utilities from the Ontario Energy Board, the TEC felt it prudent to gain clarity prior to continuing with the NTG study,3 **<u>Agreement</u>** • The TEC agrees to temporarily postpone work on the NTG
3	Ontario TEC NTG Kickoff Parking Lot Memo	June 9 2015	1. *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 <u>current</u> 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 <u>cumulative effect of the programs over time</u>, 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

Witnesses: D. Bullock
D. Johnson

			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: o Long life cycle projects versus projects of a repetitive nature; o The continuous improvement focus of the custom program design; o Asymmetrical treatment of accounting for utility influence and savings using a short term approach; and o Projects in which the lifetime claim accounts for all behaviours and years versus those projects that do not.

c) Yes the Summit Blue Custom Projects Attribution Study Final was based on a self-report methodology. At the time of that study in 2008, Summit Blue recognized limitation's to the self-report methodology with respect to the results. Summit Blue found that:

> Self-report free ridership studies like the current study depend— by design— on respondents recalling events from the past. Ideally, the interviews on which to base these studies are done as soon as possible after pivotal decisions are made for each project. C&I custom projects often have a long lead time, sometimes measured in years. Thus some projects in the current study could have been incubating from as early as

Witnesses: D. Bullock
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> 2004. The time lag between when a project is conceived or key decisions are made and when the free ridership interview was completed may mean that crucial information is unavailable to the interviewer. Key decision-makers may have forgotten details or even moved from the participating company. The study included efforts to remind respondents of the history of their interaction with the program but this can never bring the entire history of a decision back to mind. While the risks here could skew results toward higher or lower free ridership values, it is more likely that these factors will produce higher free ridership values than the opposite.[2]

In addition to the consideration and qualification noted above, it is important to recognize that, notwithstanding the fact that the Summit Blue study employed a self-report method to estimate NTG, in comparison to the EC's recent NTG study, the study was delivered differently. It employed a completely different survey instrument to the EC's NTG study, utilized a different scoring algorithm, a different sampling methodology, and was executed by a different "in person" / "on-site" interview group vs telephone interviews.

[2] CUSTOM PROJECTS ATTRIBUTION STUDY FINAL, Summit Blue,Consulting, October 31, 2008, Section E6 Page V

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #9

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 14

Preamble:

Enbridge states: Effectively, the Company believes the EAC's structure and the burden placed on OEB Staff, with limited prior experience, contributed to a lack of transparency and limited collaboration between Board Staff and members of the EAC." *Emphasis added*

Questions:

a) Enbridge indicates that there was a lack of transparency and collaboration between OEB staff and members of the EAC. Is this Enbridge's view, or is Enbridge speaking on behalf of the EAC? Please indicate the members of the EAC you consulted who also believe the process lacked transparency and collaboration.

RESPONSE

Enbridge confirms that the views and concerns outlined its application are its own and the Company does not speak on behalf of the EAC.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #10

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 14

Preamble:

Enbridge states: We understand Board Staff is currently drafting a charter in an effort to establish greater role clarity for the EAC.

Questions:

a) Please confirm that Enbridge received the OEB's DSM EAC Terms of Reference, a draft of which was shared with EAC members on December 5, 2017.
b) Related to the Terms of Reference, please confirm that Enbridge participated in a discussion with OEB staff and EAC members on December 6, 2017.
c) Please confirm that, in response to a request by an EAC member, OEB staff provided further opportunity to comment on the Terms of Reference in February 2018.
d) Please indicate whether Enbridge Gas provided input to OEB staff on the Terms of reference during b) and c).

RESPONSE

a) Enbridge confirms that following requests from the utility for the EAC to establish a Terms of Reference, Enbridge is pleased that Board Staff recognized the need to document a Terms of Reference and shared a draft EAC Terms of Reference on December 5, 2017.

b) Enbridge confirms.

c) Enbridge confirms.

d) Enbridge confirms that the utility provided input to OEB staff and the EAC on the Terms of Reference beginning on December 6, 2017 and through to February 23, 2018.

Witnesses: D. Bullock
D. Johnson

The Terms of Reference mentioned above were included with the interrogatory submission from SEC. As such, please see responses to SEC Interrogatory #12, found at Exhibit I.EGDI.SEC.13 and SEC Interrogatory #13, found at Exhibit I.EGDI.SEC.13 for additional comments regarding the Terms of Reference.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #11

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, Page 15 of 48

Preamble:

Enbridge states: With regard to one of the most significant evaluation efforts, the development of the NTG Study, though the EC did solicit comments from the EAC on the survey instrument, much of the commentary and input provided by Enbridge Gas was dismissed. In addition Enbridge Gas was not provided an opportunity to provide input in respect of the EC's determination of an appropriate scoring algorithm and upon receipt of the draft results of the free-ridership interviews, Enbridge Gas repeatedly requested details regarding the determination of participant scoring based on example feedback provided, but has received limited information from this request."

Questions:

a) Please provide a listing of all commentary and input provided by Enbridge Gas on the survey as well as an indication of which of this input was responded to by the EC.
b) Why does Enbridge believe that their comments were not considered by the EC?
c) Enbridge comments that "In addition Enbridge Gas was not provided an opportunity to provide input in respect of the EC's determination of an appropriate scoring algorithm…"
    i. Please describe Enbridge Gas' experience and expertise developing scoring algorithms for purposes of establishing program specific NTG ratios.

d) Please provide the comment matrices developed by the EC and shared with all members of the EAC in order to track all feedback provided by EAC members on the NTG study. Further, please provide the comment matrices developed by the EC and shared with all members of the EAC on the 2015 CPSV evaluation and 2015 annual report.

Witnesses: D. Bullock
D. Johnson

RESPONSE

a and b)

The EAC was provided with a draft participant interview guide (survey instrument) on November 14, 2016 and asked to provide comments by November 25, 2016 which it did. It was also provided with a draft vendor survey on January 24, 2016 and asked to provide comments by January 30, 2017 which it did. In addition these deliverables were discussed verbally during EAC meetings and conference calls however no minutes were recorded capturing these discussions. Enbridge provides the following key concerns it shared verbally and in writing in reference to the preamble above.

Enbridge would like to point out that it never stated the comments were not considered by the EC, rather that the comments were dismissed or not appropriately addressed.

Secondary Attribution

Enbridge submitted both general and specific comments to the Participant Survey. One of the general comments put forth by Enbridge was regarding the topic of secondary attribution,

> assessment of secondary attribution appears to be solely addressed through one single question (DAT6). The topic of secondary attribution was discussed at length at the TEC (see parking lot memo from DNV dated June 9th, 2015, pages 4-7), where DNV proposed that a sequence of questions would be required.

The EC's response to this comment was that "all attribution questions are identified in the submitted an [sic] approved SOW)."

On this point, Enbridge would like to clarify that the EC's comment matrix containing the above response was provided the very same day that the final NTG scope of work was provided to the EAC via the Sharepoint site, on December 15, 2016. In order for the EC's response to be appropriate, the NTG Scope of Work would have to have been already finalized, however, this was not the case. The finalization of the NTG Scope of Work was presented in concert with the provision of this feedback. Enbridge is of this view this was not reasonable. Its feedback was not addressed, and indeed the Company's concern was dismissed in this regard.

Along with the survey, the EAC was asked to provide comments on the NTG Participant IDI Methods Memo. Enbridge provided the following,

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> the topic of secondary attribution was discussed at length at the TEC with DNV (see parking lot from DNV dated June 9th, 2015, pages 4-7, where DNV proposed a sequence of questions would be required. The current methodology simply reduces assessment of secondary attribution to a single question." To this comment, the EC responded "This is consistent with the plan as stated in the previous SOW drafts. In a long interview guide prioritization needs to be given to the portions of the survey that affect the final net savings of the program. Secondary attribution is important to know to inform future evaluation and programs, but is not used to calculate net savings.

Enbridge disagrees with the EC's response. Neither the March 2, 2016 nor the revised December 15, 2016 versions of the NTG Scope of Work specified that secondary attribution would not be used to calculate net savings. To the contrary, as outlined in the EC's memo, attached to Enbridge's response to Board Staff Interrogatory #5, found at Exhibit I.EGDI.STAFF.5, the EC detailed capturing both types of attribution. A full discussion on this topic can be found in the response to Energy Probe Interrogatory #5, found at Exhibit I.EGDI.EP.5. It is Enbridge's opinion that these important comments were dismissed by the EC.

<u>Scoring Algorithm</u>

In the general comments provided on the Participant Survey, Enbridge stated

> please clarify: The scoring methodology indicates how scores for each of the timing, efficiency, and quantity attribution factors will be calculated; however, please clarify how those three attribution factors will be combined to arrive at the overall attribution factor*.*

In response, the EC stated that *"all attribution questions are as identified in the submitted an [sic] approved SOW."*

Again, Enbridge notes that the survey comment matrix and the final NTG Scope of Work were provided to the EAC via the Sharepoint site on the same date, December 15, 2016.

It is Enbridge's opinion that this indicates that its comment was dismissed by the EC. The question was seeking clarity regarding the fundamental methodology that would be employed in the NTG determinations, to ensure the utility (and others) understood and were comfortable with the approach **<u>prior</u>** to finalizing the methodology. No reasonable explanation of the methodology was provided and no review was afforded. Instead the EC simply deferred the utility to a final NTG Scope of Work. As discussed in Board Staff Interrogatory #12, found at

Exhibit I.EGDI.STAFF.12, Enbridge never received full clarity on the NTG scoring methodology through to the conclusion of the 2015 evaluation process.

Incentive Focused Questions

Enbridge shared concerns that the wording on survey questions would focus the customer only on incentive related support, while Enbridge pointed out there are many ways that the utility supports and influences participant decision making. Enbridge suggested, for example, revising wording on a number of questions to more appropriately capture influence beyond incentives, and proposed the following, *"Without Enbridge's involvement through its incentives* ***and/or other assistance****…?"* The EC responded to these comments with *"thank you for your comments"* or *"thank you for your suggestions,"* however, wording in the survey did not change.

It is Enbridge's opinion that these comments were dismissed by the EC without appropriate discussion or rationale.

"Thank you for your comments/suggestions"

Enbridge notes that on the Participant Survey Comment Matrix, 16 of the 31 comments provided by Enbridge only received an EC response of *"thank you for your comments/suggestions,"* with no response, explanation or resulting change in the text of the survey. It is Enbridge's opinion that these questions and comments were dismissed by the EC, as the utility was not afforded an opportunity to reach consensus on the appropriate way forward.

Cancellation of ESC Interviews

The NTG Scope of Work outlined that interviews with utility Energy Advisors would be completed to inform the survey instrument. When the utility followed up to confirm scheduling of these interviews, it learned that sometime between mid-November and mid-December, 2016, OEB Staff / EC had decided that they would no longer be conducting interviews with utility staff (specifically program energy advisors) to inform the NTG study participant questionnaire (survey instrument) and proceeded to finalize the survey instrument. Enbridge expressed concern regarding this departure from the NTG Scope of Work, but this was dismissed.

Delay in Process/Timing Concerns

Enbridge voiced concerns about growing delays in the project and the likelihood of the EC being therefore unable to reach informed participants who would be in a position to knowledgably respond to the surveys. As a comment on the Draft EM&V Plan, Enbridge stated:

> Given we are now in October of 2016 – it appears that the volume of evaluation work that will take place in 2017 appears significant. With concern for resourcing requirements - is there a monthly timeline proposing execution on activities?

As a response, the EC stated *"No."* It is Enbridge's opinion that this concern was dismissed.

Vendor Survey Instrument

Enbridge shared concerns regarding the extent to which business partners and vendors would be surveyed and factored into the assessment of utility influence. Enbridge provided 35 comments on the Vendor Survey Instrument. A Vendor Survey Comment Matrix was not provided by the EC. While it appears that some of the feedback provided by Enbridge was incorporated into the final Vendor Survey, Enbridge was not provided with responses to questions posed in its comments. Of note, Enbridge requested that the EC provide the proposed scoring algorithm for Vendor IDI, and received no response.

Further, Enbridge commented that:

> … vendors should be interviewed wherever the utility indicates that a vendor was involved in a project – not necessarily only where a customer is able to recall/confirm vendor involvement. For example, as per customer NTG IDI – line of questioning to customer regarding involvement of vendors may result in "don't know" response, Enbridge is of the view that where the utility has indicated vendor is direct point of contact, vendor IDI should also occur.

Enbridge believes that vendor input would provide an important indicator of utility influence, however, there was no discussion or attempt to reach consensus on this point.

c) Enbridge does not presume to be the definitive expert in the development of scoring algorithms, it is, however, a recognized member of the Evaluation Advisory Committee ("EAC"), whose role it is to provide input and advice to OEB Staff and the EC. Enbridge has, in addition, contracted Navigant, who are indeed experts in the field. Enbridge included Navigant's report, titled, "Net-to-Gross Policies: Cross-Cutting Jurisdictional Review," and a memorandum titled, "Memorandum: Discussion of Selected NTG Estimation Issues," in evidence at Exhibit B, Tab 6, Schedules 1 and 2, respectively.

On page 3 of their Memorandum: Discussion of Selected NTG Estimation Issues filed in Enbridge's evidence in Exhibit B, Tab 6, Schedule 2, Navigant states the following:

> The scoring algorithm is central to any resulting NTG estimates. As a result, it is important that the algorithms be as transparent as possible and undergo a stakeholder review process to build confidence in the approach. A process that allows for discussion of the scoring algorithms, includes sensitivity analyses to assess robustness, and is as transparent as possible is important for producing NTG values that will have buy-in from stakeholders.[1]

Regardless of Enbridge's experience and expertise in developing scoring algorithms for the purposes of establishing program specific NTG ratios, it is appropriate that Enbridge should have had full opportunity to provide input as part of a transparent process.

d) Enbridge does not believe it is in a position to file comment matrices that were not Enbridge's work product and that contain commentary from other parties on the EAC. Enbridge is willing to provide the comment matrices if directed by the Board, however, in light of the position taken by Board Senior Counsel in June of 2017 that the production of such commentary is a matter for the Board Panel, the Company will await the Board's determination in this regard (please see response provided to SEC Interrogatory #17, found at Exhibit I.EGDI.SEC.17). In the meantime, Enbridge can highlight the key concerns it shared verbally and in writing referred to in the preamble above.

Enbridge does acknowledge that a good portion of the verbal input and written comments provided by it on major deliverables through this evaluation process were accepted or appropriately considered by the EC. Enbridge's main concern with the EC's responses stems from input provided by the Company to the Scopes of Work, Participant and Vendor Surveys, and the NTG Participant IDI Methods Memo (discussion provided in parts a) and b) above). Comments provided by Enbridge that were not appropriately resolved in the early stages of the process led to significant concerns through the evaluation, and impacted results such that Enbridge is now unable to support.

[1] EB-2017-0324, Application and Evidence, Exhibit B, Tab 6, Schedule 2, page 3

Enbridge provides below examples of its comments on the Custom Savings Verification and Free-ridership Evaluation and Annual Verification that were not appropriately addressed.

Statistical Confidence in Results

Enbridge provided many comments through the Custom Savings Verification and Free-ridership Evaluation that identified Enbridge's concerns with the statistical confidence presented in the results. This topic is discussed in full in Enbridge's response to Board Staff Interrogatory #18, found at Exhibit I.EGDI.STAFF.18.

Enbridge's concerns were not appropriately resolved through the responses the EC provided. For example, the EC responded that

> …The 10% accuracy in the SOW referred to the target precision at 90% confidence. The difference between precision and accuracy is bias, which is not measurable. The sample was designed to achieve this level of precision for estimates of X, based the best information at the time. We did/didn't achieve that confidence/precision goal, due to (smaller than attempted sample sizes) (higher than anticipated variability).

Vendor Attribution

Further to Enbridge's discussion on vendor attribution in parts a) and b) above, Enbridge was concerned that vendor attribution was not appropriately assessed, as reflected in the results of the Custom Savings Verification and Free-ridership Evaluation. The report had one finding in particular,

> 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. [2]

Enbridge provided the following comment to this finding,

> Enbridge extensively engages business partners including vendors/contractors/engineers and distributors to promote the program and support customers. We do not agree with this conclusion and question the finding.

[2] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, DNV-GL, December 20, 2017, Page 51

In their comment matrix, the EC responded with *"thank you for your comment."* It is Enbridge's opinion that the issue of vendor attribution, on which Enbridge commented throughout the evaluation process, was not appropriately resolved.

Verbatim Response

Enbridge provided over 100 comments on Tables 71 to 77 in the draft Custom Project Verification and Free-Ridership Evaluation (later renamed Tables 8-17 to 8-23 of the final version of this report). [3] The content of these tables were the verbatim responses of survey participants. A full discussion of these tables is provided in response to Board Staff Interrogatory #12, found at Exhibit I.EGDI.STAFF.12.

To these comments, the EC provided one single response,

> this section has been updated to reflect that none of the verbatim responses were used in the direct scoring for NTG (see appendix J and K for details). These questions were used in the QC process and are reported here out of context to provide an indication of what respondents are saying to the "why do you say that questions."

It is Enbridge's opinion that the EC's response to the request for context and understanding of customer verbatim comments in no way appropriately addressed the Company's concerns and in Enbridge's view, further highlighted the need for a full sensitivity analysis of the scoring algorithm.

Of note, one particular theme that repeated across a number of responses reflected the customer's relative perception of the incentive dollars provided by the gas utility compared to the significantly larger incentive dollars provided by the LDC in projects supported by both utilities. In light of the Board's encouragement of DSM / CDM collaboration and direction on attribution of energy savings, this is an area that clearly requires policy consideration.

LRAM

Throughout the 2015 evaluation process, the EC used their own tools rather than Enbridge's tracking tool or LRAM calculator. A significant challenge for Enbridge in this regard was our ability to reproduce the EC's results. In order to ensure any EC adjustment was calculated correctly and to compile this clearance application, Enbridge was required to duplicate the EC's results using Enbridge's tools. However, the EC did not provide LRAM calculation backup, despite repeated verbal

[3] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, December 20, 2017, pages C-16 to C-27

and written requests by Enbridge, including comments in the Annual Verification report. In response to one request, the EC stated:

> while it is possible to create a separate document with all adjustments, such a document would require increased time and effort. For this reason, summary tables were included. Sufficient detail will be provided to recreate LRAM.

It is Enbridge's opinion that this request was not appropriately resolved. The utility should not have to recreate the auditor's calculations in order to understand the results, particularly results that impact the ratepayer. Ultimately, the process was not simple and Enbridge's analysts spent significant time in this effort. Eventually, the summary tables provided by the EC were sufficient to recalculate the EC's LRAM within $10.

BOARD STAFF INTERROGATORY #12

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 15

Preamble:

Enbridge states: In addition, despite repeated requests by Enbridge Gas for the EC to provide complete details of the data used in its determinations, in many regards, the EC would not provide Enbridge Gas with detailed documentation or clear calculations to allow Enbridge Gas to replicate (and therefore understand and confirm) the EC's findings.

Questions:

a) Please specify the findings/results of the EC Enbridge Gas was attempting to replicate. Indicate if they related to energy impacts, cost effectiveness, etc.
b) Please detail all data requests made by Enbridge Gas to the EC throughout the evaluation process. Please specify which of these requests were fulfilled and which, in the opinion of Enbridge Gas, were not satisfactorily addressed.
c) The EC was not able to provide requested data to Enbridge Gas given its confidential nature. Specifically, the data could not be provided in a manner that would protect the anonymity of survey respondents. On page 8 of Navigant's report found at Exhibit B, Tab 6, Schedule 1, as it relates to NTG data, experts note that "contractors will not release information if used to identify specific customers." Why does Enbridge Gas believe the EC should have overlooked its commitment to respondents to protect their confidential data which is contrary to best-practice?

RESPONSE

a) Enbridge requested that the EC provide details of the data in order to not only reconcile the EC's NTG determinations, but also to understand and confirm the particular scoring sequences for respondents, including how customer responses were quantified.

b) Enbridge requested the data required to replicate the NTG calculations multiple times, primarily via verbal requests in EAC meetings (as minutes are not maintained of the EAC meetings, Enbridge cannot provide recorded details of these requests). However, Enbridge's focus of concern during these EAC discussions was on seeking clarity and understanding from the EC. In Enbridge's estimation, this

Witnesses: D. Bullock
D. Johnson

required the provision of detailed explanations regarding how project NTG values were scored through the decision trees outlined in the scoring algorithm. Not until the CPSV / NTG report was finalized on August 16, 2017, did Enbridge receive any further clarity. In the final report, Appendix K, Table 8-86, [1] the EC provided selected examples of survey responses. Enbridge does not believe this provided the clarity needed.

Enbridge also provided written comments in the scoping documents for the draft participant survey as well as the draft CPSV / NTG report earlier in the process in an effort to understand the EC's approach.

It is Enbridge's opinion that these verbal and written requests were not satisfactorily addressed. The EC indicated in their comment matrix delivered with the final CPSV/NTG report "For the CPSV portion of the study the analysis dataset will be provided. For NTG, we cannot provide this information without compromising respondent confidentiality." Enbridge, however, addresses this concern further below.

c) Enbridge Gas does not believe the EC should have overlooked its commitment to NTG survey respondents to protect their confidentiality. The anonymity of survey respondents is important to Enbridge, and Enbridge does not seek to compromise that aspect of the NTG study. However, it is Enbridge's opinion that the EC could have provided Enbridge with the data requested in a way that protected survey respondent's anonymity.

   Enbridge is concerned with the scoring methodology used to evaluate the results of the NTG survey. To illustrate Enbridge's concern, there were tables provided in an appendix of the 2015 Custom Savings Verification and Free-ridership Evaluation that summarized verbatim responses from the NTG survey. [2] The first column of the table indicated whether the many questions of the survey had ultimately yielded a yes or no for the attribution result for timing, efficiency, quantity, or overall attribution. The second column of the table contained verbatim responses to a follow-up question, such as "why do you say that?" or asking the customer to summarize. In an EAC meeting, the EC explained that these questions were asked to ensure the results of the survey were in line with the overall feelings of the respondent. Further, if the EC felt these verbatim answers were out of line with the first column, they indicated they would undertake a quality control procedure to see if it was necessary to change the response.

[1] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, December 20, 2017, page K-1
[2] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, December 20, 2017, pages C-16 to C-27

Enbridge's concern with the scoring methodology is illustrated in these tables as there appear to be multiple examples where the verbatim response indicates that the utility clearly influenced the participant, and yet, this does not appear to be in line with the corresponding attribution, which is identified as "no". Enbridge provided over 100 comments on Tables 71 to 77 in the draft Custom Project Verification and Free-Ridership Evaluation (later renamed Tables 8-17 to 8-23 of the final version of this report).[3] To these comments, the EC provided one comment, "this section has been updated to reflect that none of the verbatim responses were used in the direct scoring for NTG (see appendix J and K for details). These questions were used in the QC process and are reported here out of context to provide an indication of what respondents are saying to the "why do you say that questions."" It is Enbridge's opinion that the EC's response to Enbridge's comments did not appropriately address the Company's concern.

The verbatim responses appear to indicate there was inconsistency in the scoring methodology and further investigation as to the effectiveness of the scoring algorithm, including a sensitivity analysis, is justified. Small changes in the methodology can have a significant impact to the results. To further support this point, on page 3 of their Memorandum: Discussion of Selected NTG Estimation Issues, Navigant states the following:

> The scoring algorithm is central to any resulting NTG estimates. As a result, it is important that the algorithms be as transparent as possible and undergo a stakeholder review process to build confidence in the approach. A process that allows for discussion of the scoring algorithms, includes sensitivity analyses to assess robustness, and is as transparent as possible is important for producing NTG values that will have buy-in from stakeholders.[4]

It is Enbridge's opinion that the anonymized NTG survey data should have been provided to Enbridge in a manner that protected the identity of the respondent but also clearly illustrated the link between the answers provided by the respondent and the final attribution score they received.

Alternatively, there are other ways that the methodology could have been independently verified without Enbridge viewing the data first hand. For example, cross-tabulations or frequencies of responses can be used, privileged information can be redacted, and sensitivity analysis undertaken. (Please refer to the response

[3] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, December 20, 2017, pages C-16 to C-27
[4] EB-2017-0324, Application and Evidence, Exhibit B, Tab 6, Schedule 2, Page 3

to BOMA Interrogatory #4, found at Exhibit I.EGDI.BOMA which highlighted the subjective cut offs used in assessing timing attribution, notably the biggest driver to free ridership according to the EC's report and should have been subjected to sensitivity analysis). In addition, Board Staff or an independent third party could have completed a detailed review of the methodology and the results. Mr. Violette further elaborates on this point in his response to SEC Interrogatory #70, found at Exhibit I.EGDI.SEC.70.

Finally, recognizing the EC's requirement to protect client confidentiality, given the significant errors identified by Enbridge in the EC's CPSV calculations, Enbridge is of the view there should have been additional levels of detail provided by the EC detailing their NTG estimations in order to give the utility, the EAC, and the Board any confidence in the EC's determinations.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #13

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 17

Preamble:

Enbridge states: Other examples that contributed to a less than transparent and credible process included:

- Refusal to record meeting minutes to capture key decisions (despite suggestions from the utilities to do so);
- Failing to track and follow-up on meeting action items;
- Questions and decision points that went unanswered creating uncertainty; and,
- A refusal to provide clarity and transparency regarding budgets and spending for the EM&V related activities.

Questions:

a) In order to capture both key decisions as well as action items, as of August 15, 2017, OEB Staff develop and distribute a list of these important meeting takeaways following each weekly EAC meeting. Please describe why Enbridge Gas believes recording key decision and action items is insufficient.
b) Please confirm that Enbridge Gas had an Audit Committee that undertook the annual evaluation of DSM results in 2012 to 2014, which included utility representatives and intervenor members.
c) Please confirm whether its Audit Committee kept minutes and action items that were circulated to the Audit Committee for approval after each meeting, and filed them online.
    i. If so, please provide a sample of those minutes and action items.
    ii. Please provide samples of other documentation, such as comment matrices, that the Audit Committee developed to ensure all committee members' comments were addressed.

Witnesses: D. Bullock
D. Johnson

RESPONSE

a) The practice of documenting and distributing Action Items was not in place until August 15, 2017, towards the end of the evaluation and verification of the 2015 program year, after significant pressure from the utilities who called for the implementation of documenting meeting minutes and developing an EAC charter. Enbridge believes the introduction of the Action Item Summary is a positive step however the Company still maintains that the practice of minuting meetings should be adopted. It is Enbridge's opinion that maintaining complete and accurate minutes is an important component of a properly functioning committee, and only recording key decisions and actions items does not fully record the depth of issues and viewpoints discussed in these meetings.

b) Confirmed. Enbridge had an Audit Committee in conjunction with each of the 2012, 2013 and 2014 program years whose responsibility it was to oversee the management of the respective annual audits. In addition to utility representation, the Audit Committee included three intervenor representatives elected by the DSM consultative.

c) Enbridge confirms that the auditor was tasked with recording meeting minutes, capturing items of agreement and circulating minutes to the Audit Committee following each meeting / call.

   i. Attached is an example of meeting minutes distributed by the auditor to the Audit Committee during the 2014 annual DSM audit process.

   ii. Audit Committee members provided comments on documents, including draft verification reports throughout the process. Comments were reviewed and discussed during conference calls / meetings with the Audit Committee, the auditor and the CPSV verifiers were required, and comments were addressed accordingly.

Witnesses: D. Bullock
D. Johnson

Enbridge Audit Committee
Weekly Conference Call
Minutes

Conference Call Date/Time: December 17, 2014, 8:30 am to 10:00 am

In Attendance: Audit Committee Members:

Ravi Sigurdson and Deborah Bullock, Enbridge
Chris Neme, Green Energy Coalition
Judy Simon, Low Income Energy Network
Mark Rubenstein, School Energy Coalition
Note - Mark Rubenstein left the call at 9am

David Bardaglio and Cliff McDonald, Optimal Energy Inc.

Note – these minutes are intended to only capture action items or decisions. They do not capture the actual discussions that took place.

1. **Approval of 12/8/14 AC Minutes**: The AC agreed with Enbridge's comments on the 12/8/14 AC Meeting Minutes. Optimal will revise the minutes based on Enbridge's comments. The AC approves the minutes pending this revision.

2. **Role of Audit Committee**: It was agreed that the AC would attend CPSV conference calls once the call move beyond administrative and logistical items and into substantive project-by-project discussions. It was agreed that these discussion commence once the draft CPSV reports have been issued. Enbridge will invite the AC to the weekly conference calls that take place after the draft reports are issued.

   Optimal will organize AC written comments on the draft CPSV reports such that the CPSV TEs will receive one complied list of comments.

3. **RIR Audit Recommendations:** The TEC sponsored net-to-gross study will not provide results in time for the Year 2014 audit. For Year 2014 Enbridge was asked to put forth their recommendation and justification for a Free Rider rate for the Year 2014 RIR program. Enbridge was asked to include any new studies or research that have been undertaken recently that would alter their recommended year 2013 RIR free rider rate.

   Enbridge stated that they will be surveying all the Year 2014 RIR projects and adjusting claimed savings based on the survey results. Enbridge was asked to provide the AC and Optimal with a written RIR evaluation plan that includes details on the survey instrument and savings adjustment mechanism prior to undertaking the survey. This will allow Optimal to review and approve the plan upfront. After approval of the plan the audit will verify the proper execution of the plan.

4. **CPSV Update**: The AC endorsed Optimal's recommendation concerning the use the ETools by the Commercial CPSV TE to re-calculate seasonal efficiencies for boiler replacement projects.[1] This recommendation only applies to project where post installation consumption is not available. For project where this data is available the TE will perform an independent billing regression analysis.

   The AC asked Enbridge to ask Union Gas how their CPSV TE handles seasonal efficiency calculations. This request is for informational purposes only and will not impact AC's endorsement of Optimal's recommendation.

5. **Review Draft Work Plan**: It was agreed that Enbridge and the AC would provide Optimal with written comments on its Draft Work Plan by 1/5/15. Optimal would prepare a second draft of the work plan based on these comments for review at the 1/7/15 AC meeting.

These minutes have been prepared by David Bardaglio, Optimal Energy Inc. on 12/17/14 and revised on 1/7/15.

The next AC meeting is on January 7, 2015 from 8:30 am to 10 am.

[1] Optimal submitted a memo to the AC on 12/15/14 with its recommendation.

BOARD STAFF INTERROGATORY #14

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, Page 17 of 48

Preamble:

Enbridge states: A concern for Enbridge Gas involved the practice of OEB Staff receiving and reviewing reports and deliverables from the EC prior to the EAC. During the verification process, it became clear that OEB Staff were providing comments and feedback to the EC that were not visible to the EAC, including undisclosed comments on specific evaluation reports. The utilities requested transparency in this regard; however comments were not shared with the group. Though the EC's incorporation of, or impact of these comments are not known, this lack of transparency caused concerns regarding the ability of the EC to maintain the position of an independent expert and brought the objectivity of Board Staff's role as overseer into question.

Questions:

a) Please confirm that the work deliverables referred to by Enbridge Gas were not presented to EAC members as final deliverables, and that all EAC members had an opportunity to provide input on these work deliverables before final versions were approved.
b) Please confirm that, in response to concerns raised by the EAC, OEB staff changed their process so that they no longer review documentation from the EC in advance of other EAC members.
c) Please confirm that OEB staff documented this change in the draft EAC Terms of Reference.

RESPONSE

a) Confirmed. After Board Staff had the opportunity to comment on the EC's deliverables, the EC provided the deliverables to the rest of the EAC as draft versions to provide comments. The drafts distributed to the EAC did not contain the comments provided by Board Staff. There was an exception however in regard to a CPSV site report provided by the EC on April 20, 2017 which inadvertently included comments and track changes provided by Board Staff. Please refer to the response to SEC Interrogatory #17, found at Exhibit I.EGDI.SEC.17 for details.

Witnesses: D. Bullock
D. Johnson

b) Not confirmed. Board Senior Counsel communicated via emails on June 21 and 22, 2017 that OEB Staff did not intend to make its initial comments available to the committee and that OEB Staff saw nothing improper in this approach. Enbridge is not able to confirm over the course of the 2015 evaluation whether OEB Staff changed their process so that they no longer reviewed documentation from the EC in advance of other EAC members.

c) Confirmed. The draft EAC Terms of Reference, introduced to the EAC in December 2017 during the planning stages for the 2016 evaluation process and revised on March 7, 2018, includes the following: “Any materials that are circulated by the EC for comment will be delivered to OEB staff and EAC members at the same time.”

BOARD STAFF INTERROGATORY #15

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, pp. 17-18

Preamble:

Enbridge states: Despite the utilities having responsibility and accountability for an overall annual evaluation budget for their respective DSM portfolios, OEB Staff has refused to provide details on EM&V budgets for planned verifications or details regarding forecasted spending in a given year. At a minimum, the utilities require budget information to facilitate contract payment, to assist with budgeting for other aspect of program planning and utility led evaluation (e.g. process evaluation) as well as to support financial reporting requirements. Currently Enbridge has no ability to monitor spending or accrue funds, this has proved unnecessarily challenging.

Questions:

a) Please confirm that OEB staff provided Enbridge Gas, when requested, with accrual amounts to assist them with managing their evaluation budgets.
    i. Please confirm that accruals were provided at least twice annually, in March and December of each year.
b) Please indicate what “facilitate contract payment” refers to in the text above.
c) Please indicate what other aspects of program planning refers Enbridge Gas requires the DSM Evaluation budget for.
d) Please indicate what utility-led process evaluations Enbridge Gas has funded since January 1, 2015.
    i. Please indicate the cost of each evaluation.

RESPONSE

a) Enbridge confirms that it asked OEB Staff for specific details outlining outstanding amounts owing relating to the evaluation process in order to satisfy year end accrual requirements in each of 2016 and 2017. These requests were made in November/December in each year. Emails sent by Enbridge to OEB Staff requesting accrual details were provided in the response to SEC Interrogatory #20, found at Exhibit I.EGDI.SEC.20. Enbridge confirms that OEB Staff provided high level estimates of accruals in December of 2016 and 2017 respectively in response to

Witnesses: D. Bullock
D. Johnson

these requests.

i. Enbridge confirms responses from OEB Staff to requests from the utility for accrual information was provided in December 2016 and 2017. Enbridge has no record of communications in March. Enbridge has not however received responses from OEB Staff regarding requests for budgets/forecasts of evaluation spending.

b) Enbridge is referring to the need to have an understanding of forecasted evaluation work for which the utilities will have an obligation to facilitate payment, including forecasted schedules and related costs detailing the anticipated completion of milestones / deliverables relative to the costs proposed by OEB contracted evaluators.

c) In addition to full process evaluations of identified programs which have been assigned to the utilities, outside of the evaluation process now under the governance of the EAC, the Company considers other evaluation and research work which helps to inform program planning and program improvements, assess program delivery, and customer satisfaction; and, analyze savings calculation approaches. In addition, broader policy and market assessment related studies might be considered in prioritizing evaluation efforts.

d) Enbridge completed process evaluations for both its Residential Home Energy Conservation and Low Income Part 9 Winterproofing programs in 2016. The cost of these evaluation efforts was $93,555

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #16

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 22

Preamble:

Enbridge states: A further example of concern where the intended scope of work was not followed in the EC's execution of the NTG study is in regards to the determination and consideration of secondary attribution.

Questions:

a) Within Navigant's report provided at Exhibit B, Tab 6, Schedule 1, which Enbridge provides as expert evidence, Navigant documents how leading jurisdictions define NTG. Given only Massachusetts and not Illinois and California include secondary attribution in their calculation of NTG, why does Enbridge believe this factor should be included in its NTG estimate?
b) How was the EC's decision not to consider secondary attribution inconsistent with best practice?

RESPONSE

a) & b)

First and foremost, the NTG Study Scope of Work called for the inclusion of Secondary Attribution. "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." [1] In addition see DNV's parking lot memo which addressed how DNV would approach capturing the two types of attribution (see attachment 1 provided with the response to Board Staff Interrogatory # 5, found at Exhibit I.EGDI.STAFF.5). The exclusion of Secondary Attribution in the determination of NTG is inappropriate and inconsistent with the NTG Study scope of work as outlined above. Enbridge asserts that secondary attribution must be included in the NTG values in accordance with the original resolution with the TEC and DNV, and as outlined in both DNV's original and updated scopes of work.

[1] EB-2017-0324, Application and Evidence, Exhibit B, Tab 5, Schedule 2, page 44 of 130

Witnesses: D. Bullock
D. Johnson

Beyond the clear justification outlined above, as outlined in the Navigant report, Massachusetts incorporates influence in its NTG estimation from previous program influence and the EC's decision not to consider secondary attribution in the NTG score is inconsistent with this practice. Massachusetts is a jurisdiction with programs that have been offered over a similar time frame to those in Ontario. In fact, the EC selected Massachusetts as an appropriate jurisdiction from which to obtain a proxy spillover ratio, which was then applied to the Ontario 2015 program results. Further, as Massachusetts was given ACEEE's highest rating for its energy efficiency policies, it seems appropriate to consider Massachusetts' policies to be among best practice and applicable to the circumstances in Ontario.

In addition, ACEEE's report "Recent Developments in Energy Efficiency Evaluation, Measurement, and Verification," October, 2017, states that "California and Massachusetts emerged as the overall EM&V leaders in the opinions of our experts." Given the leading nature of these states, a policy taken by one of the top two ACEEE rated states for evaluation actions is worthy of consideration.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #17

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 14

Preamble:

Enbridge states: Currently, California bases its shareholder incentives 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.

Questions:

Please explain why in California evaluated NTG results for custom programs are considered to be “uncertain” and therefore inappropriate to apply on a prospective basis.

RESPONSE

For clarity, the preamble included above is not correctly identified in the evidence. This passage is from the *Net-to-Gross Policies: Cross-Cutting Jurisdictional Review by Navigant Consulting, Inc., and Apex Analytics, December 14, 2017* and included in evidence at Exhibit B, Tab 6, Schedule 1, page 14 of 40. Accordingly, the following response is from the authors of that report.

As noted on Exhibit B, Tab 6, Schedule 1, page 17 of 40, “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.” Additional information on the California Public Utilities Commission (“CPUC”) decision can be reviewed in CPUC Decision 13-09-023 September 5, 2013; DECISION ADOPTING EFFICIENCY SAVINGS AND PERFORMANCE INCENTIVE MECHANISM, p. 50.

> For custom projects and for specific "deemed" measures with ex-ante parameters that we identify as highly uncertain, we shall require ex-post evaluations as the basis for calculating savings incentive payments. The savings award for the remaining "deemed" measures will be calculated based on the

Witnesses: S. Dimetrosky
L. Gage
D. Violette

> locked down ex-ante parameter values, and only the claimed measure count will be subject to ex-post adjustment for these measures.

Review of this decision indicates that California was trying to weigh the benefits and drawbacks of ex-ante vs ex-post application of results and combined this decision with other changes such as multiple factors used to calculate the incentive mechanism and a defined stakeholder process throughout the evaluation process. Ultimately, the designation of a measure as “highly uncertain” was a judgmental process but informed by recent evaluation efforts.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

BOARD STAFF INTERROGATORY #18

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 41

Preamble:

Enbridge states: A further concern shared by Enbridge regarding the EC's NTG findings related to the requirement, as outlined for the NTG study, that the sampling methodology should be designed to achieve a 90/10 precision target ("90/10" precision is a statistical standard for which there is 90% confidence that sample results are within +/- 10% relative precision). However the relative precision of some of the ratios did not come close to meeting this expectation.

Questions:

a) Which NTG ratios did not reach the targeted 90/10 precision target?
b) What level of absolute precision did these NTG ratios achieve?
c) For what reasons was the EC not able to achieve the targeted 90/10 precision for these NTG ratios?
d) In their report, did the EC suggest that the application of the NTG ratios which achieved less that the targeted absolute precision should not be applied and/or would result in an inaccurate/unreliable estimate of program impacts?

RESPONSE

a) The EC's Scope of Work, dated December 14, 2016, states that the objective of the sample design is to "Achieve 90/10 precision[18] at the desired stratification segment levels." It further describes the Enbridge free ridership program segments to be Custom Commercial, Custom Industrial, and Run it Right. Footnote 18 in the above quote states "90/10 precision refers to 10% **relative** [*emphasis added]* precision with 90% confidence." [1]

   Table 8-48 from the Custom Savings Verification and Free-ridership Evaluation, shown below, identifies that the relative precision for Custom Industrial was 15%

[1] EB-2017-0324, Exhibit B, Tab 5, Schedule 2, page 19

Witnesses: D. Bullock
D. Johnson

(representing 42% of program savings) and the relative precision for Custom commercial was 26% (representing 58% of program savings). Neither of these segments achieved the 90/10 precision target.

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 6-2 from the Custom Savings Verification and Free-ridership Evaluation, shown below, identifies that the relative precision for Run it Right was 27%. The Run it Right program segment did not achieve the 90/10 precision target.

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.

Further, Table 5-4 from the Custom Savings Verification and Free-ridership Evaluation, below, shows the domains at which the net to gross ratios were applied to the Enbridge projects in order to determine the net savings. This table shows that in all domains with the exception of Custom Multi-Residential Other, the relative precisions ranged from 16% to 76%, and as a result, the 90/10 precision target was not achieved.

Witnesses: D. Bullock
D. Johnson

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.

b) Since the stated objective for the Study was to achieve 90/10 precision and was defined, as referenced in part a) to mean 10% **relative** [*emphasis added]* precision with 90% confidence, this question is moot. For additional clarity, the EC's Scope of Work dated December 14, 2016 defines Relative Precision as "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)."[2] The absolute precision is identified in the "+/-" column.

c) The Custom Savings Verification and Free-Ridership Evaluation stated the following:

> 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

[2] EB-2017-0324, Exhibit B, Tab 5, Schedule 2, page 111

Witnesses: D. Bullock
D. Johnson

> precision target had the NTG ratio been at or above the assumed ratio.[3]

In addition, in response to an Enbridge comment on the Custom Savings Verification and Free-Ridership Evaluation, the EC stated the following:

> The 10% accuracy in the SOW referred to the target precision at 90% confidence. The difference between precision and accuracy is bias, which is not measurable. The sample was designed to achieve this level of precision for estimates of X, based the best information at the time. We did/didn't achieve that confidence / precision goal, due to (smaller than attempted sample sizes) (higher than anticipated variability).

The above excerpts show that EC has confirmed that as the results of the study, i.e., the NTG ratios, decrease they also become less precise. Further, the EC has confirmed that they were not able to reach their 90/10 goal due to smaller than attempted sample sizes and higher than anticipated variability. In comments provided to the Custom Savings Verification and Free-ridership Evaluation, Enbridge expressed similar concerns that the smaller sample size post stratification and high variability among samples resulted in lower confidence in the results.

It is Enbridge's opinion that as a result of study design and execution, the results of the NTG study are not robust. Enbridge does not have the expected level of confidence in the results in line with the stated 90/10 objective, and in Enbridge's opinion, the Board should not have confidence in the results either.

d) Board Staff asks "In their report, did the EC suggest that the application of the NTG ratios which achieved less that the targeted <u>absolute</u> precision…?" Enbridge wishes to clarify that the EC's Scope of Work outlined the objective of achieving a targeted 90/10 precision using <u>relative</u> precision, not absolute precision, as discussed in part a) above.

Enbridge is not aware that the EC suggested that the NTG ratios achieving less than the targeted precision should not be applied and/or would result in an inaccurate / unreliable estimate of program impacts. However, given the objective of the study in this regard, specifically, achieve 90/10 (<u>relative</u>) precision, this would have been appropriate.

[3] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, DNV-GL, December 20, 2017, Appendix P, page 31.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #19

INTERROGATORY

Reference: Exhibit B, Tab 6, Schedule 1, p. 5

Preamble:

Enbridge states: **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.

Questions:

a) Page 5 of Navigant's report states that a key theme observed across leading jurisdictions was a "Collaborative Overall Stakeholder Process" that lead to "agreed-upon approaches for estimating NTG as well as processes for finalizing NTG estimates". Please describe who the stakeholders to this process are and if and how the collaborative process used in these jurisdictions compares to the collaborative process employed in Ontario via the EAC.
b) Please identify the point in time when these stakeholder processes occur. I.e., please specify whether these stakeholder processes occur pre-program delivery as part of the program design process or post-program delivery as part of an after-the-fact evaluation process.
c) Please identify the typical amount of time these jurisdictions take to complete their annual DSM portfolio evaluation process.

RESPONSE

For clarity, the passage included in the preamble above is from the *Net-to-Gross Policies: Cross-Cutting Jurisdictional Review by Navigant Consulting, Inc., and Apex Analytics, December 14, 2017.* Accordingly, the following response is from the authors of that report.

a) Information on the composition of the Stakeholder groups involved in each state are shown below and are discussed in case studies found in the Jurisdictional Review

Witnesses: S. Dimetrosky
L. Gage
D. Violette

report (Exhibit B, Tab 6, Schedule 1, page10). Some additional information is presented below:

- **Massachusetts**. The stakeholder process leverages the Massachusetts Energy Efficiency Advisory Council ("EEAC"). The EEAC process for NTG determinations that typically includes EEAC representatives, evaluation consultants and program administrators ("Pas"), which are typically the gas and electric utilities (Exhibit B, Tab 6, Schedule 1, page 10). For other EM&V decisions, other stakeholders may be involved, such as Massachusetts Department of Energy Resources ("DOER") staff and customer groups (including advocates for low-income customers). Low-income customer groups are typically not involved in the NTG processes because Massachusetts set the NTG for low-income to be 1.0.

  The EEAC maintains a website that documents participants, meetings, meeting notes, standing committees, and reports. The information on this multiple stakeholder group and its processes can be found at: http://ma-eeac.org/ .

  From the EEAC website:

  The Massachusetts Energy Efficiency Advisory Council (EEAC) was created by the Green Communities Act of 2008, a comprehensive energy reform law. EEAC members guide the development of state- and nation-leading energy efficiency plans by the Commonwealth's investor-owned gas and electric utilities and energy providers. The Council's priorities are to develop, implement, evaluate, and monitor the implementation of these plans.

  The Council is also charged with developing a long-term vision for the Commonwealth's energy future. In recommending and overseeing specific studies and research, the Council works to achieve energy efficiency savings and to maximize the economic and environmental benefits of energy efficiency.

  Council members have several responsibilities: participate regularly in Council meetings; contribute their knowledge and expertise to the best of their abilities; participate in Council processes and discussions, including any committee processes set up by the Council; and vote, according to their best judgment, in such a way as to enable the Commonwealth to achieve the efficiency mandates of the Green Communities Act. The full Council typically conducts meetings once per month in the Greater Boston area. The Executive Committee of the EEAC holds separate meetings, also monthly in the Greater Boston area. Meeting minutes and presentations are made available to the public.

- **Illinois**. The Illinois Stakeholder Advisory Group (SAG) oversees public meetings that include multiple types of stakeholders. The participants, subcommittees, reports, and meeting minutes, along with a considerable amount of information, can be found at the SAG website: http://www.ilsag.info/meeting-participants.htm

  Background on the Illinois SAG (from website):

  > *The Stakeholder group's responsibilities include, but are not limited to: reviewing final program designs; establishing agreed-upon performance metrics for measuring portfolio and program performance; reviewing Plan progress against metrics and against statutory goals; reviewing program additions or discontinuations; reviewing new proposed programs for the next program cycle; and reviewing program budget shifts between programs where the change is more than 20% (ComEd Final Order, 07-0540 at 32; Ameren Final Order, 07-0539 at 24).*
  >
  > *In the Final Order of the second three-year electric energy efficiency plans and first three-year gas plans, the assigned additional duties to the IL EE SAG included the development of a Technical Reference Manual for approval by the ICC (e.g., ComEd Final Order, 10-0570 at 59; Policy Division Staff Report, 12-0528).*
  >
  > *In January 2014, the ICC issued final orders in the third three-year electric plans, and further expanded SAG duties to include, among other issues, reviewing new program designs, further discussing issues that remained unresolved in litigation, and the creation of an Illinois Energy Efficiency Policy Manual (e.g., Ameren IL Final Order, 13-0498; ComEd Final Order, 13-0495; DCEO Final Order, 13-0499). Final Orders in the second three-year gas plans were issued in May 2014 and include similar expansion of SAG issues (e.g., Nicor Gas Final Order, 13-0549; Peoples Gas-North Shore Gas Final Order, 13-0550).*

- **California**. The CPUC leads the research but has a process to collect public input at key points in the evaluation process (Exhibit B, Tab 6, Schedule 1, page 18). Table 3 of the Jurisdictional Review report (Exhibit B, Tab 6, Schedule 1) summarizes the stakeholder process (see below):

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

More detail is provided by the CPUC in Section 5.4 of *2013-2016 Energy Division & Program Administrator Energy Efficiency Evaluation, Measurement and Verification Plan Version 7,* which outlines key aspects of the collaborative process between the Energy Division and utilities, including:

- Requires Energy Division (“ED”) and the California Investor Owned Utility (“IOU”) staff to conduct EM&V projects in a transparent manner, including open, truthful, and timely communication; regular meetings to provide updates on projects; inclusion of ED and IOUs in all stages of all projects; sharing of data as it becomes available; and tracking of all projects in an easily accessible tracking system.
- Requires ED and the IOUs to attempt to resolve disagreements informally and collaborate where possible before seeking formal dispute resolution.
- Requires ED and the IOUs to design EM&V projects to be streamlined, to comply with Commission mandated schedules, and to avoid duplication of effort.
- Requires ED and the IOUs to follow professional standards for ethics and technical best practices.
- Grants ED and the IOUs flexibility to plan and implement EM&V in phases, while continuously optimizing the EM&V portfolio and emphasizing the flow of EM&V results to program managers for program improvements.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

- o Requires avoiding unnecessarily duplicative data collection and analysis and identifying ways in which EM&V can be organized and implemented to meet multiple needs in a cost-effective manner.
- o Affirmation of ED's authority to review, approve and oversee IOU EM&V activities.
- o Clarification that ED may conduct some formative evaluations within their portfolio of EM&V projects.
- o A requirement that the IOUs collaborate with ED in the development of non-DEER (**D**atabase for ***E**nergy **E**fficiency* **R**esources) savings work papers.
- o A stakeholder input process that supersedes the process adopted in D.05-01-055.
- o Delegation to ED to determine which projects should be subject to the stakeholder input process.
- o A dispute resolution process that involves mediation by the ALJ Division.
- o A requirement that all EM&V-related projects, regardless of funding source, adhere to the same policies and procedures as EM&V funded projects.
- o Allows ED to use program implementers as a vehicle for collecting EM&V data.

b) The points in time when these stakeholder processes occur have common elements across the three states. In all three states, there are reviews primarily at two points in time: development of the evaluation methods and also when finalizing the NTG results, as described below.

- **Massachusetts**: as described in the report (Exhibit B, Tab 6, Schedule 1, page 11), Massachusetts has developed a common practice set of NTG approaches for C&I programs that have undergone EEAC review. On Exhibit B, Tab 6, Schedule 1, page 10, the report describes the EEAC process to review evaluation results and develops a consensus decision for prospective NTG values.
- **Illinois**: as described on Exhibit B, Tab 6, Schedule 1, page 24, the SAG has an annual process to update the NTG values for application in the TRM and NTG methods defined in the TRM.
- **California**: as described in Exhibit B, Tab 6, Schedule 1, page 19, California has a working group that developed a consistent set of questions used for determining NTG. Additionally, the CPUC has a four-step process (Exhibit B, Tab 6, Schedule 1, page 18, Table 3) for gaining stakeholder input, as follows:

Witnesses: S. Dimetrosky
L. Gage
D. Violette

I. Specify what will be evaluated
II. Publicly vet evaluation plans
III. Publicly vet results for comment
IV. Respond to recommendations

c) As noted above, Illinois has an annual process to review evaluation results and determine prospective results. Massachusetts operates on a three-year program cycle and, for the most recent two cycles, has determined prospective NTG values approximate 6 to 8 months prior to the start of the next program cycle. More detailed timelines for each of the three case study jurisdictions have not been developed with respect to the time allotted for planning a specific evaluation, the length of time an evaluation is in the field, and the time taken to finalize results with stakeholder participation. These evaluation timelines vary by jurisdiction, by program year, and by the type of evaluation effort, i.e., reviewing ongoing evaluations versus constructing a common evaluation framework for future. Also, not all programs are evaluated at the same level of rigour each year.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

BOARD STAFF INTERROGATORY #20

INTERROGATORY

Reference: Exhibit B, Tab 6, Schedule 1

Question:

a) Please specify where in Navigant's report that Navigant states the NTG study completed by DNV did not leverage a best-practice approach and should therefore not be considered as a reasonable proxy for the influence of Enbridge's programs.

RESPONSE

As outlined in the Introduction on page 1 of the Navigant report referenced above (Exhibit B, Tab 6, Schedule 1):

> 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.

The Navigant report explores policies and approaches regarding NTG determinations as identified through research and by experts and summarizes its finding highlighting overarching themes and cross-cutting findings. As part of this research, the report does include commentary regarding approaches taken to mitigate concerns with self-report survey methods.

The scope of work for the Navigant study referenced above did <u>not</u> however call for it to comment on the NTG study completed by DNV. Accordingly, the Navigant report included at Exhibit B, Tab 6, Schedule 1 does not contain such a statement on the NTG study completed by DNV.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #21

INTERROGATORY

Reference: Exhibit B, Tab 6, Schedule 1, p. 5

Preamble:

Navigant's report states***: 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. *Emphasis added*

Questions:

a) Please confirm that the EC completed a self-report survey in order to establish a NTG value for Enbridge's commercial and industrial custom programs.
b) Please confirm that, consistent with Navigant's report, experts agree that a self-report methodology is the industry-accepted approach to developing NTG ratios for custom programs.
c) Please confirm whether or not, based on Enbridge's DSM program design and delivery methods, an RCT or other econometric approach is possible for any of Enbridge's DSM programs.

RESPONSE

a) Confirmed.

b) Although experts surveyed in the Navigant study discussed concerns and limitations with the self-report method, including difficulty estimating attribution, difficulty reporting the hypothetical alternative, and recall bias, these methods are still considered to be the most commonly used method for conducting custom program NTG studies. However, three case studies in the Navigant report each illustrated

Witnesses: D. Bullock
D. Johnson

that they have “developed structures that reduce the influence of after-the-fact (i.e., retrospective) application of NTG estimates.”[1]

Two of the three states do not apply NTG estimates retrospectively. The other applies NTG retrospectively, but it is only one of four factors used to determine incentive. This limitation has reduced the impact of ex-post net savings estimates that are applied retroactively.

For the purposes of the application of the EC’s NTG results, Enbridge reiterates its position that the retroactive application of the result in not appropriate nor is it in line with the Board’s Decision.

Further, it is Enbridge’s opinion that in order for the NTG results to be applied to any program year, the targets for that year must be adjusted accordingly.

c) For the programs examined in the EC’s NTG evaluation dated October 12, 2017, it is unlikely that an RCT approach is a viable option. It may be possible to use a panel data econometric model for custom commercial and industrial programs, but a more thorough review would be required to assess these alternatives.

[1] EB-2017-0324, Exhibit B, Tab 6, Schedule 1, page 4 of 40

BOARD STAFF INTERROGATORY #22

INTERROGATORY

Reference: Exhibit B, Tab 6, Schedule 1, p. 5

Preamble:

Navigant identifies that the following steps can be taken in order to mitigate the issues surrounding self-report studies:

- Fast Feedback
- Sensitivity Analysis
- Triangulation
- Other Best Practice

Navigant's report states***: 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.

Questions:

a) Please confirm that Enbridge communicated to the EAC that the participant data required to facilitate the self-report method cannot be made available by the utilities earlier than mid-March of the subsequent year. E.g., 2017 participant data cannot be provided until, at the earliest, mid-March 2018 which equates to a 15-month delay for projects undertaken in January 2017.
b) Please confirm that, due to these delays, it is not possible to complete the self-report method within the 3-month period following participation as recommended by Navigant.
c) *Specifically for custom project NTG ratios*; please indicate the extent to which the three jurisdictions discussed in Navigant's report (California, Illinois and Massachusetts) utilize all of the four steps identified above in order to mitigate the issues of self-report studies.

Witnesses: D. Bullock
D. Johnson

RESPONSE

a) & b)
Not confirmed. As in prior years, Enbridge has provided participant tracking data for its DSM program within the current program year to facilitate a sampling exercise to undertake verification. Doing so would require a plan that includes sample design utilizing a staged approach (similar to the Wave 1 and Wave 2 CPSV verifications undertaken in the previous framework). This would facilitate a survey delivery in line with the 3 month period following participation as recommended by Navigant.

c) As was outlined in the Navigant report included at Exhibit B, Schedule 6, Tab 1, each of the three jurisdictions discussed (California, Illinois and Massachusetts) incorporate the four steps in order to mitigate the issues of self-report studies in the following ways:

	California	Illinois	Massachusetts
Fast Feedback	Not required but pre-screening occurs for custom programs	NTG conducted in waves throughout the year	Not required
Sensitivity Analysis	Required	Required	Utilized in the development of NTG methods
Triangulation	Utilized (e.g., including vendors)	Include vendors	Including trade allies
Other Best Practices	- Net Saving as well as 3 other non-savings factors determine incentives - NTG algorithm includes both program and non-program influence scores	- Prospective application of NTG - NTG algorithm includes multiple factors to account for different program influence (program factor/ program influence/ no-program scores)	- Prospective application of NTG - time series check ins to support program adjustments - captures long term efforts through previous program (a.k.a. secondary) influence.

Witnesses: D. Bullock
D. Johnson

BOARD STAFF INTERROGATORY #23

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, p. 31 and Exhibit B, Tab 6, Schedule 1, p. 9

Preamble:

Enbridge states: The process undertaken to finalize NTG estimates to be used in incentive calculations, establishing targets and in informing program design involved much more than simply accepting the results of a study. In all states, stakeholders worked together to review, challenge and modify initial estimates from EM&V studies, for example aiming to arrive at a consensus value considering relevant issues raised and factors to be considered. All three states had an established collaborative, transparent stakeholder process which aims to seek agreement among stakeholders as part of the finalization of NTG estimates, particularly in the case of self-report survey methods."

Navigant's report states: 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 2019-2021 plan, NTG studies must be completed by mid-2018 and are being planned and implemented in 2017 and early 2018.

Questions:

a) Please confirm whether or not Massachusetts' newly adopted policy of prospective NTG ratios has been subjected to regulatory review. If no, when will the policy be assessed by the regulator? If yes, what were the results?
b) Please comment on the extent to which the program planning and design process employed by the jurisdictions studied (Massachusetts, California, Illinois) compares to the process used by Enbridge. Specifically, please discuss the extent the named jurisdictions include stakeholders in program development, and compare it to how Enbridge develops their programs.

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

i. Please confirm at what stage of the program life-cycle the collaborative efforts referenced by Enbridge at Exhibit A, Tab 1, Schedule 3, p. 31 are undertaken by these jurisdictions (e.g., pre-program delivery, post-program delivery, etc.)
ii. Please identify the stakeholders involved in this consultative process.
iii. Please describe the role of the utilities in the process.

RESPONSE

a) Yes. The Massachusetts Department of Public Utilities ("MA DPU") issued "Order on Program Net Savings and Environmental Compliance Costs" D.P.U. 11-120-A Order on August 10, 2012, addressing two issues related to program net savings: (1) alternate methods to determine program net savings; and (2) the prospective or retrospective application of evaluation study results. This order approved the use of net savings on a prospective basis.

D.P.U. 11-120- A, Order on Program Net Savings and Environmental Compliance Costs, Massachusetts policy on use of prospective NTG values was approved by the DPU in Order 11-120-A (dated August 10, 2012) and reflects current policy in the state.

b) i-iii)
The response to Board Staff Interrogatory #19, found at Exhibit I.EGDI.STAFF.19 also addresses the role of the collaborative in program design and evaluation. With respect to evaluation, there are reviews primarily at two points in time: 1) in the development of the evaluation approaches and 2) in the finalization of the NTG results.

- **Massachusetts**: as it is described on page 11 of Exhibit B, Tab 6, Schedule 1, Massachusetts has developed a common practice of NTG approaches, which has undergone EEAC review. On page 10 of Exhibit B, Tab 6, Schedule 1, the report describes the EEAC process to review evaluation results and develops a consensus decision for prospective NTG values.

- **Illinois**: as it is described on page 24 of Exhibit, Tab 6, Schedule 1, the SAG has an annual process to update the NTG values for application in the TRM and NTG methods defined in the TRM.

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

- **California**: as it is described on page 19 of Exhibit B, Tab 6, Schedule 1, California has a working group that developed a consistent set of questions used for determining NTG. Additionally, the CPUC has a four-step process (Exhibit B, Tab 6, Schedule 1, page 18, Table 3) for gaining stakeholder input, as follows:

  - Specify what will be evaluated
  - Publicly vet evaluation plans
  - Publicly vet results for comment
  - Respond to recommendations

As defined in each case study of the report, the following stakeholders are involved in the process:

- **Massachusetts:** The state of Massachusetts leverages the EEAC process that includes multiple stakeholders, including DOER, EEAC consultants, and PAs (Exhibit B, Tab 6, Schedule 1, page 10).

- **Illinois:** In Illinois, the SAG oversees public meetings that include multiple types of stakeholders.

- **California:** In California, the CPUC leads the research but has a process to collect public input at key points in the evaluation process (Exhibit B, Tab 6, Schedule 1, page 18).

In all states, utilities are included in the stakeholder process. The utilities do not lead the effort in any of these states.

Enbridge: Throughout 2014, Enbridge engaged intervenors, customers, channel partners, and delivery agents, including seven program design roundtables, in preparation for the 2015 program year. Enbridge spent a substantial amount of time with intervenors pursuing a negotiated Settlement Agreement for 2015 budgets, targets, and metrics. Nearly a dozen plenary and subgroup sessions were held to discuss 2015 budgets and targets that reflected program historical achievements and best available information.

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

However, the DSM Multi-Year Framework was released December 22, 2014, approximately one week prior to the start of the 2015 program year. The Board directed that the gas utilities must file their respective Multi-Year DSM Plans by April 1, 2015, thereby providing insufficient time to negotiate and finalize a Settlement Agreement with intervenors. To ensure the gas utilities and ratepayers had stability and certainty throughout the 2015 program year, the Board directed each utility to forgo a Settlement Agreement and instead rollover 2014 program parameters into 2015.

Due to the Board directed “rollover” of 2015 budgets and targets, Enbridge did not undertake a consultative program development process for 2015.

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

BOMA INTERROGATORY #1

INTERROGATORY

Ref: Filed: 2017-12-19, EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Pages1-2 of 48

Preamble: Though the current Framework encompasses 2015 to 2020, the Board directed that 2015 would act as a transition year and the "gas utilities should roll-forward their 2014 DSM plans, including all programs parameters (i.e., budget, targets, incentive structure) into 2015."

Please confirm Enbridge's understanding of "all" of the elements included in the term "program parameters" including the use of the previous audits to establish targets as the basis for review of performance of the 2015 program year.

RESPONSE

In the Revised Decision, the Board confirmed that the "input assumptions and net-to-gross adjustment factors are finalized for a given year based on the previous year's final DSM audit[1]". Therefore, Enbridge understands that 2015 results were to be evaluated using the input assumptions and net-to-gross adjustment factors from Enbridge's 2014 DSM Audit (EB-2014-0354).

In the direction that 2015 would act as a transition year and the utilities were expected to roll-forward their 2014 DSM plans, including all program parameters, Enbridge understood "all program parameters" to include the inputs and assumptions used to determine the 2014 budget and targets, and to calculate the 2014 shareholder incentive, were to be rolled forward and applied to the 2015 program year.

The Board reiterated the direction from the Multi-Year Framework in its Decision by stating "The OEB directed gas utilities to set targets for their 2015 DSM programs using the same methodology they used from 2012 to 2014. Both utilities followed this direction in developing their 2015 targets[2]."

The Board approved Enbridge's approach in the Decision: "The OEB approves Union and Enbridge's proposed 2015 metrics and targets for all scorecards. The OEB believes that it would be inappropriate at this time to make a change to the 2015 targets with the

[1] EB-2015-0049, Revised Decision and Order, p.3
[2] EB-2015-0049, Decision and Order, p.63

Witnesses: D. Bullock
D. Johnson

year completed[3]." These targets were established using the same input assumptions and net-to-gross factors from Enbridge's 2014 DSM Audit.

[3] EB-2015-0049, Decision and Order, p.63

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #2

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 5 of 48

Preamble: While it does include a proxy deemed spillover value sourced from another study conducted in Massachusetts (applied as a result of an instruction given by Board Staff – to be discussed further below), Enbridge views the report as incomplete.

Please explain why the use of a proxy deemed spillover value from another jurisdiction and another study is not appropriate.

RESPONSE

Enbridge has the following concerns with the use of a proxy deemed spillover value in this case.

The first concern is that all iterations of the Scope of Work for the NTG study included a determination of spillover based on a survey assessment of a sample of the utilities' prior DSM participants; however after the EC completed its work on the free-ridership portion of the study and prior to the spillover work being fully undertaken, the EC was instructed by Board Staff to instead conduct secondary source research to identify an estimate to apply to the utilities' DSM programs. The EC selected a proxy "deemed" spillover value from another study from the U.S and instead applied this in their final determinations. Board Staff's decision to change the approach and not follow the Scope of Work was made without engagement of the Company (or the EAC), where the utility's input / concerns could have been properly raised as well as the full input of all members of the EAC.

The second concern is that Enbridge is of the view that equal treatments to all NTG related values should be applied. The EC indicated the spillover value from Massachusetts was applicable to the utilities' DSM programs in Ontario because of the following reasons that they outlined in their final verification report:

- 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.

Witnesses: D. Bullock
D. Johnson

- The programs in Massachusetts and Ontario are mature and in leading jurisdictions.
- The Massachusetts study looked at both “like” and “unlike” spillover (however the EC noted that the Massachusetts study did not quantify “unlike” spillover and this was not consistent with what was outlined in the EC’s Scope of Work).
- The rate is within the anticipated range of results expected for spillover from custom gas C&I programs, not an extreme outlier.

The above approach and decision by Board Staff to rely on a proxy naturally gives rise to the following question: If a proxy spillover value is deemed appropriately applicable, why is a proxy free ridership value not appropriate?

It should be noted that the same Massachusetts study also determined a free ridership value of just 15.7%. No attempt has been made to explain the significant disparity in free ridership values as between the two jurisdictions. Not knowing whether there is a relationship between the two values in Massachusetts gives rise to concern about the selective use of only one value. Stated differently, if the methodology used in Massachusetts explains the low spillover and free ridership values, to use only the spillover value and then use a free ridership value generated by means of a different approach draws into question the reliability and appropriateness of the net results.

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #3

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 5 of 48

Preamble: Third, the EC Report excludes another important feature of the NTG Study specified in the scope of work, namely Secondary Attribution. DNV quantified Secondary Attribution but did not apply these findings to final NTG Study results.

Please explain the feature, “Secondary Attribution” and indicate the impact of the Evaluation Contractor not applying it to the 2015 results

RESPONSE

In the development of the original Scope of Work for the NTG Study there was considerable discussion regarding the time frame that was appropriate in assessing the utilities’ influence, i.e., if the Study was aimed at evaluating the effect/influence of the programs over time, then a longer time horizon should be used. Ultimately there was consensus among the TEC and the Evaluation Contractor that the primary objective of the free ridership estimation was to capture the effect of the program on the current project and the effect on the current project of prior and indirect program experience would be captured in a secondary, less rigorous question sequence.[1]

This consensus decision (as agreed with TEC endorsement on July 30, 2015) culminated in the Evaluation Contractor outlining two differentiated terms: “primary” and “secondary” attribution. Secondary attribution, for the purposes of this project, refers to the consideration of the longer-term effect of the program on participant decision making. Assessment of this type of influence is particularly relevant to a mature program that has been in market for many years and where the utility has provided long term support of customers prior to current year projects.

Despite the Scope of Work outlining that a “question sequence” would be used to assess Secondary Attribution, the EC only asked a single question during their customer surveys. Further, though the EC did provide quantification for secondary

[1] Measurement of NTG Factors and Custom Savings Verification for Ontario’s Natural Gas Custom Commercial and Industrial DSM Scope of Work, DNV-GL, December 14,2016 (Exhibit 6, Tab 5, Schedule 2, page 129)

Witnesses: D. Bullock
D. Johnson

attribution in its final report (approx. 9% incremental attribution overall for Enbridge) it did not include this attribution factor in its final free-ridership calculation.

Though Enbridge has made clear, the Company does not believe the retroactive application of NTG values undertaken by the EC for the purposes of the evaluation of the Company's 2015 DSM results is consistent with the Board's direction and further, though the Company is of the view that the limited consideration (single question) given to assessing secondary attribution was not sufficient to capture the full extent of the utility program's full longer term influence on its customers and that, therefore, the 9% overall value is understated, if one were to appropriately include the secondary attribution values specified by the EC in the NTG adjustments and recalculate the CCM and DSMI values outlined in the EC's final 2015 verification, the impact is provided in the response to GEC Interrogatory #4, found at Exhibit I.EGDI.GEC.4 and copied below:

	Audit Opinion of EC **without** inclusion of secondary attribution	**Audit Opinion of EC with inclusion of secondary attribution estimates**
CCM (lifetime) gas savings*	539,787,741 m^3	**604,691,217 m^3**
Shareholder Incentive (DSMI)	$ 6,207,339	**$ 7,125,344**

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #4

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 5 of 48

Preamble: Fourth, the NTG outcomes are not credible and Enbridge does not have confidence in them as they do not reflect best practice approaches in undertaking self-report NTG studies.

Please outline how the evaluation deviates from best practices with reference to the designation of free riders and the application of the concept of free riders to programs such as Run It Right which by application of the program rules for participants excludes free riders.

RESPONSE

While Enbridge is of the view that that the customer participation criteria for the Run It Right (“RiR”) program strives to exclude free riders, it also acknowledges that no mitigation strategy is 100% effective. Enbridge knows however that similar programs in other jurisdictions have NTG studies which indicate much lower values of free ridership.

In a recent evaluation reviewing the results of an impact evaluation on a joint utility retro-commissioning program offered in partnership of ComEd, Nicor Gas, Peoples Gas and North Shore Gas, and conducted by Navigant, it was concluded that a free ridership rate of 8.6% was appropriate. This calculation was determined using a self-report survey method however with surveys uniquely tailored for Retro-Commissioning participants.[1]

With regard to the approach taken to assess NTG for the RiR program, Enbridge highlights the following areas of concern with the conclusions reached by the EC:

1) The RiR program requires a multi-year participation on the part of the customer including:
    - An investigation agent who visits the facility to complete a site assessment to provide an energy consumption analysis and identify recommended low cost/no cost recommissioning/ operational improvement activities,

[1] Joint Utility Retro-Commissioning Program EPY6/GPY3 Evaluation Report, March 18, 2015, Roger Hill Navigant Consulting Inc., p 28.

Witnesses: D. Bullock
D. Johnson

- Customer agreement to proceed to implement recommended improvements and provision of implementation incentives,
- Training and Support,
- Free access to an Energy Management Information System ("EMIS") for monitoring of gas usage, and
- Monitoring of facility gas usage for 12 months for comparison to a pre-improvement baseline period.

The RiR program required the enrollment of customers in a process and includes the provision of a free site assessment (retro-commissioning study) by investigation agents, recommendations for low cost/no cost improvements, access the energy management capabilities, and ongoing technical support through the program. As such, the framing questions posed to participants in the survey instrument should have been posed uniquely from those that might have been used in identifying a customer project at a point in time. Questions should have focused on the various program factors that might have influenced the customer's decision to participate in a retro-commissioning effort as well as efforts to ascertain prior customer consideration with undertaking or participating in activities outlined in the RiR retro-commissioning activities.

2) Best practice requires that NTG surveys are conducted as soon after program participation as possible. Recall bias is an issue for any self-report study, but is particularly concerning in the case of the RiR customer surveys given that some of the customers implemented improvements three+ years prior to the time they were surveyed and these customer would have registered for RiR (i.e., decided to participate in the program even previous to the three years earlier). The EC's final report confirms the FR portion of the RiR NTG study evaluated measures implemented in 2014 (a year earlier than the NTG for the C/I custom projects) and claimed in 2015. In its initial presentation to the TEC in the planning stages of the overall NTG study, the EC had confirmed that this timeframe was too long to appropriately conduct such surveys.

3) Enbridge believes there are a number of assumptions in the scoring algorithm that should have undergone sensitivity analyses, a process recommended in best practice. These entails examining how the responses to the questions are translated into free ridership and NTG estimates. A sensitivity analysis would provide context around the estimated NTG values. The timing questions for instance are an example where the scoring algorithm for these questions is based on a subjective "cut-off". The participant is asked to go back to the time of their participation decision and estimate what month in the future (out to 48 months) they might have undertaken the same or similar improvements in the

absence of the program. This is a difficult question to answer in real time, and is made more difficult with the respondent having to recall the situation in excess of three years prior, and determining what factors would have led to their undertaking the same or similar improvement at some future point. A four year timeframe was used as a cut-off value with full attribution awarded for responses of four years or greater and only partial attribution for responses less than four years (of note, the utility does not have clarify on how the partial determinations are scored for answers between 0 and 48 months). The cut-off of four years is somewhat arbitrary and is not a consistent cut-off used across various self-report methodologies/scoring algorithms. Enbridge is of the view that asking customers to make guesses about when they might have undertaken such low cost/no cost improvements beyond one or two years is highly speculative and uncertain. Four years is a subjective inflection point. Another timeframe of 12 months or 24 months is more reasonable. The EC would have the data to estimate the NTG that would result from using cut-offs of 12 or 24 months. Given that the EC indicated that timing was the component with the most significant impact on the RiR NTG, testing how changes in the selected cut-off date affects NTG values would provide insight into the estimates and additional information on the uncertainty in the estimates not captured in the statistically derived confidence and precision levels.

BOMA INTERROGATORY #5

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 5 of 48

Preamble: Finally, in Enbridge's efforts to gain understanding of NTG adjustments made by the EC, despite continued requests for detailed information to enable the Company to replicate the calculations used by the EC to arrive at its proposed NTG values, the EC failed to provide the details required for the Company to do this analysis. Enbridge therefore had no ability to review live calculations or understand the consideration of participant responses to the NTG scoring algorithm.

Please confirm that in previous evaluation processes, the company was able to replicate the calculations used by the EC and understand how participant responses were used in the scoring algorithm.

RESPONSE

Enbridge confirms that in previous evaluation processes, the Company was able to replicate auditor's calculations pertaining to realization rates, scorecards and shareholder incentive and LRAM. Enbridge was also provided with information to assist in understanding how responses to sampled participant verification were incorporated in the auditor's determination of realization rates.

In the case of the previous commercial / industrial custom NTG study conducted by Summit Blue, Enbridge was given an opportunity and was provided with the responses to survey questions in the aggregate (to maintain customer anonymity). This allowed the utility personnel at the time to review the survey results detail with the consultant. This provided improved understanding about the various drivers in assessing program influence as well as providing more confidence in the translation of survey results and customer feedback into a scoring algorithm and analysis plan. It was apparent through this process that even slight adjustments in the scoring algorithm could have measurable impacts on the final results.

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #6

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 10 of 48

Preamble: In the first year of the new OEB Staff led EM&V process, almost 22 months after the end of the utilities' 2015 program year, the OEB issued two reports on October 16th, 2017, developed by the EC, DNV, providing its calculations for 2015 DSM verification results.

Please provide a typical schedule for annual reporting and evaluation when it was managed by the utilities.

RESPONSE

Although there were subtle variances to timelines in certain years, a typical year is provided in the example below reflecting the 2014 process:

- In the third quarter of the current program year, utility counsel would manage the Audit Committee selection whereby the DSM consultative would nominate and elect three intervenor representatives to serve on the Audit Committee for that year.

- The Terms of Reference for the audit would be drafted/finalized by the TEC / Audit Committee in the third quarter of the current program year with consideration for current evaluation priorities and the prior year's audit recommendations

- An RFP incorporating the finalized Terms of Reference would be issued in October as part of the audit committee selection process. The auditor would be engaged by the end of November of the current program year.

- Similarly, with input from the TEC, the Terms of Reference for the CPSV would be developed and RFPs would be issued for the Custom Project Savings Verification ("CPSV") consultants (engineering firms). Contractors would be assessed and selected by the Audit Committee and engaged by November of the current program year.

Witnesses: D. Bullock
D. Johnson

- Custom project data would be provided to a separate third party contractor to complete a random sample of projects for review in two “waves” (1st sample from Q1 to Q3 results and 2nd sample for year end results). CPSV site reviews/reporting would be undertaken in two waves. Beginning with a kick-off meeting in November of the program year with the auditor and CPSV verifiers followed by December to February CPSV Wave One and February to April CPSV Wave Two verification cycles.

- Following a request from the auditor for the tracking database, the balance of audit verification would be completed between March and June of the year following the program year.

- The utility’s Draft Annual Report would be completed and distributed to the consultative in Q2 of the year following the program year.

- The auditor would submit a draft auditor report to the Audit Committee by mid-June and a final audit report by June 30th of the year following the program year. The utility would file the auditor’s report with the Board.

- The Audit Committee would draft and finalize an Audit Summary Report in Q3 including a review of all audit recommendations outlined in the auditor’s report. The Audit Summary Report would include written response to all audit recommendations from both Enbridge and the Audit Committee.

- Enbridge would update the DSM Final Annual Report to reflect the audit findings and file for its Deferral Clearance application comprising all the components listed above in October of the year following the program year.

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #7

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 12 of 48

Preamble: Ultimately, a year later, the day prior to the EAC receiving a copy of the EC's draft CPSV/NTG report, Board Staff emailed the two utilities on May 23, 2017, and confirmed it had instructed DNV to retroactively apply the NTG Study results (they were not in fact NTG values, they proposed free ridership values but did not include spillover) to 2015 DSM program results.

Please confirm whether Enbridge was aware if the EAC members had received a copy of the May 23, 2017 email from Board Staff to the Evaluation Contractor.

RESPONSE

The email received by Enbridge was sent to the utilities. Enbridge has no record indicating EAC members received a copy of the May 23, 2017 email from Board Staff.

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #8

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 15 of 48

Preamble: Enbridge notes that it developed together with Union Gas and other DSM stakeholders a document entitled Joint Terms of Reference which was filed in draft and ultimately approved by the Board in EB-2011-0295. This document detailed the duties and responsibilities of all participants in the EM&V process during the 2012 to 2014 Framework and was of great assistance ensuring that the review of annual results and the updating of measure assumptions was undertaken in an objective and efficient fashion. These rules guided the parties and provided certainty as to the process. Enbridge submits that a charter which includes a materially similar set of rules would greatly assist in the timely generation of credible results in future.

Please confirm that a key element of the 2011 Charter was the use of a consensus-based process to govern EM&V.

RESPONSE

Confirmed. A more detailed response pertaining to Enbridge's position on consensus governance has been provided in the response to SEC Interrogatory #13, found at Exhibit I.EGDI.SEC.13.

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #9

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 17 of 48

Preamble: Despite the utilities having responsibility and accountability for an overall annual evaluation budget for their respective DSM portfolios, OEB Staff has refused to provide details on EM&V budgets for planned verifications or details regarding forecasted spending in a given year.

Please outline how Enbridge managed its evaluation budget when it managed the evaluation process. Please indicate the approved evaluation budgets and actual spending for the evaluations completed after the 2011 Terms of Reference were established until the completion of the 2014 evaluation. Please provide the current status of the costs of the 2015 evaluation and indicate how it compares to the OEB approved budget under the most recent DSM Framework.

RESPONSE

Prior to the current Multi-Year (2015-2020) DSM Framework, Enbridge had full oversight and management of the evaluation budget and process. The Technical Evaluation Committee ("TEC"), including the utilities, would determine evaluation priorities and meet monthly to provide updates and review on-going activities (i.e., Technical Resource Manual, Jurisdictional Review, Boiler Baseline Study etc.). The evaluation costs associated with the various activities were reviewed by the TEC. Similarly, budgets and costs associated with the annual audit were reviewed with the Audit Committee. Overall budgets, contracts and facilitation of payments were managed by the utilities. This approach was transparent and ensured the utility had clarity of budgets, forecasts and spending.

The approved evaluation budgets and actual spending for the evaluations completed after the 2011 Terms of Reference were established through to the completion of the 2014 evaluation were filed as part of the Multi-Year DSM Plan (EB-2015-0049) interrogatories. For convenience, Enbridge has included those tables in this response:

Witnesses: D. Bullock
D. Johnson

2012-2015 Evaluation Budget and 2016 - 2020 Estimated Process and Impact Evaluation Budget

Program/Category	Description	2012	2013	2014	2015*	2016	2017	2018	2019	2020
Resource Acquistion										
	Residential	$ 150,760	$ 105,000	$ 97,000	$ 98,940	$ 220,000	$ 260,000	$ 260,000	$ 265,620	$ 271,352
	Commercial	$ 212,187	$ 323,152	$ 255,300	$ 260,406	$ 290,000	$ 330,000	$ 330,000	$ 337,133	$ 344,409
	Industrial	$ 129,187	$ 217,500	$ 141,400	$ 144,228	$ 170,000	$ 210,000	$ 210,000	$ 214,539	$ 219,169
									$ -	$ -
Low Income		$ 20,000	$ 45,000	$ 35,000	$ 35,700	$ 105,000	$ 145,000	$ 145,000	$ 148,134	$ 151,331
Market Transformation and Energy Management		$ 20,000	$ 35,000	$ 25,200	$ 25,704	$ 100,000	$ 120,000	$ 120,000	$ 122,594	$ 125,240
Audit (including Audit Committee)						$ 215,000	$ 215,000	$ 215,000	$ 219,647	$ 224,380
Joint Evaluation Research		$ 197,965	$ 90,000	$ 361,797	$ 369,033	$ 150,000	$ 170,000	$ 170,000	$ 173,675	$ 177,423
Evalution Advisory Forum and Consultative						$ 250,000	$ 250,000	$ 250,000	$ 255,404	$ 260,916
Grand Total		**$ 730,099**	**$ 815,652**	**$ 915,697**	**$ 934,011**	**$ 1,500,000**	**$ 1,700,000**	**$ 1,700,000**	**$ 1,736,746**	**$ 1,774,228**

*please refer to Board Interrogatory #13 found at Exhibit I.T3.EGDI.STAFF.13

[1]

2013-2014 Actual Evaluation Spend and 2016 - 2020 Estimated Process and Impact Evaluation Budget

Program/Category	Description	2013	2014	2016	2017	2018	2019	2020
Resource Acquistion								
	Residential	$ 25,213	$ 105,605	$ 220,000	$ 260,000	$ 260,000	$ 265,620	$ 271,352
	Commercial	$ 172,840	$ 182,732	$ 290,000	$ 330,000	$ 330,000	$ 337,133	$ 344,409
	Industrial	$ 24,600	$ 162,605	$ 170,000	$ 210,000	$ 210,000	$ 214,539	$ 219,169
							$ -	$ -
Low Income		$ 14,684	$ 109,132	$ 105,000	$ 145,000	$ 145,000	$ 148,134	$ 151,331
Market Transformation and Energy Management		$ 9,944	$ 8,337	$ 100,000	$ 120,000	$ 120,000	$ 122,594	$ 125,240
Audit (including Audit Committee)		$ 165,422	$ 207,068	$ 215,000	$ 215,000	$ 215,000	$ 219,647	$ 224,388
Joint Evaluation Research		$ 214,170	$ 186,633	$ 150,000	$ 170,000	$ 170,000	$ 173,675	$ 177,423
Evalution Advisory Forum and Consultative		$ 104,136	$ 48,019	$ 250,000	$ 250,000	$ 250,000	$ 255,404	$ 260,916
Grand Total		**$731,009**	**$1,010,131**	**$ 1,500,000**	**$ 1,700,000**	**$ 1,700,000**	**$ 1,736,746**	**$ 1,774,228**

[2]

Throughout the current evaluation process, Enbridge has raised concerns regarding the lack of clarity on evaluation spending and has requested details from Board Staff regarding the Board's projected budget on Board-led evaluation activities. Enbridge has not only requested this information as the Company has responsibility for overall oversight, tracking and processing of payments, but in addition, Enbridge is also required to utilize the same budget for any internal evaluation and verification efforts led by the utility including process evaluation activities. It has therefore been challenging for the utility to budget and therefore plan these efforts without knowing what costs are being planned for Board-led activities and which will ultimately be payable from the same budget**.** Enbridge believes that with greater transparency prior to each program year and with systematic budget updates from Board Staff, the utility's ability to manage the evaluation budget and plan internal evaluation efforts would be vastly improved.

The Board approved evaluation budget for Enbridge for the 2015 program year was $934,011. However, because the evaluation effort has been delayed, payments related

[1] (EB-2015-0049) Exhibit I.T6.EGDI.GEC.26
[2] (EB-2015-0049) Exhibit I.T6.EGDI.SEC.26

to the 2015 evaluation process have spanned multiple years and are not yet fully paid, it is therefore challenging to compare the OEB approved evaluation budget for 2015 relative to the costs incurred over the course of the 2015 evaluation process

To date the Company has paid the following amounts to the OEB to cover EAC evaluation costs including Evaluation Contractor costs and EAC cost awards relating to the 2015 evaluation process:

<u>Invoice Date</u>	
October 1, 2016	$ 13,242.22
July 1, 2017	$ 223,312.74
October 1, 2017	$ 300,305.85

Following inquires to Board Staff regarding outstanding work completed but not yet billed in 2017; based on OEB Staff's estimates, the Company also accrued a further $306,742 in expected EC / EAC costs relating to the 2015 evaluation process for which we have not yet received an invoice.

In addition, to date the Company has paid the following amounts to the Evaluation Contractor for the Net-to-Gross Study.

<u>Invoice Date:</u>	
September 11, 2015	$ 14,100 USD
January 23, 2017	$ 37,130 USD
October 11, 2017	$144,270 USD

The Company estimates there is a small remaining invoice of approx. $22,000 USD to be paid to complete Enbridge's allocated share of the payments for the Net-to-Gross Study pending finalization of the EC's spillover work.

Witnesses: D. Bullock
D. Johnson

BOMA INTERROGATORY #10

INTERROGATORY

Ref: EB-2017-0324, Exhibit A, Tab 1, Schedule 3, Page 34 of 48

Preamble: Enbridge is of the view that the survey instrument employed by the EC focused the customer largely on the program's provision of customer incentive payments and did not sufficiently probe for the customer's impression of all the services, support and value provided by the utility. "If a survey is conducted 1 year or more after participation in a program, the respondent may not recall all the features of the program and all the assistance provided. Instead, respondents may focus narrowly on the influence of the rebate or incentive payment."30 Utility support and therefore influence can be part of any number of customer engagement activities, for example, site assessment, facility audits, project feasibility studies, marketing communications, case studies, workshops and education events and generally through on-going customer relationship development and support over many years. Limiting assessment of these varied influence factors puts the determination of the NTG scoring in question.

Please comment on Enbridge's understanding of how or if the contractors who delivered the survey were briefed with respect to the nature of Enbridge Programs. Did Enbridge understand if they were fully briefed on the multi-faceted nature of the Enbridge's Custom Programs which differ substantially from the prescriptive programs (which a generally composed of a higher efficiency product and an incentive with generic information about the use of such a product.)?

RESPONSE

Enbridge has no knowledge regarding how or if the contractors with responsibility for delivering the surveys were briefed regarding the particular details of Enbridge custom program projects. Enbridge was not involved in any such activities. Of note however, contrary to preparation activities outlined in the EC's scope of work, the EC was not briefed by Enbridge program energy advisors in order to better inform the participant survey/interview instruments.

The approach outlined in the EC's scope of work specified data collection efforts to inform the survey instruments based on information gleaned from interviews with utility program energy advisors, as included in Enbridge's evidence Exhibit B, Tab 5,

Witnesses: D. Bullock
D. Johnson

Schedule 1, page 23 and reproduced below:

> 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.

In a communication from Board Staff on November 15, 2016, regarding upcoming scheduled activities, Board Staff addressed the Utility Account Manager Interviews to be scheduled by the EC, noting this is a very important step in the process. On December 14, with the Account Manager Interviews not yet scheduled, the utility sent an email to Board Staff to follow up on of a number of activities including the completion of Account Manager interviews (a copy of this email is attached to this response). The utility did not receive a response on this matter from Board Staff, however on December 21 the EC responded and confirmed that the ESC interviews were no longer going to be completed and the participant survey interview guide had instead been finalized. This was despite the direction outlined in the scope of work which clearly outlined that this task would inform the survey instrument.

Enbridge presumes that Board Staff and/or the EC decided to eliminate this activity however no discussion or consultation with the EAC and/or the utilities preceded this decision. It should be noted that unbeknownst to Enbridge, a communication had gone out to the EAC on December 15th indicating that a number of documents had been

Witnesses: D. Bullock
D. Johnson

finalized; the final Scope of Work, the Participant IDI guide (survey instrument) and the Methodology memo had been posted to the project SharePoint. No Enbridge persons were included in this important communication. Instead Enbridge was informed that the survey instrument had been finalized during a conversation with Union Gas evaluation staff on December 21.

Witnesses: D. Bullock
D. Johnson

From:	Deborah Bullock
To:	"Josh Wasylyk"
Cc:	"Jones, Benjamin"; "Saleem, Muhammad"; Tina Nicholson; Eric Buan; Rodney Idenouye; Ed Reimer; Rob Kennedy
Subject:	RE: Advance Letter
Date:	Wednesday, December 14, 2016 9:32:47 PM
Attachments:	image002.png image003.png FR_CPSV Advance letter_EGDcomments.docx

Hello Josh,

Please find attached our comments on the Advance Letter. Also included on the attached is an alternative suggested draft for the communication as you requested yesterday in our phone conversation with Eric/Union Gas.

As a general comment, our aim is to ensure the client is provided advance notice in a manner that does not cause alarm or concern regarding their participation in our program. Also as discussed yesterday, we have rigid policies to ensure compliance with CASL requirements in electronic communications – we will need to ensure that any such email communication meets these requirements. Paper/snail mail/letter correspondence will not be subject to such consideration.

Josh, I recognize that at the last EAC meeting, OEB staff announced that they were working toward a deadline for completion of the 2015 evaluation by March 31st however there is a detailed scope of work and sequence of events laid out by DNV that clearly requires activities are executed to follow a defined process.

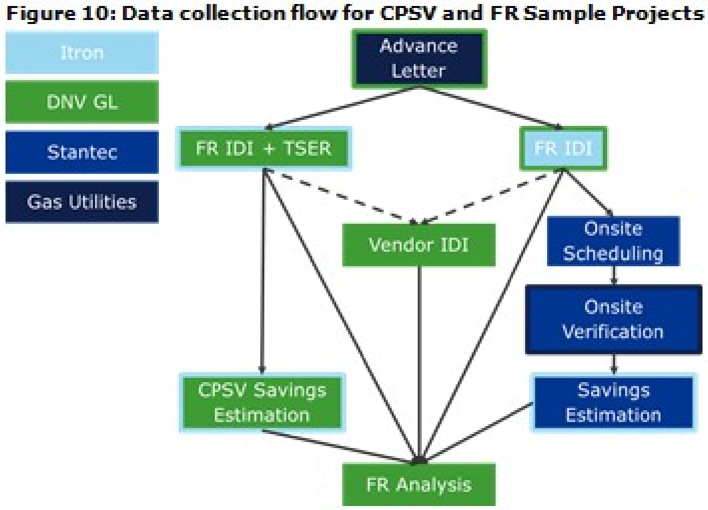
During the call yesterday you suggested you were proposing sending out letters to our customers on OEB letterhead. The utilities however are supportive of the communication coming from the utility (i.e. on utility letterhead), as outlined in DNV's Scope of Work. The scope acknowledges that all communications with program participants will adhere to each of the respective utility's protocols for customer communication and articulates the benefits of doing so. Enbridge is consistently focused on ensuring we communicate with our customers and manage our customer relationships to a high standard. We are also supportive of DNV's position that response rates are improved when such communications come from a customer's trusted and recognized utility provider.

Also during yesterday's call you indicated that you intended to speak with DNV regarding instructing them to proceed with the scheduling of site visits ahead of the FR IDI. In light of this I would like to confirm that I have a correct understanding of the proposed scope of work/methodology and highlight the following:

- DNV's proposed process follows a sequence whereby FR focused IDIs will be administered for any customer selected in the FR sample. 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. Onsite sample customers will receive a scheduling call from a Stantec recruiter to schedule an onsite visit. 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.

- Figure 10 summarizes the sequence for FR/CPSV:

Figure 10: Data collection flow for CPSV and FR Sample Projects



- There are to be 2 separate advance letters – one for CPSV/FR purposes and one for spillover purposes
- In advance of interviews, interview guides need to be finalized. Comments were provided on the draft customer survey instrument however final interview guides have not yet been provided (a component of these was to be based on interviews with program ESCs to help frame interview questions - these interviews however have not yet been completed).
- Draft survey instruments for vendors have not yet been distributed for comment.
- All parties have acknowledged challenges in reaching out/expecting response from customers over the holiday period.

Josh I again wish to make clear that we are dedicated to supporting this effort and we are working to capacity in this regard. I trust the attached is helpful in ensuring we draft a communication that is effective and well-received by customers.

Regards,
Deborah

Deborah Bullock
Lead, Audit & Evaluation

ENBRIDGE GAS DISTRIBUTION
TEL: 416-495-7228 | CELL: 416-427-2035 | FAX: 416-495-8350
2255 Sheppard Ave. E., Suite 410, Atria 1, Toronto, ON M2J 4Y1
enbridgegas.com
Integrity. Safety.Respect

From: Josh Wasylyk [mailto:Josh.Wasylyk@ontarioenergyboard.ca]
Sent: Tuesday, December 13, 2016 1:26 PM
To: Deborah Bullock; Buan, Eric
Cc: Saleem, Muhammad; Rodney Idenouye; Kevin Mark; Campbell, Bradley; Valerie Bennett; Kuiken Whitiken, Tamara; 'Nicholson, Tina'; Jones, Benjamin; Pascale Duguay
Subject: RE: Advance Letter
Importance: High

Hi Eric and Deborah,

In order to ensure the CPSV / NTG process stays on schedule, I ask that you provide approval of the advance letter by end of business day Thursday, December 15th. This will ensure that customers receive the advance letter later this week and allow DNV GL and its team to initiate calls to schedule visits.

Although we would prefer that the letters be sent with the utility letterhead as customers are more familiar with you than they likely are with the OEB, if you are not able to provide approval of the letter by end of day Thursday, we propose to send the letter out with the OEB letterhead. This will allow us to maintain the current schedule while ensuring that your customers are appropriately notified of the evaluation process. Please let me know if you have any objections to this.

Thank you very much for your continued assistance through this process.
Josh

Josh Wasylyk | Project Advisor| Ontario Energy Board
2300 Yonge Street, 27th Floor |Toronto, ON | M4P 1E4 | Ph: 416 440 7723

BOMA INTERROGATORY #11

INTERROGATORY

Ref:
https://www.mycommittee.com/BestPractice/Committees/Chairingacommittee/ChairResponsibilities/tabid/264/Default.aspx

Preamble:
Board or Committee Chair Responsibilities: The chair's duties and responsibilities include, but are not limited to, the following;
The Chair shall:

- *In consultation with the Executive Director, CEO or other board or committee members, schedule dates, times and location for meetings*
- *Ensure meeting are called and held in accordance with the organizations' mandate, terms of reference or by-laws*
- *In consultation with the Executive Director or CEO, and/or other board or committee members establish and confirm an agenda for each meeting*
- *Ensure the meeting agenda and relevant documents are circulated to the members of the committee 3-5 days in advance of the meeting*
- *Officiate and conduct meetings*
- *Provide leadership & ensure committee members are aware of their obligations and that the committee complies with its responsibilities*
- *Ensure there is sufficient time during the meeting to fully discuss agenda items*
- *Ensure that discussion on agenda items is on topic, productive and professional*
- *Ensure minutes are complete and accurate, retained, included and reviewed at the next meeting*
- *Chair in camera meetings as required.*

Union has proposed a Terms of Reference for the Evaluation Advisory Committee. Would Enbridge be agreeable to the above referenced roles and responsibilities of a committee chair to address some of the shortfalls of the current committee structure and operational processes?

RESPONSE

Enbridge would be agreeable.

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #1

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 5

Preamble: "Second, it excludes an important required feature outlined in the scope of work of the NTG Study, namely Enbridge/Union Gas program based determinations of spillover. While it does include a proxy deemed spillover value sourced from another study conducted in Massachusetts (applied as a result of an instruction given by Board Staff – to be discussed further below), Enbridge views the report as incomplete."

Can Enbridge provide its current spillover estimates and when the last time that figure was updated.

RESPONSE

Enbridge does not have a current spillover estimate and has not applied a spillover value in its determination of CCM, DSMI or LRAM outlined in this application. Enbridge has similarly not applied a spillover value in determination of results in prior years. Based on the NTG Study scope of work, Enbridge understood that the spillover value would be contained in the recent NTG Study. Instead the NTG Study only included an adjustment for free-ridership.

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #2

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 5

Preamble: “Finally, in Enbridge’s efforts to gain understanding of NTG adjustments made by the EC, despite continued requests for detailed information to enable the Company to replicate the calculations used by the EC to arrive at its proposed NTG values, the EC failed to provide the details required for the Company to do this analysis.”

Please provide a copy of these requests and the refusals from the EC.

RESPONSE

Please refer to the response to Board Staff Interrogatory #12, found at Exhibit I.EGDI.STAFF.12.

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #3

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 15

Preamble: “With regard to one of the most significant evaluation efforts, the development of the NTG Study, though the EC did solicit comments from the EAC on the survey instrument, much of the commentary and input provided by Enbridge was dismissed.”

Please provide any comments that Enbridge submitted and comments from the EC that dismissed those suggestions and the reasons for doing so.

RESPONSE

Please see Enbridge’s response to Board Staff Interrogatory #11, found at Exhibit I.EGDI.STAFF.11.

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #4

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 19

Preamble: "In particular, Enbridge shared concerns about how delayed evaluation efforts impacted and inconvenienced customers who were being queried on projects that were implemented over a year, and in some cases, over two years previous. This impacted the ability for the EC to connect with customer contacts that had sufficient (or any) knowledge of specific projects and most certainly impacted customers' recall regarding projects details and arguably effected NTG responses."

a). Is Enbridge of the view that one to two years after a DSM project is completed that the companies – and the employees overseeing the project – will have little to no knowledge over the long-term impact of these projects?
b). If many companies are unable to accurately verify DSM savings just one to two years after the project was completed, how are the Board and customers able to confidently verify those savings?
c). What about Secondary Attribution? If many companies are unable to accurately discuss DSM projects one to two years later, how can Enbridge (or Union) accurately verify Secondary Attribution benefits, given that they are based on a long-term horizon?

RESPONSE

a) No, Enbridge has not made comments regarding the customer's knowledge over the long term impact of the projects, but rather the context of the statement quoted above was with respect to the NTG study which aims to assess the utility's program influence on the customer and the decision making process with respect to undertaking an energy efficiency improvement project. Enbridge's concerns regarding challenges with customer recall and recall bias as time elapses align with those of many evaluation experts on this topic including those outlined by Research into Action and Navigant Consulting Inc. and referenced in the 2015 Clearance Application, such as:

- The longer the time that has elapsed between the behavior and the self-report about the behavior, the more likely the respondent is to forget their intentions,

Witnesses: D. Bullock
D. Johnson

the motivations, and other influences on their behavior (even if the respondent had been aware of them at the time of action).[1]

- …it is often important that the survey introduces the ways support was provided through the program. This would include making sure that program training, analysis, and support are described to the participant. These can be particularly difficult for the respondent to recall if the survey takes place 1 year or more after participation.[2]

b) The above referenced preamble addresses the impact of elapsed time between project implementation and customer representative responses to Net-to-Gross surveys which are looking for customers to recall details regarding the utility's influence on project implementation that may or may not have an impact on the calculation of that project's NTG value. It does not make reference to the customer's involvement in an audit process which focuses on efforts to verify savings.

c) As outlined in the Research into Action Review and Analysis of Net-to-Gross Assessment Issues (Exhibit B, Tab 3, Schedule 3) there are many factors and biases inherent in a self-report NTG survey approach that in no way presumes accuracy in NTG survey results including:

   a. Failure to recognize or recall all direct or indirect paths of program influence
   b. Difficulty estimating and reporting attribution and recognizing the complex factors that lead to behaviour/decision making – who gets credit for actions
   c. Difficulty reporting the hypothetical alternatives – imagining what they might have done and speculating an accurate assessment of this imagined behaviour
   d. Tendencies for people to rationalize past decisions to and provide socially desirable responses
   e. Lack of clarity in survey questions
   f. Potential arbitrariness in free-ridership scoring methods

   Enbridge asserts however that equal treatment and consideration to all NTG related values (i.e., all components of attribution including Secondary Attribution) should be undertaken. Enbridge is concerned that there has not been equal treatment of those values that reduce its results, as those that recognize the benefits that programs deliver.

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[1] EB-2017-0324, Exhibit B Tab 6 Schedule 3 Page 20 of 39
[2] EB-2017-0324, Exhibit B Tab 6 Schedule 2 Page 18 of 19

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #5

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 23

Preamble: "Also of note, though Enbridge provided comments in the development of the survey instrument, that multiple questions (in reference to "question sequence") above should be asked to capture this important component of utility influence on the customer, the EC did not incorporate this recommendation and limited the query to a single question.."

Please provide a comparison of the questions Enbridge submitted and those used by the EC.

RESPONSE

There was consensus as outlined in the EC's NTG Scope of Work that the primary objective of the free ridership estimation was to capture the effect of the program on the current project and the effect on the current project of prior and indirect program experience would be captured in a secondary, less rigorous question sequence.[1] TEC approval was recorded at the July 30, 2015 TEC meeting.

The topic of secondary attribution was raised and discussed at multiple TEC meetings (much of this discussion related to the NTG study is reflected in the memo from DNV to the TEC attached to this response), as well as the EAC (however no minutes of EAC meetings were kept). Of note, as outlined in the attached, the discussion regarding the approach and intention to capture both types of attribution were provided in DNV's attached memo as follows:

- Operationally, DNV GL proposes to capture two types of attribution that would complement one another. See examples in Figure 1.
- Primary attribution will consider all program activities that bear directly on the current study project.
- Secondary attribution will quantify the programs' effect on company prior EE activity or practices that influenced the project.

[1] Measurement of NTG Factors and Custom Savings Verification for Ontario's Natural Gas Custom Commercial and Industrial DSM Scope of Work, DNV-GL, December 14,2016 (Exhibit 6, Tab 5, Schedule 2, Page 129)

Witnesses: D. Bullock
D. Johnson

- Research questions for secondary attribution might include
  - Does your company have policies or practices regarding projects like project X?
  - How long have these practices existed?
  - How likely would your company be to have these practices by now without the program?
  - How likely would you have been to do project X without these practices?

Despite this proposal, when the EC presented the draft survey instrument to the EAC for comment in November 2016, the draft questionnaire included only a single question to address assessment of secondary attribution. Enbridge provided comments on November 25, 2016 and both utilities highlighted that the consensus (as noted above) was there was to be a secondary question sequence to assess the longer term effect that the utilities' program had on participant behaviour and decision making. Regrettably, the EC did not revise this component of the survey instrument in the final version posted on December 15, 2016, limiting this effort to a single question and, not affording the utilities with an opportunity to provide additional questions for consideration. Regrettably Enbridge was omitted from the communication from the EC notifying the EAC that the EC had finalized the survey instrument and was made aware by Union Gas colleagues on December 21, 2016 that the survey had been finalized and posted.

Witnesses: D. Bullock
D. Johnson

DNV·GL

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

Date: June 9, 2015

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.

- 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):
  - **TEC Action Item:** TEC to discuss guidelines for framing[1] questions and usage of information from program in probes. Decision required prior to survey instrument development.
  - Open questions on usage of
    - framing questions to remind customer of decision making process
    - program-supplied information in framing question-related probes
  - Rationale for questions and scoring to be provided with survey instruments once drafted.
  - 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.
   - <u>TEC Take</u>:
     - 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.

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[1] Framing questions are those that remind the customer of the decision-making process and are not used in the attribution scoring.

    - 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):
    - 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

- o 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
        - o **DNV GL Action Item:** DNV GL to provide simplified explanation of the two approaches and the pros and cons of each.
        - o **TEC Action Item:** TEC to decide whether to pursue both methods, or select one. Resolution needed prior to starting analysis.
        - o 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
        - o 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 rebated 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. (We call this the measurement the "Primary Attribution" below.) The effect on the current

project of prior and indirect program experience will be captured in a secondary, less rigorous question sequence. (We call this effect "Secondary Attribution.").

- Operationally, DNV GL proposes to capture two types of attribution that would complement one another. See examples in Figure 1.
  - Primary attribution will consider all program activities that bear directly on the current study project.
  - Secondary attribution will quantify the programs' effect on company prior EE activity or practices that influenced the project.
    - Research questions for secondary attribution might include
      - Does your company have policies or practices regarding projects like project X?
      - How long have these practices existed?
      - How likely would your company be to have these practices by now without the program?
      - How likely would you have been to do project X without these practices?

Figure 1: Example O&M Participant Attribution

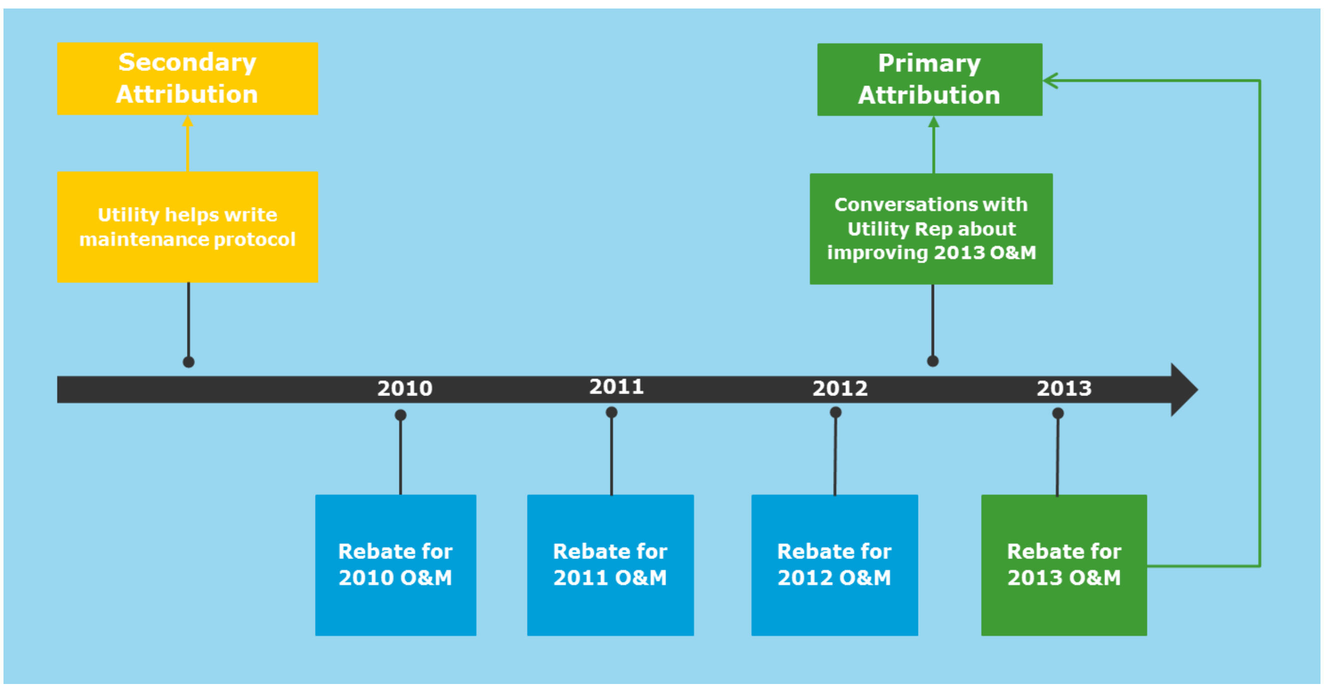
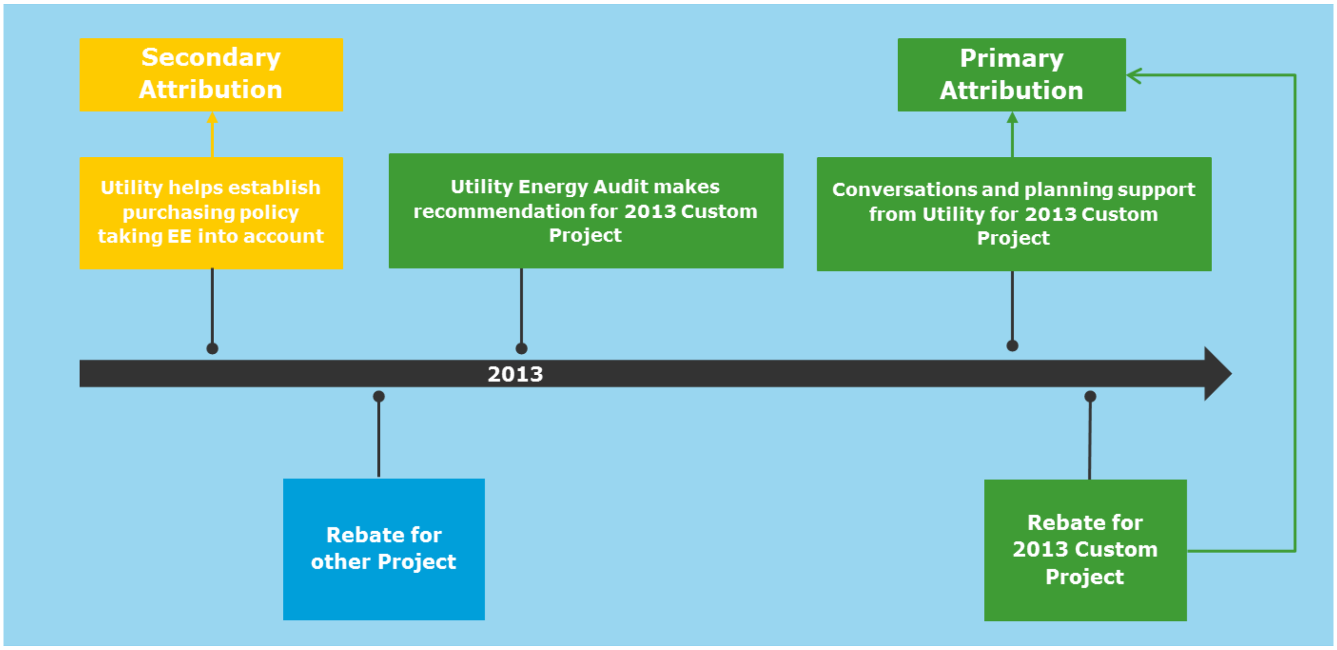


Figure 2: Example Custom Project Participant Attribution



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.
   - <u>TEC Take</u>: 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.

ENERGY PROBE INTERROGATORY #6

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 27

Preamble: “At precisely the time the Board has tasked the utilities with doing as much as possible to mitigate carbon emissions, a clear and direct positive benefit derived from DSM activity, such retroactive adjustments change the “rules of the game” after the game has been played. Had the utilities known these input assumptions, and values could be changed to rearrange outcomes, the utilities would have been disincented to expend the degree of time and effort on Commercial and Industrial Custom projects as they did. Contrary to the Conservation Directive of the Government of Ontario, this would have resulted in higher past, current, and future, Cap and Trade offset purchase requirements for customers.”

a). Can Enbridge discuss, in detail, what it would have done differently had it know that a retroactive adjustment was possible?
b). Confirm that the cap and trade program didn’t come into effect until 2017 and that it would have had little to no impact on Enbridge’s DSM programs in 2015.

RESPONSE

a) To be clear, the Company does and did not believe that the Board and the 2015-2020 Framework intended that results be adjusted retroactively as has been proposed by Board Staff. It believed that this matter had been dealt with and had been settled so the question asked is hypothetical. This being said, as has been indicated in the past, retroactive application of revised values like free ridership creates uncertainty and acts as a clear disincentive to pursue programs that are often in areas with the greatest savings potential. As an example, the Company may have focused additional resources on prescriptive programs where assumptions are not subject to retroactive changes on free ridership.

   Furthermore, during the planning and hearing for the 2015 to 2020 DSM Plan, if it was clear that the 2015 targets were to be set with the established free ridership value but the results were to be adjusted retroactively, the Company would have made a strong case that the same consistent methodology/tool needed be used as previously, to determine an updated estimate of free ridership, to ensure an apples to apples comparison.

Witnesses: D. Bullock
D. Johnson

b) Confirmed. The statement referenced above is intended to show that if Enbridge had reduced its pursuit of very cost effective Commercial and Industrial customer projects in 2015 (and even in 2016), this would result in higher Cap and Trade offset purchases in 2017 and beyond.

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #7

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 27

Preamble: "Enbridge's long-standing practice working with contractors and installers to help influence end-user decisions undoubtedly occurs at times without customers' direct knowledge of such influence taking place."

Please provide any evidence that Enbridge's relationship with customers has led to these customers making DSM decisions that they wouldn't have made had they never worked with Enbridge.

RESPONSE

A full and complete response to this question would require the company to quote from its oral and written evidence at numerous past DSM framework, plan approvals and account clearance proceedings over many years. This is, obviously, beyond the scope of this response but an obvious short answer is that the Company, with the full knowledge and support of the Board and Stakeholders, has over the years incurred the cost of hiring and keeping DSM program managers and staff that have the specialized knowledge and experience that customers, particularly industrial and commercial customers, have benefitted from for the purposes of making conservation related decisions and incurring the associated costs. This includes not only the long-standing practice of working with contractors and installers but also working directly with customers to help educate and support the adoption of energy efficient technologies and practices.

Below are recent testimonials from customers taken from case studies for projects which were implemented as a result of our programs and the support Enbridge provided to our customers.

Enbridge Gas Distribution and KI Work to Achieve Sustainable Furniture Design Operations (2016)

"*To any industrial customers looking to get started in their energy efficiency journey, I would highly recommend reaching out to your local ESC for support. KI's partnership with Enbridge and our ESC has been a driving factor behind the success we have realized in managing our energy, reducing our natural gas consumption by 30% in 2013 and 60% over our 2007- 2009 baseline period. We look forward to the continued*

Witnesses: D. Bullock
D. Johnson

success of KI's energy conservation initiatives with the assistance of the Enbridge Team.**"** – Michael Kelly, Process Engineer, KI

<u>"Green Advantage" Turns Older Buildings Into Star Performers - Starlight Investments Ltd (2015)</u>

"*Enbridge brings experience and expertise to the table. They have worked in the same types of buildings with the same equipment, so they know what works. Their impartial advice gives us confidence in the technologies and savings numbers, and their incentives really help to improve project paybacks*." John Lucic, Executive Director, Energy & Technical Maintenance, Starlight Investments Ltd.

<u>Leveraging Occupancy Data to Reduce Building Energy Costs - University of Toronto Robarts Library (2015)</u>

"*Enbridge Gas had a huge input on the algorithm development*," commented John Walker, Operations and Maintenance Manager, "*In many cases now, we are running fans at 40% speed, saving us huge amounts of energy without impacting motor safety*." "*We ultimately surpassed our original savings forecasts*," said Walker.

<u>Enbridge Helps Magna's Plastcoat Division Achieve Energy Efficiency (2015)</u>

"*We worked closely with an Enbridge Energy Solutions Consultant to find a customized solution that fits our f*acility," says Senka Donches, Manager of Energy Efficiencies, The Americas and Global Lead Coordinator, Magna International. "*I'm pleased to say that as a result of their energy efficiency recommendations, we have reduced our natural gas consumption significantly*."

<u>Goes from Good to Great in Energy Performance-Cadillac Fairview's Simcoe Place (2015)</u>

"*All Cadillac Fairview properties are expected to improve their energy performance and we are always raising the bar. This can be quite a challenge for buildings that are already good performers. Enbridge made an important contribution to our energy saving efforts at Simcoe Place by identifying valuable solutions and backing them up with incentives*." Nathan Mordaunt, General Manager Cadillac Fairview Corporation

Witnesses: D. Bullock
D. Johnson

ENERGY PROBE INTERROGATORY #8

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3 Page 46

Preamble: "As well, applying the NTG Study values to future DSM Plan targets will result in significantly reduced targets all of which may cause concern with both rate payers and the Government of Ontario who all seek a material decrease in carbon emissions in the short term. As outlined in its submissions for the Mid-Term Review, as the level and pace of activity continues to ramp up as the Province orients itself to meet its emissions targets by spending Cap & Trade Funds, then the attribution of utility activity can only wane, resulting in even higher Free Ridership rates. Compliance Planning, and the mitigation of carbon related expenses, are predicated on gross volumes. In other words, the inevitable outcome would be less utility activity and higher carbon related Cap & Trade expenses, both of which will result in higher rates for ratepayers."

Energy Probe is interested in Enbridge's position on this issue.

a). Wouldn't higher cap and trade costs lead to greater, non-utility conservation investments?
b). Isn't this the entire point of the cap and trade program (or a carbon tax)? The environmental costs of energy usage or borne by those customers consuming energy, providing them with the perfect price signal to offset those costs if it's economic to do so?
c). Doesn't the cap and trade program (or alternative carbon tax) reduce the need for utility-run conservation programs, as the external costs of their consumption are now clear to consumers?

RESPONSE

a) Cap and Trade is a market based carbon policy that assumes the price on carbon will provide a signal to the marketplace in their purchasing and consumption decisions. However, higher costs related to increasing carbon instrument costs are one variable that factor into conservation investments. There are many other factors that influence customer decisions to make any consumption or purchasing decisions including those related to conservation. EGD recognizes that reality and aims to address all of the components that come into play for a household, business or other institution when making energy efficiency investments specifically. If energy

Witnesses: D. Johnson
F. Oliver-Glasford

efficiency investments were purely a financial decision, then all projects with an acceptable payback would be implemented. Through Enbridge's long history in energy conservation it knows that this is not the case and has designed programs to target additional barriers to energy efficiency.

b) Please see response to a).

c) As described in the response to part a), price signals are only one of the factors in customer decisions around energy efficiency investments that EGDs programs target.

Witnesses: D. Johnson
F. Oliver-Glasford

GEC INTERROGATORY #1

INTERROGATORY

Regarding Exh. A/Tab 1/Sch 3/ p. 4:

a) Please confirm that the only difference between the Shareholder Incentive and Lost Revenue values under the “Audit Opinion of EC” and “Enbridge Application” columns is that the Enbridge Application includes different Custom Measure NTG assumptions than the EC.
b) If there are differences other than Custom Measure NTG assumptions, please identify all other such differences and explain the basis for them.
c) Please provide Enbridge’s calculation of its proposed shareholder incentive, including all relevant assumptions at the measure level (provide at the projector program level for cases in which measure level information was not used), in an Excel spreadsheet with all formulae intact. The calculations provided should include, at a minimum, each of the following for the most disaggregated level available:
    i. the measure name/description (or project or program, if measure level information was not used);
    ii. the number of units participating;
    iii. the gross per unit first year m^3 savings;
    iv. the measure life;
    v. the gross total first year savings across all units (i.e. units multiplied by first year savings);
    vi. the gross total lifetime savings across all units (i.e. units multiplied by first year savings multiplied by measure life);
    vii. the NTG assumption;
    viii. the net total first year savings (i.e. units multiplied by first year savings multiplied by NTG ratio); and
    ix. the net total lifetime savings (i.e. units multiplied by first year savings multiplied by measure life multiplied by NTG ratio).

Witnesses: D. Bullock
D. Johnson

RESPONSE

a) In undertaking this comparison it appears that although the EC fully verified Enbridge's performance with regard to the Low Income (Part 3) Building Performance Metric (i.e., 100% verified), which uses a percentage achievement value, the EC completed their calculation using a rounded percent score with fewer decimal places than that used in Enbridge's calculation. As such there is a rounding difference of $44.

Otherwise Enbridge confirms that the only difference between the Shareholder Incentive and Lost Revenue values under the "Audit Opinion of EC" and "Enbridge Application" columns outlined below is that the Enbridge Application applied different custom measure NTG assumptions than those applied by the EC.[1]

2015 DSM Achieved Savings, Shareholder Incentive, and Lost Revenue	**Enbridge Pre-Audit**	**Audit Opinion of EC**	**Enbridge Application**
Shareholder Incentive	$10,318,594	$ 6,207,339	$ 10,077,695
Lost Revenue	$28,800	$ 16,405	$ 28,216
DSMVA	$ 825,460	$ 825,460	$ 825,460

b) see response to a)

c) In response to part c), Enbridge has modified the EC's tool that was provided to the EAC, and used it to illustrate the DSMI calculation for Enbridge's Application. The tool provided by the EC originally utilized the NTG ratios as provided in the EC's Annual Verification Report.[2] Enbridge has similarly used this tool but instead applied the custom measure NTG ratios reflected in Enbridge's Application. Therefore, the only cells requiring updates are highlighted in yellow in the "Resource Acquisition" tab. This spreadsheet has been attached to this IR response.

The EC did not provide the EAC with a breakdown of its shareholder incentive calculation to the level of disaggregation requested above.

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[1] The table reproduced above reflects updated evidence filed by Enbridge on March 26, 2017 to correct a minor mathematical error in the LRAM calculation in Enbridge's original application. This minor adjustment resulted in a $760 reduction in Enbridge's earlier LRAM claim.
[2] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, Dec 20, 2017.

Witnesses: D. Bullock
D. Johnson

		Tracking				Verification Results		Verified Savings		There is no spillover for Low Income
		Gross Annual	Gross CCM	Net Annual	Net CCM	Gross RR	Net RR	Gross CCM	Net CCM	
LI Multi-Family	Custom	3,061,043	63,801,575	3,061,043	63,801,575	91%	100%	58,365,681	58,365,680.81	
	Prescriptive: showerheads	226,389	2,263,890	198,543	1,985,432	88%	100%	1,985,432	1,985,432	THIS ROW HAS REMOVAL RATE IN IT
	Prescriptive: all other	137,591	3,439,775	137,591	3,439,775	105%	100%	3,618,241	3,618,241	
	Total	**3,425,023**	**69,505,240**	**3,397,177**	**69,226,782**	**92%**	**100%**	**63,969,354**	**63,969,354**	
Single Family	Winterproofing	1,128,367	28,209,176	1,128,367	28,209,176	99%	100%	27,927,084.24	27,927,084.24	
	Prescriptive: Novitherm and stats	3,434	53,226	3,434	53,226	108%	100%	57,250	57,250	
	Prescriptive: bathroom aerators	3,437	34,368	638	6,379	23%	100%	7,733	7,733.00	THIS ROW HAS REMOVAL RATE IN IT
	Prescriptive: kitchen aerators	4,532	45,315	1,500	14,999	33%	100%	14,999	14,999.00	THIS ROW HAS REMOVAL RATE IN IT
	Prescriptive: showerheads	6,864	68,640	6,020	60,197	88%	100%	60,197	60,197.00	THIS ROW HAS REMOVAL RATE IN IT
	Total	**1,146,633**	**28,410,725**	**1,139,959**	**28,343,978**	**99%**	**100%**	**28,067,263**	**28,067,263**	
Total		**4,571,656**	**97,915,965**	**4,537,136**	**97,570,759**	**94%**	**100%**	**92,036,617**	**92,036,617**	
Total Prescriptive		382,246	5,905,214	347,726	5,560,008	97%	100%	5,743,852	5,743,852	

The EC result is the same as the reported utility result. (65%)

Tracking Estimate		
Free Rider %		
MF Custom	0%	
MF Prescriptive	0%	showerheads
MF Prescriptive	0%	all other
Winterproofing	0%	
SF Prescriptive	0%	Novitherm and Stats
SF Prescriptive	0.00%	Bathroom aerators
SF Prescriptive	0.00%	Kitchen aerators
SF Prescriptive	0.00%	showerheads

Removal rate		
MF Prescriptive	12.3%	showerheads
SF Prescriptive	77.50%	Bathroom aerators
SF Prescriptive	66.90%	Kitchen aerators
SF Prescriptive	12.30%	showerheads

Matches referenced file

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Enbridge Ratios by rate class.xlsx 9/1/2017

utility	program	rpt_prog	CPSV Adjustment	NTG Adjustment
Enbridge	Custom Commercial	Custom Commercial	91.48%	17.40%
Enbridge	Custom Commercial	Large New Construction	91.48%	18.22%
Enbridge	Custom Commercial	Multi-Residential	91.48%	35.07%
Enbridge	Custom Industrial	Agriculture	99.47%	28.17%
Enbridge	Custom Industrial	Custom Industrial	100.27%	32.87%
Enbridge	Low Income	Low Income	91.48%	100.00%
Enbridge	Run-it-right	Run-it-right	100.00%	50.06%

From Bradley; table he put in Appendix C, Enbridge section

Table 68: Enbridge Tracking and Certified Savings, Annual and Lifetime, Pure-Prescriptive Measures

Measure	Tracking Savings (m3, net)	Tracking Savings (ccm, net)	Certified Savings (m3, net)	Certified Savings (ccm, net)
LI Prescriptive - Bathroom Aerators	638	6,379	773	7,733
LI Prescriptive - Kitchen Aerators	1,500	14,999	1,500	14,999
LI Prescriptive - Novitherm Reflective Panels	572	10,296	573	14320
LI Prescriptive - Programmable Thermostats	2,862	42,930	2,862	42,930
LI Prescriptive - Showerheads 2.6+	6,020	60,197	6,020	60,197
Multi Family Low Income Showerheads	198,543	1,985,432	198,543	1,985,432

Table 69: Enbridge Tracking and Certified Savings, Annual and Lifetime, Quasi-Prescriptive Measures

Measure	Tracking Savings (m3, net)	Tracking Savings (ccm, net)	Certified Savings (m3, net)	Certified Savings (ccm, net)
LW.MR.HEBO (Space Htg)	130,116	3,252,900	137,254	3,431,359
LW.MR.HEBO (Water Htg)	7,475	186,875	7,475	186,882

		Tracking				Verification Results				Verified Savings		
		Gross Annual	Gross CCM	Net Annual	Net CCM	Gross RR	(1-FR)	Spillover	NTG	Gross CCM	Net CCM	
Home Energy Conservation		**7,956,225**	**120,488,487**	**6,762,791**	**102,415,214**	**100%**	**85%**	**0%**	**85%**	**120,488,487.07**	**102,415,214**	
	all others	1,887,743	28,521,642	1,793,356	27,095,560	97%	95%	0%	95%	27,676,474.74	26,292,651	
	Ozone washer	660,733	9,910,995	607,874	9,118,115	101%	92%	0%	92%	10,018,285.87	9,216,823	
	showerheads	1,036,656	10,366,560	788,377	7,883,769	85%	90%	0%	90%	8,759,743.33	7,883,769	THIS ROW HAS REMOVAL RATE IN IT
	Boilers	1,071,155	26,778,875	942,616	23,565,410	99%	88%	0%	88%	26,585,131.82	23,394,916	
Commercial Prescriptive	MF boiler, dish stationary, fryer, oven, cooker	1,067,451	19,738,277	853,961	15,790,622	97%	80%	0%	80%	19,233,963.75	15,387,171	
	dish conveyor	73,781	1,475,620	53,860	1,077,203	100%	73%	0%	73%	1,475,620	1,077,202.60	
	infrared	1,053,455	21,069,100	705,815	14,116,297	100%	67%	0%	67%	21,069,100.48	14,116,297.32	
	dish undercounter	7,791	77,910	4,675	46,746	102%	60%	0%	60%	79,330	47,598	
	Total	**6,858,765**	**117,938,979**	**5,750,534**	**98,693,722**	**97%**			**85%**	**114,897,650**	**97,416,428**	
Commercial Custom		**14,007,133**	**210,800,594**	**12,326,277**	**185,504,523**	**91%**	**88%**	**0%**	**88%**	**192,840,383.39**	**169,699,537**	
Run it Right		**536,821**	**2,684,105**	**536,821**	**2,684,105**	**100%**	**100%**	**0%**	**100%**	**2,684,105**	**2,684,105.00**	
Multiresidential		**7,363,563**	**152,593,766**	**5,890,850**	**122,075,013**	**91%**	**80%**	**0%**	**80%**	**139,592,777.17**	**111,674,222**	
New Construction		**4,091,779**	**102,294,475**	**3,027,916**	**75,697,912**	**91%**	**74%**	**0%**	**74%**	**93,578,985.73**	**69,248,449.44**	
Industrial Custom		**22,195,244**	**336,500,502**	**11,097,622**	**168,250,251**	**100.27%**	**50%**	**0%**	**50%**	**337,417,582.15**	**168,708,791.07**	
	all others	80,729	1,210,935	76,693	1,150,388	100%	95%	0%	95%	1,210,935	1,150,388.25	
Industrial Prescriptive	infrared	480,792	9,615,850	322,131	6,442,619	100%	67%	0%	67%	9,615,849.82	6,442,619.38	
	Total	**561,521**	**10,826,785**	**398,824**	**7,593,008**	**100%**			**70%**	**10,826,785**	**7,593,008**	
Industrial Ag		**611,305**	**7,856,800**	**366,783**	**4,714,080**	**99%**	**60%**	**0%**	**60%**	**7,815,133.07**	**4,689,079.84**	
Total		**64,182,357**	**1,061,984,493**	**46,158,419**	**767,627,826**	**96%**			**72%**	**1,020,141,888**	**734,128,834**	
Total Custom		48,805,845	812,730,242	33,246,270	558,925,883	95%			68%	773,928,967	526,704,184	
Total Prescriptive		7,420,287	128,765,764	6,149,357	106,286,729	98%			84%	125,724,435	105,009,436	
Custom not RiR		48,269,024	810,046,137	32,709,449	556,241,778	95%			68%	771,244,862	524,020,079	
Custom not RiR or New Construction		44,177,245	707,751,662	29,681,532	480,543,867	96%			67%	677,665,876	454,771,630	

The EC found 5,646 qualifying deep savings participants, which is the same number reported by the utility.

Tracking Estimate
Free Rider %

Home Energy Conservation	15%	
Commercial Prescriptive	5%	all others
Commercial Prescriptive	8%	Ozone washer
Commercial Prescriptive	10%	showerheads
Commercial Prescriptive	12%	Boilers
Commercial Prescriptive	20%	MF boiler, dish stationary, fryer, oven, cooker
Commercial Prescriptive	27%	dish conveyor
Commercial Prescriptive	33%	infrared
Commercial Prescriptive	40%	dish undercounter
Commercial Custom	12%	
Run it Right	0%	
Multiresidential	20%	not showerheads
New Construction	26%	
Industrial Custom	50%	
Industrial Prescriptive	5%	all others
Industrial Prescriptive	33%	Infrared
Industrial Ag	40%	

Removal rate
Showerheads 15.50%

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Enbridge Ratios by rate class.xlsx 9/1/2017

rpt_prog	CPSV Adjustment	NTG Adjustment	
Custom Commercial	91.48%	88.00%	ok
Large New Construction	91.48%	74.00%	ok
Multi-Residential	91.48%	80.00%	ok
Agriculture	99.47%	60.00%	ok
Custom Industrial	100.27%	50.00%	ok
Run-it-right	100.00%	100.00%	ok

SUMMARY WHERE DIFFERENCES

Measure	Tracking Savings (m3, net)	Tracking Savings (ccm, net)	Certified Savings (m3, net)	Certified Savings (ccm, net)
Ozone	607,875	9,118,115	614,456	9,216,823
RA.DISH.ST.RACK.HT, RA.DISH.S	853,962	15,790,621	832,012	15,387,171
RA.HEBO, RA.SCH.P	942,616	23,565,410	935,796	23,394,916
RA.DISH.HT	4,675	46,746	4,760	47,598
RA.SHA*	788,377	7,883,769	788,377	7,883,769
All Other (not all others but the	1,793,325	27,095,562	1,739,824	26,292,651
*thought there was difference for draft; was corrected for final			-6	820965
			-3	4255560
			3	1618005

From Bradley; table he put in Appendix C, Enbridge section

Table 68: Enbridge Tracking and Certified Savings, Annual and Lifetime, Pure-Prescriptive Measures

Measure	Tracking Savings (m3, net)	Tracking Savings (ccm, net)	Certified Savings (m3, net)	Certified Savings (ccm, net)	
RA.AIR	5,703	85,543	5,703	85,543	
RA.AIR.2	15,978	239,671	15,978	239,671	
RA.AIR.4	17,968	269,525	17,968	269,525	
RA.AIR.4.IND	17,968	269,525	17,968	269,525	
RA.AIR.5	78,299	1,174,485	78,299	1,174,485	
RA.AIR.5.IND	58,724	880,864	58,724	880,864	
RA.DCKV.1	54,731	820,971	43,963	659447	
RA.DCKV.2	283,704	4,255,563	259,770	3896549	
RA.DCKV.3	107,867	1,618,002	99,915	1498730	
RA.DISH.HT	1,278	12,780	1,363	13,632	UNDERCOUNTER
RA.DISH.LT	3,397	33,966	3,397	33,966	UNDERCOUNTER
RA.DISH.RACKCON.MULTI.LT	1,802	36,047	1,802	36,047	CONVEYOR
RA.DISH.RACKCON.SINGL	818	16,352	818	16,352	CONVEYOR
RA.DISH.RACKCON.SINGL LT	51,240	1,024,803	51,240	1,024,803	CONVEYOR
RA.DISH.ST.RACK.HT	24,341	365,112	25,078	376,176	
RA.DISH.ST.RACK.LT	376,512	5,647,680	361,248	5,418,720	
RA.FS.FRYER	105,882	1,270,579	105,882	1,270,579	
RA.FS.OVEN	6,228	74,736	6,228	74,736	
RA.FS.STCOOK	7,111	85,334	7,111	85,334	
RA.SCH.P (Elementary School)	193,517	4,837,932	193,517	4,837,932	
RA.SCH.P (Secondary School)	261,233	6,530,832	261,233	6,530,832	
RA.SHA	788,377	7,883,769	788,377	7,883,769	The Enbridge net value (and the DNV GL-verified value) already have the removal rate in it.

Table 69: Enbridge Tracking and Certified Savings, Annual and Lifetime, Quasi-Prescriptive Measures

Measure	Tracking Savings (m3, net)	Tracking Savings (ccm, net)	Certified Savings (m3, net)	Certified Savings (ccm, net)
RA.CB 1 (Space Htg)	1,046	26,149	1,045	26,137
RA.CB 2 (Space Htg)	13,485	337,131	13,485	337,123
RA.CB 3 (Space Htg)	40,746	1,018,661	38,664	966,598
RA.CB 3 (Water Htg)	0	0	2,082	52,041
RA.COND.MUA	11,845	178,125	11,590	173,850
RA.DCV - 10 Year ML - Retail	44,099	440,990	44,099	440,989
RA.DCV - 15 Year ML - Commercial	21,260	318,901	10,767	161,498
RA.DCV - 15 Year ML - Retail	942,814	14,142,213	942,820	14,142,305
RA.ERV 1	51,041	714,569	51,041	714,569
RA.ERV.3	5,772	80,811	5,772	80,811
RA.HEB.199	1,248	31,208	1,248	31,192
RA.HEB.99	272	6,793	272	6,797
RA.HEBO (Space Htg)	486,228	12,155,704	479,409	11,985,219
RA.HEBO (Water Htg)	1,638	40,942	1,637	40,933
RA.HEBO.MR (Space Htg)	288,426	7,210,640	296,885	7,422,115
RA.HEBO.MR (Water Htg)	45,462	1,136,540	29,580	739,511
RA.HRV	19,465	272,504	19,464	272,497
RA.HRV.2	1,736	24,299	1,632	22,841
RA.HRV.3	74,246	1,039,448	74,247	1,039,453
RA.INFRD	5,345	106,900	5,345	106,900
RA.INFRD.2	266,827	5,336,535	266,827	5,336,535
RA.INFRD.3	133,193	2,663,855	133,193	2,663,855
RA.INFRD.4	3,243	64,856	3,243	64,856
RA.INFRD.5	83,262	1,665,240	83,262	1,665,240
RA.INFRD.6	213,946	4,278,912	213,946	4,278,912
RA.INFRD.IND.2	154,664	3,093,283	154,664	3,093,283
RA.INFRD.IND.3	129,525	2,590,496	129,525	2,590,496
RA.INFRD.IND.5	17,999	359,976	17,999	359,976
RA.INFRD.IND.6	19,943	398,864	19,943	398,864
RA.OZ	157,130	2,356,943	168,221	2,523,310
RA.OZ.2	44,366	665,491	44,366	665,488
RA.OZ.3	223,036	3,345,534	227,129	3,406,931
RA.OZ.5	183,343	2,750,147	174,740	2,621,094

	Tracking				Verification Results		Verified Savings	
Offering	Gross Annual	Gross CCM	Net Annual	Net CCM	Gross RR	Net RR	Gross CCM	Net CCM
Home Energy Conservation	7,956,225	120,488,487	6,762,791	102,415,214	100%	85%	120,488,487	102,415,214
Commercial Prescriptive	6,858,765	117,938,979	5,750,534	98,693,722	97%	85%	114,897,650	97,416,428
Commercial Custom	14,007,133	210,800,594	12,326,277	185,504,523	91%	88%	192,840,383	169,699,537
Run it Right	536,821	2,684,105	536,821	2,684,105	100%	100%	2,684,105	2,684,105
Multiresidential	7,363,563	152,593,766	5,890,850	122,075,013	91%	80%	139,592,777	111,674,222
New Construction	4,091,779	102,294,475	3,027,916	75,697,912	91%	74%	93,578,986	69,248,449
Industrial Custom	22,195,244	336,500,502	11,097,622	168,250,251	100%	50%	337,417,582	168,708,791
Industrial Prescriptive	561,521	10,826,785	398,824	7,593,008	100%	70%	10,826,785	7,593,008
Industrial Ag	611,305	7,856,800	366,783	4,714,080	99%	60%	7,815,133	4,689,080
Total RA	**64,182,357**	**1,061,984,493**	**46,158,419**	**767,627,826**	**96%**	**72%**	**1,020,141,888**	**734,128,834**
LI Multi-Family	3,425,023	69,505,240	3,397,177	69,226,782	92%	100%	63,969,354	63,969,354
Single Family	1,146,633	28,410,725	1,139,959	28,343,978	99%	100%	28,067,263	28,067,263
Total LI	**4,571,656**	**97,915,965**	**4,537,136**	**97,570,759**	**94%**	**100%**	**92,036,617**	**92,036,617**

	Tracking				Verification Results		Verified Savings	
All Prescriptive	Gross Annual	Gross CCM	Net Annual	Net CCM	Gross RR	Net RR	Gross CCM	Net CCM
commercial prescriptive	6,858,765	117,938,979	5,750,534	98,693,722	97%	85%	114,897,650	97,416,428
industrial prescriptive	561,521	10,826,785	398,824	7,593,008	100%	70%	10,826,785	7,593,008
LI prescriptive	382246.32	5905214.2	347725.7341	5560008.341	97%	100%	5743852	5743852
Total	7,802,533	134,670,978	6,497,083	111,846,738	98%	84%	131,468,287	110,753,288

2015 DSMIDA SCORECARD

Program Type	Sector	Current Method			Performance Band			Actual YTD
Resource Acquisition Total			**Actual YTD**	**Weight**	**Lower**	**Middle**	**Upper**	**Score**
Resource Acquisition	Res/Comm/Ind	Target (CCM)	734.13	92%	**758.9**	**1011.9**	**1264.9**	45%
Residential deep savings	Existing Residential	# of customers >25% savings	5,646	8%	**571**	**762**	**952**	1385%
						Weighted Score		152.32%
RA Total DSMIDA					**$ -**	**$ 2,593,097**	**$ 6,482,744**	**$6,482,744**
Low Income Total			**Actual YTD**	**Weight**	**Lower**	**Middle**	**Upper**	**Score**
Low Income	Residential Winterproofing	Part 9	28.07	50%	**18.1**	**24.1**	**30.2**	133%
Low Income	Commercial Multi-Residential	Part 3	63.97	45%	**51.6**	**68.7**	**86.0**	86%
Low Income	Commercial Run It Right	Part 3 - RIR	64.7%	5%	**30%**	**40%**	**50%**	224%
						Weighted Score		116.2%
LI Total DSMIDA					**$ -**	**$ 998,288**	**$ 2,495,721**	**$1,483,792**
SBD Residential Total (MT)			**Actual YTD**	**Weight**	**Lower**	**Middle**	**Upper**	**Score**
Market Transformation	Residential New Construction	SBD Res Top 80	19	60%	**13**	**18**	**22**	113%
Market Transformation	Residential New Construction	SBD # Units	1,987	40%	**833**	**1111**	**1389**	258%
						Weighted Score		170.52%
MT Total DSMIDA					**$ -**	**$ 430,597**	**$ 1,076,493**	**$1,076,493**
SBD Commercial Total (MT)			**Actual YTD**	**Weight**	**Lower**	**Middle**	**Upper**	**Score**
Market Transformation	Commercial New Construction	SBD Commercial	24	100%	**11**	**18**	**24**	150%
						Weighted Score		150.00%
MT Total DSMIDA					**$ -**	**$ 167,308**	**$ 418,269**	**$418,269**
Home Labeling Total (MT)			**Actual YTD**	**Weight**	**Lower**	**Middle**	**Upper**	**Score**
Market Transformation	Existing Residential	Home Rating	41,650	50%	**-**	**5,001**	**10,001**	466%
Market Transformation	Existing Residential	Home Rating : # voluntary reports	333	50%	**2,250**	**4,500**	**6,750**	7%
						Weighted Score		236.95%
MT Total DSMIDA					**$ -**	**$ 246,559**	**$ 616,397**	**$616,397**

TOTAL DSMIDA AVAILABLE		TOTAL DSMIDA
Middle	**Upper**	**Actual YTD**
$ 4,435,849	**$ 11,089,624**	**$10,077,695**

GEC INTERROGATORY #2

INTERROGATORY

Regarding Exh. A/Tab 1/Sch 3/pp. 4-5, paragraphs 8-12: Enbridge lists five reasons why the EC report should not be accepted by the Board. The fifth reason is that errors were made throughout the audit.

a) Please confirm that only errors in the EC's final report are those noted in footnote 4 of Enbridge filing. If there are others, please explain.
b) If the EC were to file a report correcting the errors noted in footnote 4 of Enbridge's filing, would the Company remove the objections raised in paragraph 12? Or is the Company suggesting that because errors were made during the audit process, the EC's report is problematic, even if all identified errors were corrected? Please explain the response.

RESPONSE

a) Enbridge cannot confirm that the only errors in the EC's 2015 Natural Gas DSM Annual Verification including the 2015 Custom Savings Verification and Free-ridership Evaluation are those identified in footnote 4 as we did not have access to all the required data to undertake a full review. Enbridge can confirm that footnote 4 does however highlight that there were specific errors that Enbridge was able to identify in the process of filing its evidence in this Application.

b) Enbridge was not in a position to review the calculations done by the EC to determine its proposed NTG adjustments, however, in the process of preparing this Application, Enbridge did uncover significant errors in our final analysis of the EC's calculations of CPSV adjustments where the back-up details were provided. While it is appropriate for the EC to file a report correcting the errors noted in footnote 4, without having the opportunity to review the detailed NTG calculations, Enbridge does not have confidence in the EC's report because it is unable to confirm that all errors have been identified.

Witnesses: D. Bullock
D. Johnson

GEC INTERROGATORY #3

INTERROGATORY

Regarding Exh. A/Tab 1/Sch 3/p. 11, paragraph 26: Enbridge states that "the March 4, 2016 letter from the Board did not contemplate that OEB Staff could unilaterally alter of change the scope of DNV's work already underway."

a) Is Enbridge suggesting that the Board's letter explicitly prohibited Board Staff from altering DNV's scope of work? If so, please explain the basis for that interpretation, including references to specific language in the letter that supports Enbridge's interpretation.
b) If the answer to part "a" of this question is "no", is Enbridge suggesting that the Board's letter would have had to explicitly direct Staff to change the scope of work in order for Staff to be permitted to make any changes? If so, what is the basis for that conclusion?

RESPONSE

a) No.

b) No. Please reference Enbridge's response to SEC Interrogatory #3, found at Exhibit I.EGDI.SEC.3.

Witnesses: D. Bullock
D. Johnson

GEC INTERROGATORY #4

INTERROGATORY

Regarding Exh. A/Tab 1/Sch 3/p. 23, paragraph 58: Enbridge states that NTG ratios would have been 10% higher when secondary attribution is correctly included in the value. Please provide an estimate of how just changing the NTG to include secondary attribution effects would change the EC's estimates of first year savings, lifetime savings and the $6.207 million shareholder incentive shown on Exh A/T1/S3 p. 4.

RESPONSE

As the Company has made clear in its evidence, Enbridge is of the view that the Board's Decision and Order (January 20, 2016) and Revised Decision and Order (February 24, 2016) in respect of the Company's 2015-2020 Multi-year DSM Plan (EB-2015-0049) does not provide that the net-to-gross factors which have been proposed by the EC are to be used in the evaluation of the Company's 2015 DSM program year results in a retroactive manner. To be clear, Enbridge does not believe the Board's direction is consistent with retroactive application of NTG values undertaken by the EC for the purposes of the evaluation of the Company's 2015 DSM results.

Notwithstanding the Company's view, for the purposes of providing a response to this interrogatory, Enbridge has taken the following steps:

1) Enbridge referenced the CCM values recommended by the EC which factored into their calculation of $6,207,339 DSMI
2) Enbridge utilized the EC's calculation worksheet and applied the Secondary Attribution Ratios for each of the Commercial and Industrial Custom Project Domains outlined in Table 8-58 of the EC's 2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation dated October 12, 2017 and included with the EC's 2015 Natural Gas Demand Side Management Annual Verification report[1]
3) Recalculating the EC's values with the inclusion of both the Primary and Secondary attribution finding of the EC provides an estimate of the impact of capturing all quantified attribution outlined in the NTG study on the EC's verified results.

[1] EB-2015-0245, Ontario Gas DSM Evaluation Contractor, 2015 Natural Gas Demand Side Management Annual Verification, Dec, 20, 2017, page F-2.

Witnesses: D. Bullock
D. Johnson

The following table summarizes the EC's values without inclusion of secondary attribution (in column A) as well as the re-calculations as outlined above with the inclusion of secondary attribution (column B).

	A Audit Opinion of EC **without** inclusion of secondary attribution	**B** **Audit Opinion of EC with inclusion of secondary attribution estimates**
CCM (lifetime) gas savings*	539,787,741 m^3	**604,691,217 m^3**
Shareholder Incentive (DSMI)	$ 6,207,339	**$ 7,125,344**

*Based on the information provided in the EC's calculation tool, the Company is unable to estimate the impact to first year savings.

Witnesses: D. Bullock
D. Johnson

GEC INTERROGATORY #5

INTERROGATORY

Regarding Exh. B/Tab 1/Sch 1 p. 30 of 117, TRC Plus Screening results shown in table 4.4 and PAC screening results shown in Table 4.5 of Enbridge's 2015 DSM Annual Report

a) Please provide a break-down into the following categories, by program and for the portfolio of programs as whole, of the NPV of TRC Benefits:
   i. Gas benefits (without adders)
   ii. Electric benefits (without adders)
   iii. Water benefits
   iv. Non-energy benefits (i.e. the portion of gas and electric benefits associated with a 15% non-energy benefits adder)

b) Please provide all of the assumptions and calculations underpinning the TRC Plus cost- effectiveness results. Please provide them in Excel, with all formulae intact, disaggregated at the measure level (wherever possible). The assumptions should include:
   i. Measure name
   ii. Number of measures (used for gross savings calculations)
   iii. Per unit incremental cost
   iv. Per unit incentive/rebate cost
   v. Per unit gross first year gas savings
   vi. Per unit gross first year electric savings
   vii. Per unit water savings
   viii. Measure life
   ix. Net-to-gross assumption
   x. Avoided gas costs, with and without non-energy benefits adder
   xi. Avoided electric costs, with and without non-energy benefits adder
   xii. Avoided water costs
   xiii. Discount rate
   xiv. Other program costs (i.e. other than rebates/incentives)
   xv. Other portfolio costs (i.e. other than rebates/incentives)

c) For each measure, please also provide each of the following outputs of the cost-effectiveness calculations:
   i. NPV of TRC Plus costs,
   ii. NPV of PAC costs
   iii. NPV of TRC Plus gas benefits

Witnesses: D. Bullock
D. Johnson

iv. NPV of TRC Plus electric benefit
v. NPV of TRC plus water benefits
vi. NPV of TRC Plus total benefits
vii. NPV of PAC benefits
viii. TRC Plus Benefit-cost ratio
ix. PAC benefit-cost ratio

RESPONSE

a) Enbridge provided the requested cost-effectiveness data to the EC as part of their 2015 DSM Verification. The results of the EC's 2015 evaluation outcomes were included in their 2015 Annual Verification Report.[1] This report does not, however, disaggregate the NPV of TRC Benefits as outlined above.

b) Enbridge provided the requested cost-effectiveness data to the EC as part of their 2015 DSM Verification. The results of the EC's 2015 evaluation outcomes were included in their 2015 Annual Verification Report.[2]

The EC did not provide the EAC with their final cost-effectiveness model used to calculate the EC's final results included in 2015 Annual Verification Report.[3] However, Enbridge can provide the following references in response to this Interrogatory.

i. EC verified measure level savings can be found in Appendix C of the 2015 Annual Verification Report.[4]

ii. The total number of measures by offer was provided in Enbridge's Final Annual Report in tables 5.4 [5] and 5.5. [6]

iii., v.-ix. These input assumptions were based on the Joint Input Assumption Filing for New and Updated DSM Measures, EB-2014-0354, for prescriptive projects, as identified in Appendix A: Input Assumptions in

[1] EB-2015-0245, Ontario Gas DSM Evaluation Contractor, 2015 Natural Gas Demand Side Management Annual Verification, Dec 20, 2017.
[2] Ibid.
[3] Ibid.
[4] Ibid, page C-1.
[5] EB-2017-0324, Application and Evidence, Exhibit B, Tab 1, Schedule 1, page 41 of 117.
[6] Ibid, page 60 of 117.

Enbridge's Final Annual Report[7].

iv. Per unit incentives are outlined in Enbridge's Final Annual Report in sections 5.1 [8], 5.2 [9] [10], and 5.3.[11]

x.-xiii. Avoided gas, electric, and water costs as well as the discount rate are provided in Appendix B: 2015 Avoided Costs of Enbridge's Final Annual Report.[12] The 15% non-energy benefit adder in the TRC calculation is applied in aggregate as part of the TRC-plus test as outlined in the Board's Decision (it represents 15% of the NPV of total avoided costs).

xiv.-xv. All program and portfolio costs are provided in Table 10.1 of Enbridge's Final Annual Report.[13]

c) The EC did not provide the EAC with their final cost-effectiveness model used to calculate the EC's final results included in 2015 Annual Verification Report.[14] As a result, Enbridge cannot provide the details of this request.

[7] Ibid, page 115 of 117.
[8] Ibid, page 37 of 117.
[9] Ibid, page 45 of 117.
[10] Ibid, page 47 of 117.
[11] Ibid, page 58 of 117.
[12] Ibid, pages 116-117 of 117.
[13] Ibid, page 108 of 117.
[14] EB-2015-0245, 2015 Natural Gas Demand Side Management Annual Verification, Dec 20, 2017.

Witnesses: D. Bullock
D. Johnson

OSEA INTERROGATORY #1

INTERROGATORY

Reference: Exhibit A, Tab 1, Schedule 3, Page 3 of 48

Preamble:

Enbridge has identified the following primary concerns with the Board Staff coordinated 2015 verification process and results:

- The evaluation and audit process lacked the appropriate and necessary degree of transparency, collaboration, efficiency and balanced stakeholder input to ensure a fair and credible process and result;
- The retroactive application of the NTG ratios from the NTG Study is inappropriate and contrary to the Board's earlier Direction and is both inappropriate and inconsistent with best practices.
- The determination of NTG ratios in the NTG Study by DNV are inappropriate and flawed in that the NTG Study deviated from the appropriate scope of work and did not reflect industry best practice.

a) Please outline the timetable and major events for:
   i. the 2015 evaluation and audit process completed by the Evaluation Contractor
   ii. the evaluation and audit process for previous years when Enbridge managed the process with participation of the Technical Evaluation Committee (TEC) and each of the company specific Evaluation Committee (EC) post 2011.

b) Please advise what Enbridge recommends to reduce delays seen in the 2015 EM&V process.
c) Please advise what takeaways from the previous process, where the Technical Evaluation Committee (TEC) and company specific Evaluation Committees operated primarily on a consensus basis with intervenor representatives, can be used to improve collaboration within the EM&V process moving forward.
d) Please list the major decisions during the EM&V process that were directed by Board staff rather than the EAC.
e) Was Enbridge informed whether the expert members of the EAC were informed of these directions in advance?
f) Please describe any specific improvements in the current EM&V process compared to the Stakeholder developed process approved by the Board in the 2011 proceeding.

Witnesses: D. Bullock
D. Johnson

g) Please outline the impacts of the delayed 2015 EM&V process on the following:
    i. Customers and customer representatives
    ii. Company Evaluation Staff
    iii. Commercial and Industrial Customer representatives
    iv. Company Program Development Staff.

h) Please outline the impact of the lack of transparency on the following, including any differences between the process established in 2011 and the current process:
    i. Decision making
    ii. Participation of Enbridge representatives on the EAC
    iii. Participation of Expert representatives, and
    iv. Enbridge's ability to replicate evaluation results and understand the application of the modelling and other processes used by the Evaluation Contractor and the direction provided to subcontractors.

i) Please describe the top three major impacts to audit results resulting from any deviation from best practices.

j) Please describe Enbridge's view of the process and results of the following:
    i. Free Riders, including the validity of survey results, transparency of modelling survey comments, and assessment of customer responses.
    ii. Spillover, including the application of deemed results from study estimates in the United States.

RESPONSE

a) i) See the response to SEC Interrogatory #21, found at I.EGDI.SEC.21.

   ii) See the response to BOMA Interrogatory #6, found at I.EGDI.BOMA.21.

b) Enbridge shared recommendations for improvements with Board Staff including:

- the establishment of a charter/terms of reference to clearly outline roles and responsibilities for the EAC.

- the establishment of a single comprehensive project timeline with input from all stakeholders at the outset of the process with constant updates and reviews throughout the process to better manage priorities, activities and deadlines, and reset as needed.

Witnesses: D. Bullock
D. Johnson

- Reconsider having the EC use its own tool to make adjustments and calculate CCM, DSMI and LRAM. Given it was challenging and time consuming to reproduce the adjusted results (and errors were identified), and work back into the utilities calculation tools in order to finalize the Company's Annual Report and file a Clearance application.

- Inclusion of live calculations by EC to support understanding of adjustments and avoid unnecessary comments/review.

c) Lessons from the previous process:

- Ensure that there is an EAC charter established which outlines that the EAC with OEB staff have a primary objective of striving for consensus; and clarifies the roles/responsibilities of the various parties

- Ensure appropriate transparency and consultation is maintained, and ensures no single party makes decisions on material matters.

- Record meeting discussions, outcomes, agreements and takeaways to avoid confusion and ensure transparency

- Ensure a clear comprehensive timeline is laid out in advance which addresses all planned activities, with input from all stakeholders

- Ensure scopes of work are established and agreed to early in the process and fully adhered to throughout

- Involve stakeholders ("EAC") in the contractor selection process and fully disclose budgets for evaluation activities

d) For clarity, the EAC is an advisory committee formed as part of the OEB-led governance structure to provide input, advice and expert guidance to the EC and OEB Staff on evaluation activities undertaken. All decisions relating to the 2015 process were ultimately made by the EC and / or OEB Staff. Though Enbridge can only comment on actions that were apparent to the Company, there were occasions where OEB staff directed the EC, or decided with the EC, to take action without EAC consultation. See the response to SEC Interrogatory #5, found at I.EGDI.SEC.5 for details.

Witnesses: D. Bullock
D. Johnson

e) Enbridge has no record and is therefore unaware of any communication which would indicate that the expert members of the EAC were informed of these directions in advance.

f) See the response to SEC Interrogatory #2, found at I.EGDI.SEC.2.

g) i. Impacts to customers and customer representatives:

- Customers involved in the CPSV / NTG reviews were confused by the delay. In some cases staff had changed or were no longer employed with the customer and knowledgeable contacts involved at the time of the evolution and implementation of the project were no longer accessible. In other cases, given the time elapsed, customers had to investigate project details to attempt to answer verification questions. Additionally, since customers may undertake more than a single project at a facility and in some instances, with limited details regarding the interviews in advance, customers reported being unprepared for which particular projects were in question. Enbridge expects this was compounded with the delay between project implementation and verification/NTG follow-ups.

- Clearance of 2015 variance account amounts will not impact customers (will not be cleared in rates) until 2018, and delays increase the likelihood that customer composition in each rate class will not be consistent from 2015. In addition, depending on the timing of the 2016 and 2017 evaluation processes, customers could see rate impacts for multiple DSM program years over a short time period.

ii. Company Evaluation Staff

- The delayed 2015 process has meant that evaluation staff have not been able to relay audit recommendations and outcomes to the DSM group in a timely manner. As such, outcomes from the 2015 audit, delivered in late 2017, can only be considered for the 2018 program year.

- Given uncertainty with budgets for OEB-led evaluation efforts that are spanning multiple years, evaluation staff had difficulty planning other evaluation work to help evolve program improvements.

- Resourcing issues with evaluation staff supporting various evaluation efforts across multiple years has proved challenging.

Witnesses: D. Bullock
D. Johnson

iii. Commercial and Industrial Customer representatives

- Commercial/Industrial ESCs have been called upon to research details/contact information and source data for projects which were completed two years prior. This was compounded with internal staff changes/turnover. These ESCs also fielded questions/concerns from customers through the process as addressed in part i. above.

iv. Company Program Development Staff

- Program development staff are responsible for the evolution of programs. The delay in the 2015 evaluation meant that program development/management staff were not able to consider audit findings and recommendations in a timely manner in an effort to enhance/improve programs in 2016 or 2017.

h) i. The nonexistence of a clear charter outlining the roles and responsibilities of the EAC, including transparency in decision making caused confusion and uncertainty for the utility. Enbridge is of the view that while some decisions were made by the EC and OEB staff with appropriate EAC input and consultation, some key decisions were made without appropriate consultation. Enbridge cannot qualify the impact of these actions to the 2015 outcomes, but is nonetheless concerned about the appropriateness of these actions.

ii. Enbridge is of the view it was not always able to fully act within its advisory role as it was not always consulted on decisions as outlined in evidence.

iii. Enbridge cannot comment on the impact to other members of the EAC. However, similar to the prior evaluation process, through the TEC and the audit committees, including experts in the current evaluation process through the EAC is positive. These experts have continued to provide insights, historical context and perspective to evaluation efforts.

iv. Enbridge had no involvement in the direction provided to subcontractors so it is unable to comment.

i) The three major impacts to audit results due to deviation from best practices are:

1. The retroactive application of NTG values relative to targets set using a different set of inputs. As outlined in evidence, Enbridge is of the view that the Board's Revised Decision and Decision in respect of the Company's 2015 -2020 Multi-

year DSM Plan (EB-2015-0049) and the DSM Framework does not provide that the net-to-gross factors which have been proposed by the EC are to be used in the evaluation of the Company's 2015 DSM program year results in a retroactive manner. Enbridge does not believe the Decision is consistent with the view of retroactivity promoted by Board Staff for the purposes of the evaluation of the Company's 2015 DSM results. As provided in evidence, leading jurisdictions are eliminating or reducing the retroactive application of NTG studies. As summarized in Navigant's Net-to-Gross Policies: Cross-Cutting Jurisdictional Review:

> 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.[1]

The Navigant report further goes on to outline:

> 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.[2]

2. The free-ridership assessment through the NTG study was impacted due to the delay in executing the interviews inherent in the self-report method. Best practice for a self-report survey is to conduct the study as soon as possible after a project is complete to mitigate factors such as recall bias. Additionally, the full assessment of the utility's influence on customers was not factored into the EC's NTG determinations as a result of the EC's exclusion of secondary attribution in the estimates.

3. Enbridge lacks confidence in the results due to limited transparency and because the NTG scope of work was not followed. Leading jurisdictions have transparent stakeholder processes that aim to have consensus among all stakeholders. Key examples are survey instruments/questions and scoring algorithms.

[1] EB-2017-0324, Application and Evidence, Exhibit B, Tab 6, Schedule 1, Page 4 of 40
[2] Ibid.

j) i. Enbridge's view is that the delay in the implementation of the NTG study surveys from the time decisions were made to undertake projects by customers, resulted in incorrect and overstated free ridership values due to issues with recall bias, ability of reaching the appropriate person, as well as biases related to respondents providing socially desirable responses.

In addition Enbridge questions the omission in the process to undertake sensitivity analysis to examine the scoring methodology particularly where subjective classifications were outlined by the EC (for example, 0 to 48 month timeline parameters in the scoring methodology for accessing timing influence; and criteria for determining the inclusion of vendor survey feedback). Though the EC in its final report provided sample attribution scores, Enbridge was not provided with sufficient information to understand how scores were determined, particularly for timing related questions.

Enbridge was unsuccessful in getting an understanding and explanation from the EC with regard to the customer responses. This might have been accomplished by providing the Company with responses to the questions in the surveys in aggregate (to maintain customer anonymity). This would have allowed the utility to review the survey results in more detail with the consultant and support improved understanding regarding the various drivers in assessing program influence as well as providing more confidence in the translation of survey results and customer feedback into a scoring algorithm. Furthermore, Enbridge requested more understanding with regard to the verbatim customer responses summarized in the EC's CPSV / NTG report in Tables 8-17 through 8-23. Though the EC states these responses were not part of the scoring algorithm, Enbridge was not able to understand and therefore reconcile how some of the responses aligned with the indication of Full, Partial or None attribution categories indicated in the tables.

ii. Enbridge does not believe it was appropriate for OEB Staff to direct the EC to undertake secondary research to identify and apply a spillover value from another jurisdiction without any EAC consultation and contrary to the approach outlined in the NTG Study scope of work.

Witnesses: D. Bullock
D. Johnson

OSEA INTERROGATORY #2

INTERROGATORY

Reference: Exhibit B, Tab 3, Schedule 1, Pages 26-27 of 50

Preamble:

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. Enbridge response: Enbridge will look at considerations to define approaches to energy savings calculations for fuel switching and district heating/cooling measures.

a) Please advise about Enbridge's status in reviewing approaches for energy saving calculations for these measures.
b) Please provide further explanation about the steps Enbridge is taking to follow the EC's recommendation about creating rules for energy saving calculations for fuel switching and district heating/cooling measures.

RESPONSE

a&b)
EGD is in the process of drafting a fuel switching policy. A key element is that the project must result in reduced overall GHG emissions. This is requiring significant consideration due to the impact of site vs source emissions in cases of fuel switching to electricity.

For district heating/cooling measures, EGD did not have any projects where savings were claimed by switching to or from a district heating/cooling system. For projects where a gas fired districting heating system supplied heat, the base case needs to be calculated for that particular case based on that systems efficiency, as different district heating systems operate differently and the efficiencies can vary significantly.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #1

INTERROGATORY

[Exhibit A, Tab 1, Schedule 3, p. 2.] Please provide an enumerated list of the benefits and disbenefits of the change in EM&V process from the previous approach, used for 2014 and prior years, and the OEB staff-led process commencing in 2015.

RESPONSE

In assessing the change in the EM&V process from the previous (2014 & prior years) approach to the OEB Staff led process effective 2015, Enbridge provides the following general observations:

Benefits:

- The implementation of the Evaluation Advisory Committee ("EAC") has centralized the efforts that were previously dispersed among the joint Technical Evaluation Committee and two separate utility Audit Committees.
- The EAC has provided a single working group allowing for the participation of more stakeholders involved in a joint evaluation and audit process of the DSM activities of both utilities.
- The EAC membership has been comprised of stakeholders with a good understanding and historical experience with the utilities' DSM programs as well as the Ontario DSM framework; and, who collectively represent and contribute varied and wide ranging knowledge, experience and insight in the advisory role to the evaluation process.

Disbenefits:

- The previous process had evolved over the course of a number of years into a robust, cooperative and efficient, technical process built on the principle of striving for consensus based outcomes; whereas the operation of the EAC through the 2015 evaluation effort was not consensus based and has resulted in a contested clearance application in this its first year.
- The previous process assured timely Final Audit Reporting such that the audit process was expeditiously completed based on the requirement that the auditor's report be completed and filed by June 30th of the year immediately following program year. Conversely, the first year of the OEB led process was delayed in getting started and has taken significantly longer in reaching completion.

Witnesses: D. Bullock
D. Johnson

- The previous process required multiple stakeholder input into the selection of consultants including the auditor and verification contractors; whereas, in the 2015 process, the EAC was excluded and was not consulted in the EC and third party consultant selection process. Both were instead determined privately by Board Staff without transparency in respect of matters previously completed in a more transparent manner such as the comparison of RFP bids, scoring matrices and the determination of winning proponents.
- The 2015 evaluation process did not provide transparency regarding the evaluation budgets contemplated for the various evaluation activities even though the utilities are expected to manage the evaluation budgets as part of their overall DSM program management. The utilities therefore have a significant challenge in attempting to budget for their own, utility directed evaluation research or program evaluation efforts.
- The process did not provide transparency regarding comments submitted by Board Staff to the EC and lacked transparency regarding the calculations used in the determination of the EC's findings.
- The process in 2015 did not provide a clear comprehensive timeline that laid out the various activities roles, responsibilities and requirements for deliverables and deadlines for all parties involved in the 2015 evaluation effort.
- The exercise did not incorporate approaches to managing effective committee operation, for example, no committee charter or terms of reference and no documentation reflecting action items, decision points and meeting minutes.
- The experience in the 2015 evaluation was one that saw Board Staff make unilateral decisions on a number of important policy decisions and/or changes to processes without appropriate consultation of the EAC.
- It is Enbridge's expectation that once all of the costs of the new 2015 evaluation process are tallied including Board and EAC costs, the process will prove to be more costly and with a loss of consensus and hence confidence in results.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #2

INTERROGATORY

[A/1/3, p. 5] Please file the draft Spillover study presented to the EAC in 2018.

RESPONSE

Enbridge does not believe it is in a position to file the draft Spillover study presented to the EAC in Q1 of 2018, given that the deliverables from the EC for this study are not the work product of Enbridge, but rather of the Board. As well, the study remains a work in progress (we understand an updated draft report is scheduled to be provided to the EAC in late April). Enbridge is therefore of the view that direction from the Board regarding this request is appropriate.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #3

INTERROGATORY

[A/1/3, p. 9, 10] Please confirm that the Applicant believes neither OEB Staff nor the EAC is allowed to modify the objectives of the NTG study from that stated by the Scope of Work approved by the TEC, or make any other changes, including improvements, to that study.

RESPONSE

In the case of the NTG study referenced above, in a meeting of the TEC which included Board Staff on November 24, 2015, Board Staff delivered a power point presentation and overview regarding the transition of TEC activities to the OEB and communicated that the Net-to-Gross Study was to be transferred to OEB/EAC to oversee after the work plan was agreed on by TEC/consultant. At a final meeting of the TEC including Board Staff on March 10, 2016, DNV presented its Scope of Work for the NTG Study, dated March 2, 2016.[1] These steps appear consistent with the Board's correspondence dated March 4, 2016 to the Utilities, the TEC and the EAC (EB-2015-0245) which specifically noted the planned TEC meeting of March 10, 2016 and provided that "following input from the TEC" the NTG would be transitioned to the Board.

Subsequently however, on June 6, 2016, without consultation with the full EAC, Board Staff emailed the EAC including a number of documents outlining proposed changes to the 2015 evaluation, combining the 2015 CPSV with the NTG study, and revising the objective of the TEC's NTG study from the development of a factor to be used on a "go forward" basis to one that would re-evaluate NTG values along with the engineering savings verification for the 2015 custom program. The approach contemplated a revised sample design and a revised "LCNS" methodology to facilitate a retrospective application of NTG adjustments on 2015 program year results.

Enbridge is of the view that under the circumstances, no individual party, including Board Staff, should unilaterally modify the objectives and / or scope of work which had been considered at length by the TEC as was the case of the scope of work for the NTG Study. More generally Enbridge is of the view that the scope of work of contractors and the consideration of all evaluation activities contemplated in the current DSM evaluation governance structure should be done with the consultation of the EAC and with the goal of achieving a consensus. It should be recognized that DSM and the

[1] EB-2017-0324, Exhibit B, Tab 5, Schedule 1, filed December 19, 2017.

evaluation of its results has been ongoing for many years and that the EM&V process can and would benefit from the experience and expertise that stakeholders bring to the exercise. This is particularly the case where issues arise around the interpretation of Board decisions and policy. Enbridge believes that changes made without appropriate consultation draw into question the reasonableness of the process and the credibility of the suggestion that such changes are improvements.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #4

INTERROGATORY

[A/1/3, p. 10] Please identify all contacts relating to EC selection between OEB Staff and EAC members, including the two utilities, prior to the selection of the EC by OEB Staff. Please file copies of all objections to the selection of DNV GL by either of the utilities prior to or within three months of the DNV GL selection as EC.

RESPONSE

Neither Enbridge, nor any member of the EAC (to the best of Enbridge's knowledge) was consulted regarding the selection of the EC by OEB Staff, therefore Enbridge was in no position to comment about any consultant selection.

Further, Enbridge did not submit objections to Board Staff within three months of the Board's selection of DNV GL as the EC.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #5

INTERROGATORY

[A/1/3, p. 12] Please describe all instances in which OEB staff “directed” the EC to take material actions without consulting with the EAC.

RESPONSE

Enbridge can only comment on actions that were apparent to the Company. Examples of material actions include:

On June 6, 2016 the EAC received documents from OEB Staff including a memo from the EC outlining changes the EC was now proposing for the NTG Study in tandem with its integration with the CPSV verification effort. The original NTG study’s objective outlined that “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.”[1] The June 6th memo outlined a free-ridership and spillover evaluation to be applied to 2015, whereby the sample designs would change as well as the calculation methodology. Evidently Board Staff had instructed the EC to revise the approach and objective of the NTG Study from that previously presented to the TEC dated March 2, 2016. No consultation with the EAC precipitated this direction.

Sometime between mid-November and mid-December, 2016, OEB Staff / EC decided, contrary to the tasks outlined in the scope of work, that they would not undertake interviews with utility staff (specifically program energy advisors) to inform the NTG study participant questionnaire (survey instrument) and proceeded to finalize the survey instrument, despite that this important task was outlined in the scope of work. No consultation with the utilities or the EAC preceded this decision.

During a conference call with the EAC on September 27, 2017, Board Staff communicated that they had instructed the EC to undertake research to identify a proxy deemed spillover value to be applied to the utilities’ 2015 program results, notwithstanding the fact that the spillover study was still ongoing and incomplete. Board Staff indicated that, rather than wait for the final results of the EC’s spillover research, the decision had been made to instead find and apply a deemed value to approximate spillover effects based on a spillover value in another jurisdiction and to then finalize the 2015 program results verification. No consultation with the utilities or the EAC preceded this decision.

[1] EB-2017-0324, Application and Evidence, Exhibit B, Tab 5, Schedule 1, page 5 of 48

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #6

INTERROGATORY

[A/1/3, p. 12] Please advise to whom, if anyone, the Applicant believes that the EC should report. If the Applicant believes that the EC should not report to anyone, please describe how the Applicant believes the EC should get instructions on how to proceed with its work.

RESPONSE

As outlined in the Board's August 21, 2015 letter regarding the 2015-2020 Demand Side Management Evaluation Process of Program Results EB-2015-0245, the OEB is responsible for overseeing the selection of a third party Evaluation Contractor and as such procurement and contracting responsibilities should rest with Board Staff. In carrying out the evaluation and audit processes of all DSM programs, Enbridge is of the view the EC should report to the EAC which is mandated with providing input and advice on the evaluation and audit of DSM results.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #7

INTERROGATORY

[A/1/3, p. 12] Please describe the extent of discussions between the members of the EAC with respect to i) how to apply the NTG study, and ii) what spillover component should be used for 2015. If there were disagreements between members of the EAC, please describe.

RESPONSE

In the absence of EAC minutes, Enbridge is only able to address its own views and is not able to comment for other members of the EAC.

i) Following the communication from Board Staff on June 6, 2016 which communicated proposed changes to the NTG Study from the original Study undertaken by the TEC there was a meeting of the EAC on June 15, 2016. The utilities as requested had submitted comments on the documents prior to the meeting. The Company recalls the proposed documented changes were discussed at this meeting. Enbridge shared concerns regarding Board Staff's interpretation of the Board's decision and the proposed change in the NTG scope of work regarding the application of the NTG study.

   On September 16, a draft EM&V plan was distributed to the EAC for comments. In addition, an updated draft CPSV / NTG study was distributed by Board Staff to the EAC on October 8, 2016 requesting comments on same. The utility provided comments on both of these draft documents. Subsequently there was a meeting of the EAC on October 20, 2016. The utility recalls that these drafts were discussed with the EAC, including the application of the NTG study results. The Company recalls that following some discussion, no clear decision was made regarding how NTG Study results were going to be applied and Board Staff indicated the EAC would revisit the issue at a future meeting. Enbridge does not recall the matter being discussed again prior to May 23, 2017. That day, one day prior to the EC's draft CPSV / NTG report being distributed to the EAC, Board Staff emailed the two utilities and confirmed it had instructed DNV to retroactively apply the NTG Study results (they were not in fact NTG values, they proposed free ridership values but did not include spillover) to 2015 DSM program results.

ii) There were no discussions or consultations with the EAC regarding specifically what spillover component should be used for 2015. During a conference call of the EAC

Witnesses: D. Bullock
D. Johnson

on September 27, 2017, Board Staff communicated that they had instructed the EC to undertake research to identify a proxy deemed spillover value to be applied to the utilities' 2015 program results. The utilities voiced concerns regarding Board Staff directing the EC to apply a deemed spillover value instead of completing the spillover study in line with the scope of work outlined for the NTG study, and further that there was no consultation with the EAC regarding this decision. Enbridge has no record of the various views of other members of the EAC at the time of being advised of Board Staff's decision.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #8

INTERROGATORY

[A/1/3, p. 12] Please provide a copy of all communications between the Applicant and OEB Staff in or before March 2016 relating to the application of the NTG study.

RESPONSE

Enbridge has no record of and no recollection of any communication between the Company and Board Staff on or before March 2016 regarding the application of the NTG Study. It was not until June 6, 2016, in an email to the EAC that Board Staff provided documentation that indicated they were proposing to revise the NTG Study and the application of same. Please also see the response to SEC Interrogatory #7, found at Exhibit I.EGDI.SEC.7.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #9

INTERROGATORY

[A/1/3, p. 13] Please confirm that both the utilities complained about the delay in getting a spillover number for 2015.

RESPONSE

Enbridge confirms that it was concerned about delays throughout the process and was concerned about the overall time required to complete the 2015 verification process. Enbridge does not however recall voicing any specific delays about the spillover determination in particular.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #10

INTERROGATORY

[A/1/3, p. 14] Please provide details of the conflicts of interest referred to.

RESPONSE

This reference was not made with any indication by Enbridge as to whether there were or were not conflicts of interest but rather as one of the topics that could and should be addressed in an effective committee charter.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #11

INTERROGATORY

[A/1/3, p. 14, 19] Please provide a head to head comparison of the prior experience and expertise of each member of OEB Staff involved in the work of the EAC, relative to the prior experience and expertise of each representative of the Applicant that attended EAC meetings on behalf of the Applicant. Please provide full CVs for each of those included in the comparison. If you do not have the full CVs for the relevant OEB Staff, please request them from the Board.

RESPONSE

Enbridge surmises that this interrogatory originates from a misinterpretation of Enbridge's commentary in the sections referenced (Exhibit A, Tab 1, Schedule 3, page 14 and 19). To provide some context to the references, Enbridge notes Board Staff's lack of experience from the perspective of taking on the new role of EAC Coordinator, a role that had not previously resided with Board Staff.

Enbridge is not challenging the curriculum vitae of individual Board Staff members, rather it was simply commenting on a "perfect storm" of limited experience as an organization in taking on this oversight role, an initial delay in getting started with the new responsibility of overseeing the evaluation and audit responsibilities, coupled with a lack of clarity and ambiguity regarding the operative roles, responsibilities and expectations of the respective parties to the EAC structure.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #12

INTERROGATORY

[A/1/3, p. 15, 48] Attached to these interrogatories is a draft charter for the EAC prepared by OEB Staff in consultation with the EAC. Please advise whether the Applicant believes this draft charter would be acceptable. If there is anything in it that the Applicant does not believe is acceptable, please provide details, and provide a critical comparison to how the Union Gas charter deals with the impugned issue.

RESPONSE

The draft charter (Terms of Reference) document appended to the Interrogatories submitted by SEC has evolved through a number of revisions following consultation and solicitation of comments from the EAC since Board Staff initially presented their draft to the EAC on December 5, 2017, following numerous requests from the utilities for an EAC charter. Enbridge is of the view that the draft attached by SEC has improved considerably and, in large part, reflects an approach that it can support with a few suggested enhancements.

Enbridge believes that a key objective of the process is the achievement of consensus. Enbridge therefore proposes the following edits on page 3 of the document:

> The ~~EC,~~ EAC~~,~~ and OEB Staff will **be guided by and will promote the principle of striving** to reach ~~attempt to achieve~~ consensus on all EM&V related decision points. However, if ~~a~~ consensus **cannot be reached on particular matters** ~~is not possible~~, for the purpose of finalizing DSM EM&V results and reports without undue delay, the following parties will be relied upon to make decisions on each of these points.

Next, Enbridge is of the view that all references to EAC input or consultation being sought only “as requested” be deleted. EAC consultation and input should consistently be sought.

Further EAC input and consultation should be required in regard to the procurement and selection of third party contractors and the development of scopes of work for RFPs to facilitate the procurement of contractors. Budgets and forecasts for evaluation efforts should be transparent and shared with the EAC ahead of each evaluation process.

Enbridge continues to be of the view that minutes are an important and beneficial

Witnesses: D. Bullock
D. Johnson

component of effective committees, particularly those involving many stakeholders and covering a broad array of activities. Minutes provide structure, drive action, document progress and provide a record to help mitigate potential inaccuracies in recalling events.

Finally, Enbridge is supportive of including the additional clarity regarding the role of the chair outlined in the response to BOMA Interrogatory #11, found at Exhibit I.EGDI.BOMA.11.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #13

INTERROGATORY

[A/1/3, p. 15] Please advise the legal governance the Applicant proposes with respect to the activities of the EAC, e.g. consensus requirements, voting, weight of votes if any, OEB Staff role as arbiter or tie-breaker, etc.

RESPONSE

It is Enbridge's opinion that the EAC should be driven by the goal of consensus. A consensus approach was central to the Joint Terms of Reference on Stakeholder Engagement for DSM Activities which governed a successful, cooperative and efficient operation of the TEC and both Audit Committees prior to the introduction of the new (current) governance structure.

Ultimately Enbridge understands, when or where consensus cannot be reached, there must be a system in place to make decisions so as to enable the process to move forward. In the case of the evaluation process for 2015 program year, Board Staff made decisions when consensus could not be reached, regrettably, there were also occasions when Board Staff made decisions without EAC consultation.

As per the response provided by Enbridge to SEC Interrogatory #12, found at Exhibit I.EGDI.SEC.12, the draft charter attached to SEC's interrogatory submission has improved considerably from its initial draft and, in large part, reflects an approach that the utility can support.

Generally, Enbridge is of the view that if Board Staff's role is to be defined as chair and decision maker where consensus cannot be reached, there needs to be assurance that the input from the EAC advisory group is actually what drives decision making and avoid situations where decisions are already effectively made by the party overseeing the process, or the chair dominates with its opinions and the EAC is told what is going to happen. To this end, it should be made clear that as chair, Board Staff's role is primarily to facilitate the process.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #14

INTERROGATORY

[A/1/3, p. 15] Please provide specific details of the information withheld by the EC from the Applicant, and the reasons the EC claimed the information had to be withheld.

RESPONSE

Please refer to Enbridge's response to Board Staff Interrogatory #12, found at Exhibit I. EGDI.STAFF.12.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #15

INTERROGATORY

[A/1/3, p. 16] Please enumerate and explain the changes that should be made to the Ontario EM&V process, in the Applicant's opinion, to be consistent with the UMP. Please be specific.

RESPONSE

To be clear, the Uniform Methods Project ("UMP") is an extensive compendium of procedures aimed at developing measurement and verification protocols for determining energy savings. Enbridge did not and is not proposing that wholesale changes should necessarily be made to the Ontario EM&V process to be consistent with UMP as suggested in this IR. However, with regards to the specific chapter referenced, namely *Chapter 21: Estimating Net Savings – Common Practices*, from the Uniform Methods Project, Enbridge does believe there is valuable guidance that should be considered based on the research and recommendations provided, specifically as it relates to practices concerning self-report survey methods as a means to determining NTG factors, including survey consultation, design and delivery.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #16

INTERROGATORY

[A/1/3, p. 16] Please provide details on the number and length of meetings of stakeholders during the 2015 EM&V process, and compare that to the number and length of meetings of stakeholders during the 2014 EM&V process. Please exclude meetings at which stakeholders other than Enbridge were not invited.

RESPONSE

Details and dates regarding meetings related to the 2014 EM&V process (length of meetings was not recorded) can be found in the 2014 Application for Clearance of DSM Accounts, EB-2015-0267, Exhibit B, Tab 3, Schedule 1, page 19 and 20. Copies of these tables have been attached to this IR response. There were 47 meetings during the course of the 2014 program year audit process, 38 of these included the audit committee.

Enbridge's records reflect the following meetings/conference calls during the 2015 process:

November 13, 2015	Meeting	3 hours – (limited discussion about 2015 evaluation)
May 12, 2016	Meeting	3 hours (½ the meeting re: 2015 evaluation process)
June 15, 2016	Call	1 ½ hours
October 20, 2016	Meeting	6 ½ hours
February 22, 2017	Call	2 hours
February 27, 2017	Call	2 hours
March 6, 2017	Call	3 hours
March 21, 2017	Call	2 ½ hours
March 31, 2017	Call	3 hours
April 13, 2017	Call	2 hours
April 28, 2017	Call	2 hours
May 10, 2017	Call	3 hours
June 22, 2017	Meeting	6 hours
July 25, 2017	Call	2 hours
August 15, 2017	Call	2 hours
August 30, 2017	Cal	2 hours
September 13, 2017	Call	2 hours (little time on 2015 evaluation)
September 27, 2017	Call	2 hours
October 11, 2017	Call	2 hours (no discussion of 2015 evaluation)
October 25, 2017	Call	2 hours (no discussion of 2015 evaluation)
December 6, 2017	Meeting	6 hours – (1 hour re: 2015 evaluation process

Witnesses: D. Bullock
D. Johnson

2014 Audit and CPSV Meeting Summaries[1]

2014 Audit Meetings

Date	Activity	Attendees: Audit Committee	Attendees: Auditor	Attendees: Enbridge
16-Sep-14	1st EGD 2014 Audit Committee (AC) Meeting	X		X
20-Oct-14	Joint EGD/UG AC Conference Call to draft Auditor RFP terms of reference	X		X
21-Nov-14	AC Conference Call	X		X
8-Dec-14	Audit Kick-Off Meeting	X	X	X
17-Dec-14	AC Weekly Conference Call	X	X	X
7-Jan-15	AC Weekly Conference Call	X	X	X
22-Jan-15	AC Weekly Conference Call	X	X	X
28-Jan-15	AC Weekly Conference Call	X	X	X
4-Feb-15	AC Weekly Conference Call	X	X	X
11-Feb-15	AC Weekly Conference Call	X	X	X
19-Feb-15	AC Weekly Conference Call	X	X	X
25-Feb-15	AC Weekly Conference Call	X	X	X
6-Mar-15	AC Weekly Conference Call	X	X	X
12-Mar-15	AC Weekly Conference Call	X	X	X
8-Apr-15	AC Weekly Conference Call	X	X	X
15-Apr-15	Final CPSV Report Review	X	X	X
17-Apr-15	Final CPSV Report Review	X	X	X
22-Apr-15	AC Weekly Conference Call	X	X	X
29-Apr-15	AC Weekly Conference Call	X	X	X
13-May-15	AC Weekly Conference Call	X	X	X
21-May-15	AC Weekly Conference Call	X	X	X
3-Jun-15	AC Weekly Conference Call	X	X	X
10-Jun-15	AC Weekly Conference Call	X	X	X
18-Jun-15	AC Weekly Conference Call	X	X	X
24-Jun-15	AC Weekly Conference Call	X	X	X
22-Jul-15	AC Conference Call	X		X
29-Jul-15	AC Conference Call	X		X
8-Oct-15	AC Conference Call	X		X
14-Oct-15	AC Conference Call	X		X

[1] EB-2015-0267, Exhibit B, Tab 3, Schedule 1, Page 19 and 20

2014 Custom Project Savings Verification (CPSV) Meetings

Date	Commercial	Industrial	Attendees			
			CPSV	Auditor	Enbridge	AC
13-Nov-14	Wave 1 Kick-off Meeting		X	X	X	
17-Nov-14		Wave 1 Kick-off Meeting	X	X	X	
25-Nov-14	Weekly Conference Call	Weekly Conference Call	X	X	X	
4-Dec-14	Weekly Conference Call	Weekly Conference Call	X	X	X	
11-Dec-14	Weekly Conference Call	Weekly Conference Call	X	X	X	
17-Dec-14	Weekly Conference Call	Weekly Conference Call	X	X	X	
8-Jan-15		Weekly Conference Call	X	X	X	
16-Jan-15		Weekly Conference Call	X	X	X	
4-Feb-15		Review Wave 1 Report/Optimal Memo	X	X	X	X
5-Feb-15	Wave 2 Kick-off Meeting	Wave 2 Kick-off Meeting	X	X	X	
11-Feb-15	Review Wave 1 Report/Optimal Memo		X	X	X	X
12-Feb-15		Review Wave 1 Report/Optimal Memo	X	X	X	X
18-Feb-15	Weekly Conference Call	Weekly Conference Call	X	X	X	X
26-Feb-15	Weekly Conference Call	Weekly Conference Call	X	X	X	X
5-Mar-15	Weekly Conference Call	Weekly Conference Call	X	X	X	X
12-Mar-15	Weekly Conference Call	Weekly Conference Call	X	X	X	X
2-Apr-15	Review Wave 1 & 2 Draft Report/Optimal Memo	Review Wave 1 & 2 Draft Report/Optimal Memo	X	X	X	X
7-Apr-15	Review Wave 1 & 2 Draft Report/Optimal Memo	Review Wave 1 & 2 Draft Report/Optimal Memo	X	X	X	X

SEC INTERROGATORY #17

INTERROGATORY

[A/1/3, p. 17] Please provide copies of all drafts of reports or other documents that were annotated or commented on by OEB Staff prior to being delivered to the EAC, including all such annotations and comments. If the Applicant does not have those documents, please request them from OEB Staff.

RESPONSE

On or about April 20, 2017, Enbridge and the EAC were provided with a number of CPSV site reports for review. Among these was a site report that included comments and track changes to the document provided by Board Staff to the EC in advance of the EAC. As a result it became apparent that Board Staff had been making comments on the EC's site reports prior to "clean" revised versions subsequently being distributed to the EAC.

At the next EAC conference call, Enbridge raised concerns about this finding and requested that any and all comments made by Board Staff to the EC on the verification efforts (in this case CPSV site reports) should be transparent and visible to the EAC. Other EAC members shared similar concerns, however Board Staff declined to share the comments.

In response to further requests from EAC members that Board Staff provide the EAC with any comments it had provided to the EC regarding the savings verifications reports, the EAC received email communications from Board Senior Counsel on June 21 and 22, 2017 confirming that Board Staff did not intend to make its initial comments available to the EAC. Board Senior Counsel further commented that in the event there was a request made by a party for production of any Board Staff comments as part of an OEB proceeding, the OEB panel assigned to the proceeding would need to reach whatever decision they think is appropriate. Board Senior Counsel further addressed the circumstance whereby, in a subsequent proceeding, any request was made of any EAC member to produce comments made on draft reports through the EAC process, and similarly indicated that determinations about the production of such comments was a matter for the Board panel assigned to a proceeding.

Given that the IR request has already been made, as outlined above, it appears any response requires direction from the Board. Presumably it is also a request that could be made directly to Board Staff by any member of the EAC or party to this proceeding.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #18

INTERROGATORY

[A/1/3, p. 17] Please confirm that every EAC meeting is followed up with a detailed Action List that goes to all EAC members. Please confirm that all action items on the Action List have been subsequently discussed at the EAC and resolved or removed. If either is not confirmed, please provide specifics.

RESPONSE

Confirmed. Currently (in April 2018), EAC meetings are now followed up with an Action Item Summary that is distributed to EAC members. When items on this list have been adequately addressed, the intention is that they are marked as complete.

The practice of documenting and distributing Action Items was not in place through most of the 2015 program year evaluation process and was only initiated on August 15, 2017, towards the end of the evaluation and verification of the 2015 program year, after significant pressure from the utilities who called for the implementation of documenting meeting minutes and developing an EAC charter. Enbridge believes the introduction of the Action Item Summary is a positive step however still maintains that the practice of minuting meetings should be adopted.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #19

INTERROGATORY

[A/1/3, p. 17] Please provide a list of "questions and decision points that went unanswered". Please distinguish between utility complaints that were not accepted by all members of the EAC, and those that were just ignored completely by the EC, OEB Staff, or both.

RESPONSE

In this IR, SEC has asked Enbridge to distinguish whether questions and decision points were not accepted or ignored by the EC, OEB Staff or both. However, the reference, Exhibit A, Tab 1, Schedule 3, page 17 refers only to transparency and a credible process with respect to Board Staff. A full discussion of the EC's response to Enbridge comments can be found in response to Board Staff Interrogatory #11, found at Exhibit I.EGDI.STAFF.11.

The majority of questions and decision points that went unanswered by Board Staff were requests made by Enbridge during discussions at EAC meetings. The oversight of not recording action items and takeaways during the 2015 evaluation process (action item tracking did not begin until August 15, 2017) and the fact that EAC meeting minutes were not maintained created uncertainty and confusion. Enbridge provides the following examples in response to this Interrogatory.

Retroactive Application of Net-to-Gross Study

Initially, the EC's first Scope of Work, dated March 2, 2016, stated that "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." [1] This Scope of Work was produced when the TEC was managing the evaluation process.

Subsequently, after management of the evaluation process was transferred to Board Staff, Enbridge was told Board Staff would revisit this issue to determine if NTG should be applied retroactively. Enbridge posed questions about the retroactive application of NTG multiple times, via verbal comments at EAC meetings, comments to the December 14, 2016 Scope of Work, and a memo provided by Enbridge to the EAC and Board Staff on June 14, 2017.

[1] EB-2017-0324, Application and Evidence, Exhibit B, Tab 5, Schedule 5, page 8

This memo was provided as requested in response to SEC Interrogatory #26, found at Exhibit I.EGDI.SEC.26.

Enbridge discussed this issue in its evidence, on Page 22 of 48 of Exhibit A, Tab 1, Schedule 3, as follows:

> Throughout the 2015 DSM EM&V process, in an effort to seek clarity on OEB Staff's position on the application of NTG Study application to 2015 DSM program results, the utilities continued to raise concerns regarding the change to the NTG study scope of work and how the study outcomes would be applied (including at subsequent EAC meetings). During the October 2016 EAC meeting, OEB Staff committed to consider the matter and respond. [2]

Enbridge was not privy to any discussion on the issue, and was only told via email on May 23, 2017 that Board Staff had directed the EC to apply the NTG results retroactively to 2015 DSM program results. It is Enbridge's opinion that Board Staff did not fully consider and respond to Enbridge's questions on this issue.

Budgets

Despite the utilities having responsibility and accountability for an overall annual evaluation budget for their respective DSM portfolios, OEB Staff was not responsive in providing details on EM&V budgets for planned verifications or details regarding forecasted spending in a given year. As a result, Enbridge had no ability to monitor spending and therefore no ability to budget for utility lead activities.

Omission of ESC Interviews Contrary to Scope of Work

Enbridge raised the scheduling of ESC interviews to Board Staff in mid-December 2016. Board Staff did not respond. However, the Company learned a decision had been made to omit this activity from the Scope of Work from the EC. Please see Enbridge's response to BOMA Interrogatory #10, found at Exhibit I.EGDI.BOMA.10 for more details and email attachment.

Commentary Provided Directly from OEB Staff to EC

Despite requests from the EAC for Board Staff to share all undisclosed commentary they provided to the EC, Board Staff declined. Enbridge is unaware of the extent of comments. Please refer to Enbridge's response to SEC Interrogatory #17, found at Exhibit I.EGDI.SEC.17 for full discussion on this topic.

[2] EB-2017-0324, Application and Evidence, Exhibit A, Tab 1, Schedule 3, page 22.

Witnesses: D. Bullock
D. Johnson

Request for a Comprehensive Project Timeline

Despite Enbridge requests for a comprehensive schedule in order better facilitate resource planning, Board Staff did not provide a project timeline to the EAC for the 2015 evaluation process. This created confusion and, as the utility was not afforded the opportunity to provide input regarding the setting of timeframe requirements, there were challenges in meeting those deadlines. Enbridge is pleased that in the 2016 evaluation process, the EC has produced such a schedule and the process has been more efficient and effective.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #20

INTERROGATORY

[A/1/3, p. 17] Please file all communications between the Applicant and OEB Staff with respect to EM&V budgets and forecasts.

RESPONSE

Please see attached copies of various related emails between Enbridge and Board Staff with respect to accruals and budgets. In addition, this topic was discussed during meetings with the EAC, however, with no minutes Enbridge cannot provide recorded details.

Further, as part of the review period for the CPSV/NTG Scope of Work, Enbridge submitted a comment directed to Board Staff as follows:

> When will the utilities be provided details on evaluation/verification costs to be incurred in 2016? In mid November, accounting process will require that we accrue required funds for work to be completed in balance of year. Also when will utilities be provided details on evaluation/verification costs to be incurred in 2017?

Witnesses: D. Bullock
D. Johnson

From:	Deborah Bullock
To:	"Josh Wasylyk"
Cc:	Tina Nicholson
Subject:	RE: DNV Expenditures
Date:	Tuesday, October 18, 2016 8:07:54 PM

Hi Josh,

I too am getting repeated requests to updated spending against our 2015 evaluation budget and begin to prepare documentation to support year end accruals (I included a comment in the DNV scope of work in this regard). Happy to discuss this further as needed (perhaps on our next utility touchpoint call).

Thanks,

Deb

From: Nicholson, Tina [mailto:tnicholson@uniongas.com]
Sent: Tuesday, October 18, 2016 7:02 PM
To: Josh Wasylyk
Cc: Deborah Bullock
Subject: DNV Expenditures

Hi Josh,

At an earlier touch point we had discussed budget and requested Evaluation Contractor costs for 2016. I have been asked from our finance department to provide an update on budget/accruals. At the next utility touch point which is scheduled for Monday, October 24th can you please share DNV costs incurred to date that we haven't been invoiced for as well as any future expenses for work that will be completed from now till end of year.

Thanks in advance.

Tina

From: Deborah Bullock
To: "Josh Wasylyk"
Cc: Ben.Jones@dnvgl.com; Kuiken Whitiken, Tamara (Tamara.Kuiken@dnvgl.com); Ed Reimer
Subject: RE: NTG Contract
Date: Tuesday, December 13, 2016 9:51:29 AM

Hello Josh et.al.,

As a follow-up to this email, we will need to work to resolve the contract issue in consultation with our legal folks. In the meantime, my urgent need however is to finalize accruals for 2016 as we've discussed previously. Are you able to confirm:

1) What $ where payable to ICF at the time the contract expired at the end of May, 2016? (As we communicated, we still have an outstanding accrual relating to NTG from 2015 which we also need to clear ASAP).
2) What payables are due for work completed w.r.t. the NTG study for the balance of 2016?

A written communication summarizing these amounts will be required to satisfy our finance requirements for accruals.

Thanks,
Deborah

From: Josh Wasylyk
To: Deborah Bullock
Cc: Ed Reimer
Subject: RE: OEB DSM Evaluation Accruals (2016)
Date: Wednesday, December 14, 2016 11:35:59 AM

Hi Deborah,

Responses are below.

Let me know if you need anything else.
Josh

Josh Wasylyk | Project Advisor| Ontario Energy Board
2300 Yonge Street, 27th Floor |Toronto, ON | M4P 1E4 | Ph: 416 440 7723

From: Deborah Bullock [mailto:Deborah.Bullock@enbridge.com]
Sent: December 13, 2016 8:30 PM
To: Josh Wasylyk
Cc: Ed Reimer
Subject: RE: OEB DSM Evaluation Accruals (2016)

Hello Josh,

In order to meet the utility's accrual support requirements I will need to provide some additional detail…please confirm the following:

1) Is the full amount of $494,823 payable to DNV (i.e. the only payee for this amount is DNV GL)?

   JW Response: Confirmed. DNV GL is the only payee.

   Also please confirm that the amount Enbridge is required to accrue for payment to DNV GL is $295,360.

   JW Response: Confirmed. EGD is responsible for $295,360 of the $494,823 total.

2) Please confirm Enbridge's share of EAC costs total $23,649.

   JW Response: Confirmed. EGD's share of the EAC costs is $23,649.

   Please confirm if the sole payee for this amount will be the OEB;

   JW Response: Confirmed. The OEB will be the sole payee.

   or else provide a breakdown of accrual amounts of Enbridge's share of the EAC costs by intervenor/payee (example follows):

SEC (Jay Shepherd)	$
GEC (Energy Futures Group/Chris Neme)	$
BOMA (Marion Fraser)	$

Ted Kesik (Knowledge Mapping Inc.) $
Bob Wirtshafter (Wirtshafter Associates Inc.) $
Any other payees? $.
Total $ 23,649

JW Response: N/A – see above

Thanks,
Deborah

From: Josh Wasylyk [mailto:Josh.Wasylyk@ontarioenergyboard.ca]
Sent: Tuesday, November 22, 2016 2:11 PM
To: Tina Nicholson; Deborah Bullock
Cc: Pascale Duguay
Subject: OEB DSM Evaluation Accruals (2016)

Hi Tina and Deborah,

As requested, here is the accrual information related to the OEB's 2016 DSM evaluation costs.

	2016 Accrual Amount
DNV GL Costs	$494,823
EAC Costs	$39,621
TOTAL	**$534,443**

Based on the OEB's cost assessment model, the apportionment to the utilities would be:

	Utility Share
Enbridge	$319,009
Union	$214,205
NRG	$1,229

Tammy indicated that DNV GL will be sending invoices to the utilities directly in relation to the NTG work.

If you have any questions or would like to discuss, please let me know.

Josh

Josh Wasylyk | Project Advisor| Ontario Energy Board
2300 Yonge Street, 27th Floor |Toronto, ON | M4P 1E4 | Ph: 416 440 7723

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From:	Deborah Bullock
To:	"Valerie Bennett"; Erin Dunlop
Cc:	Leslie Kulperger; Eric Buan; Bailey Kaufman; Ed Reimer
Subject:	RE: 2017 Year-End Accruals
Date:	Tuesday, December 05, 2017 9:16:00 PM

Hi Valerie,
Appreciate that Erin has brought this forward. Great summary email Erin.

I know both utilities have mentioned this briefly a few times but it is indeed getting down to the wire here at EGD also to report our accrual amounts.
December 12th is right in line with our deadline also.

Thanks,
Deb

From: Valerie Bennett [mailto:Valerie.Bennett@oeb.ca]
Sent: Monday, December 04, 2017 6:05 PM
To: Erin Dunlop
Cc: Leslie Kulperger; Eric Buan; Deborah Bullock
Subject: [External] RE: 2017 Year-End Accruals

Hi Erin – I should be able to provide what Josh provided last time, but won't have time to look into this before Wednesday's meeting. Let's touch base later this week.

Thanks and see you on Wednesday.

Valerie

Valerie Bennett, P. Eng, CMVP
Project Advisor – Application Policy & Climate Change
Ontario Energy Board
2300 Yonge St.
Toronto, ON M4P 1E4
Tel.: 416 440-7747
Fax: 416 440-7656
E-mail: **NEW!** valerie.bennett@oeb.ca

From: Erin Dunlop [mailto:EDunlop@uniongas.com]
Sent: Monday, December 4, 2017 12:23 PM
To: Valerie Bennett <Valerie.Bennett@oeb.ca>
Cc: Leslie Kulperger <LKulperger@uniongas.com>; Eric Buan <EBuan@uniongas.com>; Deborah Bullock <Deborah.Bullock@enbridge.com>
Subject: 2017 Year-End Accruals

Hi Valerie –

Hard to believe but we're fast approaching the end of the year and an important part of completing our DSM year end process is to ensure that all 2017 related expenses are recorded appropriately. In cases where we have not received invoices but work has been performed in 2017, these expenses need to be recorded ("accrued") by Finance prior to year-end. It is essential that we capture all DSM costs in the proper period to ensure that deferral balances and cost recoveries from rate payers are calculated appropriately. In order to accrue expenses, our Finance department requires adequate support to ensure the amounts are accurate. Supporting documentation may include a "draft" of an invoice or a written email communication from the vendor stating the estimated cost associated with the work completed in 2017 that requires an accrual.

I'm assuming we will not be receiving another OEB invoice prior to year-end so we will require a written email from you/DNV outlining the estimated cost of all work completed but not billed to-date as well as costs for work expected to be complete by the end of the year. Estimates for EAC costs are not required - we will use the cost awards in process to account for these.

Last year, DNV provided this estimate and did so by program. Looking back at what Josh provided in August, we were also able to get the first OEB invoice and projected spending for the rest of the year broken out in this manner. I'm hoping we can revisit this issue and get the second OEB invoice as well as the accrual detailed in this way. This is ideal as it helps better assign and track costs and is required for TRC calculations. Josh had grouped costs in the following manner although a category could also be added for general portfolio costs:

- Resource Acquisition – Res
- Resource Acquisition - C&I
- Performance-Based
- Low Income
- Large Volume
- Market Transformation

To adhere to year-end deadlines and provide time for review, approval and processing, we require this information by EOD on December 12th. I'm not sure if EGD has reached out to you yet but they will certainly be in a similar situation and require this information for their year-end accruals too. I will be attending the EAC meeting on Wednesday so, if needed, we can discuss further then.

Look forward to seeing you,
Erin

Erin Dunlop
Senior DSM Program Evaluator
_

Union Gas Limited | An Enbridge Company
TEL: 416-496-5200 | CELL: 647-309-8975 | EDunlop@uniongas.com
2901, 777 Bay Street Toronto, ON M5G 2C8

From: Valerie Bennett
To: Deborah Bullock; Erin Dunlop
Subject: [External] RE: OEB DSM Evaluation Accruals (2016)
Date: Wednesday, December 13, 2017 9:09:44 AM
Attachments: Rest_of_2017_accruals_dec13.xlsx

Hi Deborah and Erin –

Here's the accruals we have for Union and Enbridge, which I've put together with help from DNV GL. I've attached the excel sheet I used to calculate these so you can see the details. I've done this by 2015 and 2016 evaluation years.

2015 Budget - accrual amounts

DNV GL Costs	$ 405,494
EAC Costs (pending OEB Panel review, incl. HST – may/may not be included in next invoice depending on when Decision is issued)	$ 108,398
Total	$ 513,893

Based on the OEB's cost assessment model, apportionment would be:

Enbridge	$ 306,742
Union	$ 205,968
NRG	$ 1,182

2016 Budget - accrual amounts

DNV GL Costs	$ 254,668
EAC Costs (none for 2016 DSM Year)	$ -
Total	$ 254,668

Based on the OEB's cost assessment model, apportionment would be:

Enbridge	$ 152,011
Union	$ 102,071
NRG	$ 586

Erin, I've further broken down these for Union, since you need them to match the program evaluation budgets approved by the OEB. I'm using the same assumptions (% allocation to each program) that DNV GL used last year (all in the spreadsheet).

Union	2015 Programs
Program	DNV GL
Resource Acquisition - Res	$ 1,694
Resource Acquisition - C&I	$ 102,258
Low Income	$ 20,839
Large Volume	$ 80,693
Market Transformation	$ 484

Union	2016 Programs
Program	DNV GL
Resource Acquisition - Res	$ 19,153
Resource Acquisition - C&I	$ 38,267
Performance-Based	$ 6,384
Low Income	$ 9,576
Large Volume	$ 22,306
Market Transformation	$ 6,384

Let me know if you have any questions.

Thanks,
Valerie

Valerie Bennett, P. Eng, CMVP
Project Advisor – Application Policy & Climate Change
Ontario Energy Board
2300 Yonge St.
Toronto, ON M4P 1E4
Tel.: 416 440-7747
Fax: 416 440-7656
E-mail: **NEW!** valerie.bennett@oeb.ca

From: Deborah Bullock [mailto:Deborah.Bullock@enbridge.com]
Sent: Monday, December 11, 2017 9:45 AM
To: Valerie Bennett <Valerie.Bennett@oeb.ca>
Cc: Erin Dunlop <EDunlop@uniongas.com>
Subject: FW: OEB DSM Evaluation Accruals (2016)

Hi Valerie,
Here is what Josh sent last year to outline the outstanding spend there remained in 2016 for work which was to be completed by the year's end but for which the utilities had not yet been invoice. The summary broke out EAC costs vs. contractor costs.

So as a result – in Enbridge's case this email provided support to our accounting folks for me for accrue $319K from our 2016 evaluation budget in anticipation of invoices to come

Hope that helps.

From: Josh Wasylyk [mailto:Josh.Wasylyk@ontarioenergyboard.ca]
Sent: Tuesday, November 22, 2016 2:11 PM
To: Tina Nicholson; Deborah Bullock
Cc: Pascale Duguay
Subject: OEB DSM Evaluation Accruals (2016)

Hi Tina and Deborah,

As requested, here is the accrual information related to the OEB's 2016 DSM evaluation costs.

	2016 Accrual Amount
DNV GL Costs	$494,823
EAC Costs	$39,621
TOTAL	**$534,443**

Based on the OEB's cost assessment model, the apportionment to the utilities would be:

	Utility Share
Enbridge	$319,009
Union	$214,205
NRG	$1,229

Tammy indicated that DNV GL will be sending invoices to the utilities directly in relation to the NTG work.

If you have any questions or would like to discuss, please let me know.

Josh

Josh Wasylyk | Project Advisor| Ontario Energy Board
2300 Yonge Street, 27th Floor |Toronto, ON | M4P 1E4 | Ph: 416 440 7723

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SEC INTERROGATORY #21

INTERROGATORY

[A/1/3, p. 18] Please quantify each of the major causes of delays in the 2015 process, and identify the primary reason for each.

RESPONSE

Delays in the 2015 audit process are addressed in Exhibit A, Tab 1, Schedule 3, pages 18 and 19. Since Enbridge no longer has oversight of the annual evaluation process the Company does not have the information required to fully identify the major causes of delays, nor the primary reasons for same. Enbridge can provide the following timeline/observations:

Date	Activity	Comment
November 13, 2015	First meeting of the EAC	
December, 2015	OEB Staff solicit input from EAC re: Evaluation Contractor Scope of Work	In prior years this would be completed in Q3 of the current program year
January, 2016	Scope of Work finalized by OEB Staff	In prior years this would be completed in Q3/Q4 of the current program year
February 8, 2016	OEB Staff advise EAC they have posted RFP for EC procurement	In prior years this would be completed in Q4 of the current program year
March/April, 2016	OEB Staff select EC	In prior years this would be completed in Q4 of the current program year
May 12, 2016	Evaluation Contractor/EAC Kick Off Meeting	In prior years this would be completed in Q4 of the current program year
September 16, 2016	Draft EM&V Plan Scope of Work provided by EC for comments	
October 8, 2016	Draft CPSV/NTG Scope of Work provided by EC for comments	

Witnesses: D. Bullock
D. Johnson

November, 2016	CPSV sample data requests sent to utility	In prior years this would be completed in Q4 of the current program year/Q1 of the following year
December 15, 2016	Final CPSV/NTG Scope of Work posted by EC	
January – April 2017	CPSV Site Visit/Telephone Surveys completed by EC	
January, 2017	2015 Full Tracking Database Request sent to utility	In prior years this would be completed in Q1 of the following program year
February, 2017	Final 2015 Annual Verification Plan and 2016-2018 EM&V Plan posted by EC	
May 24, 2017	Draft CPSV and F/R Report provided to EAC by EC	
July 26, 2017	Draft 2015 Annual Verification Report provided to EAC by EC	
September 27, 2017	Board Staff advise EAC they have instructed the EC to source and apply a deemed value for spillover	
October 16, 2017	Final EC CPSV/FR Report and 2015 Annual Verification Report (version 1)	
December 20, 2017	Revised 2015 Annual Verification Report	

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #22

INTERROGATORY

[A/1/3, p. 19] Please provide copies of all communications by either of the utilities asking for more time to complete work required of them for the EM&V process.

RESPONSE

Discussions regarding timelines and deadlines generally occurred during EAC conference calls. Particularly through the CPSV "batch reviews", deadlines were set by OEB Staff meeting to meeting (call to call) and review periods were often challenging given the number of reports being reviewed, especially in the final batches.

Enbridge has attached a written communication (an email) which communicated concerns to OEB Staff regarding a deadline on comments on the draft report in May of 2017.

Witnesses: D. Bullock
D. Johnson

From: Deborah Bullock
To: "Josh Wasylyk (josh.wasylyk@oeb.ca)"
Cc: Ed Reimer; Kulperger, Leslie; Buan, Eric; Jones, Benjamin; "Kuiken Whitiken, Tamara"; "Valerie Bennet (valerie.bennett@oeb.ca)"
Subject: RE: COMMENTS on Draft CPSV and NTG (FR only) Report
Date: Monday, May 29, 2017 3:44:00 PM

Good afternoon Josh,

Although there are a number of important items specific to the Draft Report that we continue to work through internally, I wanted to raise some more immediate concerns regarding DNV/Board Staff's suggested timelines.
Further to the EAC call and as discussed during the OEB Board Staff touchpoint with the utilities, we understood that the updated CPSV project reports (as well as a complete spreadsheet list detailing adjustments) would be provided along with the Draft Results Report for comment.

The suggestion that 2 weeks would be sufficient time to review this material was very aggressive when proposed. As indicated in the email from Ben Jones when forwarding the Draft Report, the updated project reports were not yet available and to date have not been posted. As such it not reasonable nor possible to provide comments on the Draft Results Report until such time as we have an opportunity to review those site reports.

Enbridge would like to provide full comments with the consideration of all known information if this part of the process is to reasonably meet our expectations. We will therefore be unable to provide all comments without at least a 2 week period following receipt of all the materials. We will however attempt to provide comments sooner on a best efforts basis.

Regards,
Deborah

Deborah Bullock
Supervisor, Audit & Evaluation

ENBRIDGE GAS DISTRIBUTION
TEL: 416-495-7228 | CELL: 416-427-2035
500 Consumers Road, North York, ON M2J 1P8
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SEC INTERROGATORY #23

INTERROGATORY

[A/1/3, p. 20] Please provide evidence that the TEC decided prospective application of NTG results was appropriate for all years.

RESPONSE

With regard to the NTG Study undertaken by the TEC in response to an RFP process, the proposal submitted by DNV and the evolution of the scope of work reviewed and endorsed by the TEC outlined that the objective of the study was “to develop transparent free ridership and spillover factors for custom commercial and industrial programs, to be used for future programs”. Enbridge has no record of any specific discussions or decision regarding the application of NTG results beyond the endorsement of the objective of this NTG study as outlined above.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #24

INTERROGATORY

[A/1/3, p. 20] Please provide details of the complaints by the utilities “on multiple occasions’ relating to the approach to the NTG study, including copies of any written communications in that regard. Please provide the dates of all such complaints, both before and after the draft results were provided to the EAC. Please provide details of all concerns expressed by the utilities as to the application of any NTG results to 2015.

RESPONSE

Please refer to the response to SEC Interrogatory #7, found at Exhibit I.EGDI.SEC.7. Also please refer to the response to SEC Interrogatory #26, found at Exhibit I.EGDI.SEC.26.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #25

INTERROGATORY

[A/1/3, p. 21] In the Applicant's view, who should interpret any Board decision or order so that the EAC can implement it?

RESPONSE

Enbridge provided their view on this matter in a memo to Board Staff on June 14, 2017 provided in an attachment to SEC Interrogatory #26, found at Exhibit I.EGDI.SEC.26.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #26

INTERROGATORY

[A/1/3, p. 21] Please provide a copy of the memo dated June 14, 2017.

RESPONSE

See the attached copy of Enbridge's June 14, 2017 memo as requested.

Witnesses: D. Bullock
D. Johnson

memo

Date: June 14, 2017

From: Enbridge Gas Distribution

Re: **General Comment Regarding DNV's Proposed NTG Ratios And Application To 2015 Program Year Results**

As we have made clear on several occasions, Enbridge is of the view that the Board's Decision and Order in respect of the Company's 2015 -2020 Multi-year DSM Plan (EB-2015-0029/0049) and the DSM Framework (together Decision) does not provide that the net-to-gross factors which have been proposed by DNV are to be used in the evaluation of the Company's 2015 DSM program year results in a retroactive manner. To be clear, Enbridge does not believe the Decision is consistent with the view of retroactivity promoted by Board Staff for the purposes of the evaluation of the Company's 2015 DSM results. In this regard, we remain willing to discuss this issue further with Board Staff in the hope of ultimately resolving the matter.

However, in the event that Board Staff's interpretation continues to differ from that of the Company, it is Enbridge's view that the determination of this issue is not the prerogative of Board Staff, the evaluation contractor or any member of the Evaluation Advisory Committee. The interpretation and application of a Decision and Order of the Board is solely a matter for the Board. While every stakeholder including Board Staff may in a future clearance application take a position which differs from Enbridge, Board Staff in its role as the coordinator and overseer of the evaluation and audit process (as set out in the Board's August 21, 2015 Letter, EB-2015-0245), is not the entity that should be in effect rendering a determination about how a Board Decision and Order should be interpreted and applied. It is Enbridge's view that where a difference exists as between any member of the EAC and/or Board Staff as to the interpretation and application of the Decision, such differences and the resulting impact on program results should both be presented in the evaluation results report which will ultimately then be filed with the Board. This would necessarily mean that where the evaluation contractor has been directed to undertake an evaluation based upon an interpretation of the Decision which is very much in dispute, the evaluation contractor should be required to undertake the evaluation using both interpretations so that there is a full record that is presented to the Board for adjudication. It would then be open to each stakeholder to file evidence and make such argument as they consider appropriate to support their interpretation of the Decision.

SEC INTERROGATORY #27

INTERROGATORY

[A/1/3, p. 22] Please provide evidence that the EAC reached a consensus to include spillover questions in the NTG study. Please explain why those questions were to be "less rigorous".

RESPONSE

Enbridge presumes SEC is inquiring about secondary attribution, as it is secondary attribution and not spillover that is discussed in the referenced section of the evidence.

Following distribution of the participant survey instrument to the EAC for comment, the utilities and some members of the EAC submitted comments. The utility submitted its comments, including questions for clarification on November 25, 2016. There was however no further opportunity provided for discussion with the EAC to review these comments or discuss any changes or improvements to the survey instrument. Instead, the EC sent out an email to the EAC (omitting Enbridge in that communication) on December 15th indicating that the survey instrument had been finalized and was posted on the SharePoint. Regardless, in both the draft distributed by the EC and the final version utilized by the EC in interviewing participants, there was only a single question designated to assessing the longer term effects of the program.

This is counter to the approach outlined in the scope of work regarding assessing the longer term impact of the program on participants. This approach was initially endorsed and captured as an agreement item by the TEC on July 30, 2015 as follows:

> 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 operationalizing this approach.[1]

In discussions with the TEC, DNV termed these two types of attribution: Primary Attribution and Secondary Attribution (see pages 5 to 7 of the memo from DNV submitted as an attachment to the response to EP Interrogatory #5, found at Exhibit I.EGDI.EP.5)

[1] EB-2017-0324, Exhibit B, Tab 5, Schedule 2, page 129, Memo from DNV to TEC.

Witnesses: D. Bullock
D. Johnson

Enbridge is of the view that the differentiation between the primary objective and the secondary objective with respect to the overall survey outlined above logically supports that in relative terms, more effort and rigour would address the primary objective and less to assessing the longer term, prior and indirect program experience.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #28

INTERROGATORY

[A/1/3, p. 25] Please confirm that input assumptions and NTG factors and realization rates are different. Please provide an explanation of the differences. Please explain the difference, if any, between empirical measurement of results, and general assumptions used to determine savings.

RESPONSE

Confirmed. Input assumptions, NTG factors and realization rates are different. Providing a detailed explanation of the differences between input assumptions, NTG factors and realization rates would require a lengthy detailed response which the Company believes goes well beyond the scope of this proceeding particularly given the fact that each of the individual values and measurements are influenced to a greater or lesser degree by engineered calculations, interpretation, and empirical observations.

Regarding the difference between empirical measurement of results and general assumptions, the Company could not find a reference to this in Enbridge's evidence. Without context and an evidentiary reference, the Company is unable to answer this question. Please see the response to SEC Interrogatory # 32, found at Exhibit I.EGDI.SEC.32.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #29

INTERROGATORY

[A/1/3, p. 28] Please confirm that, if the Board applies NTG results retrospectively, the Applicant will reduce its prioritization of DSM programs, or some component of DSM programs. Please provide details.

RESPONSE

Please see the response to Energy Probe Interrogatory #6, found at Exhibit I.EGDI.EP.6

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #30

INTERROGATORY

[A/1/3, p. 28] Please explain in more detail why the Applicant believes the Board engaged in "bait and switch" tactics.

RESPONSE

For clarity, the company does not believe the Board has engaged in "bait and switch" tactics. The company believes, the Board's direction in the DSM 2015 to 2020 Framework was clear that it expects the utilities to use 2015 as a roll over year. As specified in the Decision and Order EB-2015-0049 p.21

> 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. (emphasis added)

This indicates that the Board did not intend that free rider rates, which were rolled over from 2014 into 2015, would be adjusted retroactively. Updating targets going forward is an entirely different and appropriate step which is what the Company believes the Board intended by this determination.

Inconsistent with the above, the Company does have concern with Board Staff proposing that updated NTG values be applied retroactively to 2015. The Company worked under the assumptions laid out in the Board's Framework and Decision, which does not provide for the retroactive application of a revised NTG value in 2015.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #31

INTERROGATORY

[A/1/3, p. 29] Please confirm that program design, or program implementation, can materially affect the actual experienced level of free ridership for that program. Please provide details as to how the Applicant ensures that free ridership is minimized in its program design, and its program implementation.

RESPONSE

Enbridge understands that program design can have impacts on the potential for free ridership.

The Company believes however it's important to distinguish between actual free ridership and free ridership estimation by way of self-report survey methods. Due to the various issues outlined in Enbridge's evidence (a lack of focus on technical support, business partner influence, timing delays in the study, etc.) it believes there is a very significant gap between the actual level of free-ridership in its programs and the estimated value of free ridership as proposed by the study.

The Company has identified a number of efforts it has undertaken to mitigate the potential for actual free ridership in its program design and implementation. These are outlined in the Company's October 1, 2017 mid-term submission (EB-2017-0128) starting on page 4.

An example of how the Company minimizes free ridership through program implementation is its focus on customer engagement, technical support and education that reduces free ridership by helping the customer to identify projects in the first place.

An example of how the Company minimizes free ridership through program design is its detailed consideration of the base case. By taking this step it minimizes cases where equipment or technologies are now standard practice.

In addition to the above, because of its concerns with the limitation in measuring free ridership, Enbridge has been focusing some of its effort on improved documentation of programs efforts, such as prior studies or technical support that identified a project. To be clear, this is not expected to change the actual free ridership, but it is aimed to reduce the gap between the actual free ridership value and the measured value in future studies.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #32

INTERROGATORY

[A/1/3, p. 31] Please describe the benefits and disbenefits of negotiated NTG results vs. empirically or independently derived NTG results.

RESPONSE

This response is provided with the assistance of Navigant.

It should be noted that empirically derived results may or may not be independently derived results. In addition, negotiated results can also be independently arrived at in some settings. Trying to make these distinctions can be difficult.

The design of empirical studies in evaluation often include many negotiated elements between stakeholders, particularly with respect to the design of questions; agreed-upon scoring methods; and, treatment of complex NTG concepts such as timing and acceleration of investments; and, procedures to mitigate bias (including recall bias, response bias, and bias in survey implementation e.g., interviewer bias and non-response bias). All three state jurisdictions addressed in the Navigant review set out certain NTG evaluation processes in advance of implementation. This requires careful review, comments, proposed approaches, and then an agreed-upon approach. Many elements in this process represent a negotiation in terms of developing an approach in advance of its fielding to develop NTG estimates.

As discussed above, NTG results can be both empirically and independently derived, and also can be subject to stakeholder negotiations. This is the case in Massachusetts and Illinois, where evaluation results are used to inform stakeholder consensus processes for prospective application of NTG values. This negotiation process is particularly important for prospective application where changes are expected to occur in markets or participation.

Negotiated results can be more expansive in the issues that are considered. These can include a recognition of market effects and secondary attribution that might be difficult to estimate empirically but are known not to be zero. Ignoring these known factors, or assuming they have a value of zero where logic and empirical studies show they are, in

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

fact, non-zero, can lead to poor policy decisions. Negotiated approaches make use of empirical studies (both within the jurisdiction and from other jurisdictions as appropriate) but are also able to consider the context and robustness of empirical estimates. Knowledge of what is included in a NTG empirical study and what is left out (e.g., secondary attribution, other program influences, spillover, and market effects) can be assessed and addressed judgmentally by making informed adjustments to results where they are aligned with the overall EE policies in a jurisdiction.

Overall, the benefits of negotiated NTG informed by empirical studies include:

1. A focus on developing values that are viewed by the stakeholder group as being “fair”.
2. The ability to make reasoned adjustments for factors that were not able to be included in the empirical study (e.g., spillover, market effects, and any secondary influences).
3. Developing context around empirical study results through examination of the influence of assumptions and judgments embedded in the empirical study regardless of the method used (i.e., econometric, self-report, or quasi-experimental designs). This would include assessing the robustness of estimates across differing sets of assumptions (e.g., scoring methods) applied to the empirical findings.

Empirical NTG results provides benefits in terms of:

1. It is a self-documenting method, where the data that drive the findings are collected and reported.
2. It might be viewed as being less arbitrary, however, there will be reasoned judgments and assumptions in the design of any empirical study and in the interpretation of the results.
3. It forces stakeholders to look at customer and market data that are collected to validate program influence hypotheses – in this context, empirical studies are important.
4. Empirical studies can provide key information for use in decision making regarding NTG values and EE policies; and, can assist in both negotiated and independent assessment processes.

Summary – The best approach is likely to be a negotiated process informed by a review of empirical studies and results. This would involve developing a reasonable range of

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

attributed NTG values (rather than point estimates) based on well-designed empirical studies. Assessing the context and robustness of the estimates from empirical studies is important. There should be a particular focus on the influence factors have been successfully addressed by the study as well as those that may have been omitted due to lack of data or an inability of the methods to address these influence factors. Once the empirical results have been reviewed and discussed in a stakeholder process, reasoned judgment should be used to finalize NTG values that equitable considering use of the estimates (e.g., for planning, measuring progress towards targets, and financial incentives).

Witnesses: D. Bullock
S. Dimetrosky
L. Gage
D. Johnson
D. Violette

SEC INTERROGATORY #33

INTERROGATORY

[A/1/3, p. 33] Please provide copies of all written comments to the EC, EAC and OEB Staff. Please divide those comments into those i) accepted, ii) appropriately resolved, iii) "not addressed", and iv) "not appropriately resolved".

RESPONSE

It is Enbridge's view, that the depth and breadth of attempting to expend the necessary time and effort to address the voluminous request of compiling the copious aggregate comments of all participants in this process across a myriad of documents, reports and emails and attempting to judge how each of those comments should be catalogued would be unreasonable in terms of the time commitment required and would be completely out of proportion relative to the limited value, if any, that it would provide the Board in this proceeding.

Further, as outlined in Enbridge's response to SEC Interrogatory #17, found at Exhibit I.EGDI.SEC.17, Board Senior Counsel advised in June of 2017 that requests for the production of comments provided by other participants to the evaluation process should be considered by the Board panel. Enbridge therefore declines to produce the comments of other participants at this time.

Enbridge, along with other EAC members provided views, opinions, feedback and comments (verbal and written) to OEB Staff and the EC throughout this process. Much of this commentary was well considered. Some of the comments were administrative (making corrections, addressing presentation of data, etc.). Some sought clarity and asked questions while others were highly relevant to the contributing party. This being said, it is with respect to those specific issues raised by Enbridge during the 2015 evaluation process that it has identified in this proceeding that it continues to have particular concerns. Enbridge has discussed these in its evidence and refers to the Company's response to Board Staff Interrogatory #11, found at Exhibit I.EGDI.STAFF.11 for additional detail.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #34

INTERROGATORY

[A/1/3, p. 34] Please file all communications expressing “concerns regarding the EC’s decision to not factor secondary attribution”, and all communications from the EC or OEB Staff “dismissing” those concerns.

RESPONSE

Upon receipt of the draft participant survey instrument in November 2016, Enbridge provided comments, as requested of all EAC members, which included highlighting that the draft survey only outlined a single question to assess longer term impacts of the utility’s influence on the participant’s decision to move forward. Despite the scope of work specifying that a “question sequence” was planned to assess and capture this attribution. Further the EC had previously provided the TEC with a number of examples of research questions for secondary attribution but did not incorporate these. Despite the Company’s comments, the single question included in the EC’s draft went unchanged following input from the utilities. The EC proceeded finalizing the participant survey unchanged in this regard and advised the EAC that final documents were posted on the SharePoint on December 15, 2016 (Enbridge was erroneously omitted from this communication and learned of the finalization of document from Union Gas).

The scoring methodology for the NTG survey was also finalized and similarly posted to the SharePoint on December 15, 2016. Nowhere in the scoring methodology did the EC indicate that they would not be including secondary attribution in the NTG estimates. Further, at no time previously had the EC stated that secondary attribution was not to be factored in the NTG estimates. To the contrary, as outlined in DNV’s memo to the TEC during the NTG development stage, DNV differentiated the two types of attribution and addressed capturing both (see the attachment to EP Interrogatory #5, found at Exhibit I.EGDI.EP.5).

It was not until the EC delivered it’s draft report to the EAC in late May 2017 did it become apparent that the EC’s proposed free-ridership value did not factor secondary attribution, despite the EC quantifying a value for secondary attribution in its finding.

Enbridge provided comments on the draft report expressing concerns regarding this omission and during the EAC meeting on June 22, 2017 both utilities repeated these concerns and highlighted that these actions were not in line with the scope of work.

Witnesses: D. Bullock
D. Johnson

Ultimately, the EC made no change to the free-ridership values to include both types of attribution.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #35

INTERROGATORY

[A/1/3, p. 38] Please file all minutes of TEC meetings referring to discussions regarding the Navigant jurisdictional review.

RESPONSE

The following TEC quarterly reports reference the Navigant jurisdictional review:

- TEC 2012 Q2
  https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202012%20Q1-2%20Report.pdf

- TEC 2012 Q3
  https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202012%20Q3%20Report.pdf

- TEC 2012 Q4
  https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202012%20Q4%20Report.pdf

- TEC 2013 Q1
  https://www.oeb.ca/documents/TEC/Quarterly%20TEC%20Reports/TEC%202013%20Q1%20Report.pdf

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #36

INTERROGATORY

[A/1/3, p. 40] Please confirm that the Applicant is proposing the use of zero free-ridership for the Run-it-Right program.

RESPONSE

Confirmed. The NTG value that the EC determined in the recent study was not intended to be applied retroactively to 2015.

Furthermore, the RiR operational improvement program brings awareness to energy consumption management and highlights low-cost/no-cost energy reduction activities through a process of site investigation, implementation, training and monitoring. As discussed in detail in the Company's response to BOMA Interrogatory #4, found at Exhibit I.EGDI.BOMA.4, the measurement of NTG for such a program is uniquely challenging relative to custom project NTG determination and Enbridge is of the view the approach undertaken through the recent NTG study was not appropriately tailored to provide a NTG reflective of this type of programming.

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #37

INTERROGATORY

[A/1/3, p. 43] Please explain why, if it is "impossible to extract the influence of a single program", any savings should be attributed to the Applicant's programs at all. If some savings should be attributed in this scenario, on what basis does the Applicant believe they should be determined?

RESPONSE

The quote referenced above is pulled from a section of Enbridge's evidence that summarizes the disadvantages of utilizing self-report methods for NTG estimation as outlined in the Research Into Action report included in the Company's evidence at Exhibit B, Tab 6, Schedule 3. As stated in the report: "The limitations of self-report to assess free-ridership, and consequently, NTG, are numerous..." [1] The report goes on to outline specific areas of limitation with self-report methods including difficulty in isolating program influence from longer-term market transformation effects:

> The decisions and behaviors of people and organizations are not solely influenced by an individual program, but by a variety of other forces. As described by Vine et al. (2010), numerous public policies and market interventions influencing energy efficiency often operate simultaneously, and it is likely impossible to extract the influence of a single program. This is an especially difficult task for a single respondent. For example, in addition to the specific program in question, public policy (e.g., state government messaging advocating for energy efficiency, tax credits for energy efficiency measures) as well as market interventions (e.g., media coverage of energy efficiency issues, other private-sector advertising) and other forces such as energy efficiency education in universities and other schools likely all exert their influence on the consumer's behavior. The individual respondent would conceivably have difficulty identifying the unique contribution of the program on their behavior apart from the other numerous influences, including market transformation effects.[2]

The statement does not suggest that program influence does not exist but rather specifically addresses the limitation of a self-report survey method to be able to quantify the unique contribution of the program among other influences.

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[1] Review and Analysis of Net-to-Gross Assessment Issues for Natural Gas Demand Side Management Custom C&I Programs, by Research Into Action, Inc., dated August 25, 2017, Exhibit B, Tab 6, Schedule 3, page 16 or 39
[2] Ibid. page 19 of 39

Witnesses: D. Bullock
D. Johnson

SEC INTERROGATORY #38

INTERROGATORY

[A/1/3, p. 46] Please confirm the Applicant's view that empirical studies of NTG will show increased free-ridership as cap & trade becomes more important. Please explain why this would result in reduced DSM activity by utilities.

RESPONSE

In terms of the above question implying that NTG studies are strictly "empirical", please see the response to SEC Interrogatory #32, found at Exhibit I.EGDI.SEC.32.

If future NTG studies focus too heavily on the value of customer incentives, this could show an increase in free-ridership as Cap & Trade becomes more important. Enbridge could be forced to reduce program dollars on technical support, education, etc, and redirect those dollars towards customer incentives, which would result in lower overall results.

This is one of the key concerns Enbridge has with the NTG study, that it did not sufficiently consider the impact of other program influences such as technical support, education and business partner influences. Because it focused on incentives, the results show a higher level of free ridership then Enbridge believes to be the case. If the only barrier to energy conservation investments was financial, then incremental Cap and Trade costs could replace incentives in some cases. Enbridge firmly believes that if its programs, which target other barriers in addition to financial, were removed from the market, it would result in decreased energy efficiency investment and thus higher carbon abatement costs (and energy costs) to customers.

Ideally, future NTG studies should obtain a more fulsome view of the impact of the Company's programs, along with the impact of other funding sources. This would allow the Company to use this information to prospectively design programs to ensure they target all barriers to energy efficiency and are complimentary to any impacts from Cap & Trade, thus maximizing results for ratepayers. In this case we would not expect to see a significant increase in free-ridership as Cap & Trade becomes more important.

Witnesses: D. Johnson
F. Oliver-Glasford

SEC INTERROGATORY #39

INTERROGATORY

[B/6/3] Please provide the full CVs of the six named authors of the report.

RESPONSE

The authors' resumes are provided as attachments to this response.

Witnesses: R. Bliss
J. Peters

research › into › action inc

Ryan Bliss, M.A.

Managing Director

Work History

- Self-Employed: Consultant, Writer, Editor
- Spherix, Inc.: Assistant Director for Government Business Development, Biostatistician
- Harvard University, School of Dental Medicine: Research Analyst

Education

- M.A., Child Psychology: University of Minnesota, Minneapolis
- B.A., Psychology: Cornell University, Ithaca, NY

Mr. Bliss has more than 37 years of research and analysis experience, including 11 years in energy efficiency. He directs all aspects of market research and evaluation projects, from conception to final presentation of results, including budgeting, work plan development, and management of staff and subcontractors. He is a staff resource in development of complex sampling and analysis plans and has particular expertise in free-ridership and spillover assessment and energy efficiency in the nonresidential sector. Prior to joining Research Into Action, he had more than 25 years of research experience: as an analyst on National Institutes of Health-funded social and health research for Harvard University, the Veterans Administration, and Midwest Research Institute; as a biostatistician at a private research firm in Maryland; and as a research consultant for several university faculty members in Bangkok, Thailand. He has published research reports in peer-reviewed journals and presented at national and international conferences.

Representative Experience

AMEREN MISSOURI

- **Business Electric Energy Efficiency Program Evaluation, 2013-present:** Managed successive one-year process evaluations of a portfolio of business energy efficiency programs that included prescriptive and custom retrofit, new construction, and retro-commissioning incentives. To make the most efficient use of resources, the successive evaluations used alternating sources of market feedback. Further, the evaluation followed a strategy of tailoring each year's efforts to address specific issues identified in the previous evaluation. This evaluation has several interesting features. First, it uses a quarterly online participant survey to provide feedback to program implementers throughout the year. Second, the quarterly feedback also makes extensive use of analyses of program tracking data and customer population data to show the program reach and to identify under- or over-served groups. Third, **the evaluation carries out an annual study of spillover savings using a new methodology, introduced in 2015, that identified both direct and indirect pathways of program influence in multiple sales channels; this new methodology was presented at the 2017 International Energy Program Evaluation Conference and has since been adapted for use in a residential program**.

AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

- **2007 Behavior, Energy & Climate Change Conference White Paper: "Lessons Learned After 30 Years of Process Evaluation", 2007:** Conducted in-depth interviews with evaluation experts to identify lessons learned from 30 years of process evaluation of energy efficiency programs.

AVISTA UTILITIES

- **Independent Third-Party Verification of 2006-to-2008 Natural Gas DSM Energy Savings, 2007-2009:** Led a three-year verification audit of nonresidential, residential, and limited-income energy efficiency programs. Developed a spreadsheet system to automatically calculate verifiable savings from hard copy documentation and client-supplied algorithms and update cumulative summary results, including precision estimates, with each year's data. Identified key causes of unverified data and made recommendations to improve data quality.
- **Portfolio Review, 2014-2015:** Managed the process evaluation of nonresidential program portfolio in close coordination with staff conducting the residential portfolio evaluation. The evaluation included in-depth interviews with utility and implementer staff and surveys of trade allies, program participants, and nonparticipants. Unusual features of this effort included an assessment of the degree to which nonresidential customers purchased lighting that had received upstream incentives through a residential upstream program.

BC HYDRO/DUNSKY ENERGY CONSULTING

- **Fortis BC and BC Hydro New Homes Participants, 2011:** Investigated and quantified the role of energy cost savings in decisions for new home purchases. Devised a stratified sampling plan and post-sampling data weights to adjust for a participant population that did not reflect market share on key demographic variables.

CITY OF PORTLAND-METRO

- **Metro Telephone Survey - Household Hazardous Products, 2007:** For a regional government, conducted segmentation analyses of data on consumer use and disposal of household hazardous chemicals and alternative or "green" products. Used analysis of variance to identify interactions among predictors of use and disposal behavior, and multiple regression analysis to identify and eliminate redundant predictors. Also, contributed the stratified sampling strategy for a study of consumer awareness of and attitudes regarding energy efficiency. Developed stratum weights to adjust survey data for differences from census data on multiple demographic characteristics.

COLORADO GOVERNOR'S ENERGY OFFICE

- **Colorado ARRA Evaluation, 2011:** Managed a project to develop assessments of program satisfaction and free-ridership tailored to a wide range of residential and nonresidential energy efficiency programs and measures. Developed an online survey instrument that allowed interviewers to ask varying mixes of measure-specific satisfaction and free-ridership questions with multiple program participants.

CONNECTICUT ENERGY EFFICIENCY BOARD

- **Small Business Energy Advantage (SBEA) Program, 2016-2017:** Managed the evaluation of a program providing no-interest, on-bill financing and incentives for energy efficient equipment to small businesses in Connecticut. In addition to assessing the overall effectiveness of program implementation, the evaluation investigated the barriers to acceptance of program offerings, including resistance to taking on debt. The evaluation also investigated the role of community and cultural organizations in bridging the trust gap that may exist between some small business owners and program administrators.

DUKE ENERGY

- **Energy Education Programs, 2015-2018:** Principal-in-charge for a process evaluation of energy efficiency school-based programs, funded by Duke Energy and implemented by the National Theatre for Children and the National Energy Education Development Project. Programs serve K-12 schools and are implemented in five states: North Carolina, South Carolina, Indiana, Kentucky, and Ohio. The common feature of all the programs is distribution of educational materials and a kit containing low-cost energy efficiency measures, including faucet aerators and LEDs. Participated in calls with client and provide high-level review and guidance of research plan development, data collection and analysis, and reporting. The process evaluation examined program processes and gathered satisfaction, program influence, behavioral and demographic data using in-depth interviews with program staff, implementers, and teachers and surveys with teachers and student families.
- **Save Energy and Water Kit Programs, 2016-2019:** Principal-in-charge for the evaluation of the water and energy efficiency kit programs for residential customers across multiple jurisdictions. The program provides direct install kits with water and energy efficiency measures to homes with electric water heat. Evaluation tasks included: development of survey and interview guides, fielding web surveys of participants, analyzing and reporting on participant survey data, and **net-to-gross analysis**.

ENBRIDGE GAS

- **Net to Gross Analytic Literature Review, 2016-2018:** Led an analytic literature review of literature relating to net savings adjustments for energy efficiency programs. The comprehensive review covered methods for assessing net savings, addressing both free-ridership and spillover, disadvantages of the self-report method, other methodological concerns with net-to-gross assessment, and policy considerations relating to net-to-gross. Key findings and conclusions from the review were: 1) multiple factors limit the accuracy of self-report responses or introduce potential biases; 2) researched net-to-gross can, and often does, lack precision, the extent of which often is under-appreciated; and 3) spillover often and possibly usually is under-accounted for, resulting in the under-estimation of net savings.

ENERGY TRUST OF OREGON

- **Fast Feedback Projects:** Acted as principal-in-charge or project manager for several projects relating to Energy Trust's fast feedback process for collecting net-to-gross and satisfaction responses for all programs. **In 2009**, managed a project to compare Fast Feedback survey response rates and survey responses survey across phone, web, and paper delivery modes. Provided feedback on survey questions, developed formatting and delivery approaches; established the sampling and mode assignment plan; oversaw data collection; designed a process to prevent re-surveying repeat participants; analyzed response rates and trends; and provided recommendations. **In 2010**, managed a project to help Energy Trust roll out Fast Feedback to its full suite of residential, C&I, appliance recycling, and renewable programs. Adapted the pilot survey instrument to each of 23 participant quota groups, calculated sample sizes, conducted the phone surveys, and analyzed the resulting responses. **In 2014**, managed a project that analyzed four years of historical data from the Fast Feedback process to examine the relationship between program success indicators and time, attributes of participation, and program and market changes; the consistency between qualitative and quantitative responses; and the quality and consistency of performance by project contractors. **In 2018**, was principal-in-charge for a project to assess the feasibility of shifting from phone to web survey for Fast Feedback. Developed a randomized-control research design to test phone and web modes and three incentive conditions within the web mode.

- **Process and Impact Evaluation of Existing Buildings Program, 2009-2014:** Led four consecutive process evaluations of a large U.S. nonresidential program, both as project manager of a combined process and impact evaluation and as the subcontractor. Documented program strengths and weaknesses and conducted special investigations of the use of free direct-install equipment to enter an underserved segment, segment-specific marketing and outreach, decision-making throughout multiple phases of energy assessments, the transition to a new implementation contractor, and coordination with utilities on program marketing. Oversaw all evaluation aspects, including development of complex sampling plans. Key contributions included developing an index of savings potential by market segment and showing the role that energy assessment professionals play in recruiting program participants.
- **Survey of Multifamily Property Owners, 2010:** Managed survey research to identify and quantify non-energy benefits of energy efficiency upgrades in multifamily residences. Devised an automated rolling sampling methodology that randomly assigned participants to survey conditions and tracked contact results. Managed a rollout of the methodology to the client's portfolio of programs, tailoring the free-ridership assessment to multiple programs and measure types. Identified the most common types of property improvement; the influence of tenant requests, potential energy savings, and competitor/peer influence on decision-making; and the impact of energy efficiency upgrades on tenancy, income, and property value. Developed an algorithm to estimate the economic benefit of energy efficiency upgrades.
- **Process Evaluation of Existing Multifamily Program, 2013:** Managed the first process evaluation of a program that provides free direct-install and incented measures to multifamily properties. The evaluation focused on property owners' motives for carrying out energy-efficient upgrades, the value of installing energy-saving measures in renter-occupied areas, the level and drivers of customer re-engagement, and the role of trade allies. Key achievements of this evaluation included: a market characterization that provided information on the size of the multifamily market and

identified geographic areas with as-yet untapped potential for savings; an analysis questioning whether direct-install measures subsequently lead to larger projects; and analyses documenting the importance of interacting directly with property owners rather than with property managers.

- **Process Evaluation of Energy Trust Programs in NW Natural's Washington Service Territory, 2009-2010 and 2012:** Managed process evaluation of pilot energy efficiency programs offered to Northwest Natural's residential and commercial natural gas customers in Southwest Washington and managed the process evaluation of the expanded programs two years later. In addition to obtaining general information about program processes and implementation, identified barriers, opportunities, and challenges in rolling out the program and achieving goals, and assessed whether trade allies in SW Washington faced any particular challenges in promoting the programs and whether any additional marketing efforts might be required in that area. Identified major differences between the SW Washington and Oregon markets. In particular, carried out analyses of fuel type use, housing stock characteristics, and demographics to shed light on the potential for gas savings in the area served by the pilot program and to identify which parts of the pilot service area had the greatest potential for additional residential savings. Used U.S. Census data to demonstrate that variability in participation rates were more closely related to population density than other factors the program had focused on, thus identifying untapped residential potential.
- **Trade Ally Survey, 2011, 2012:** Managed the update and analysis of an annual survey of trade allies for a client's entire program portfolio. Led the review of more than 100 survey questions to improve question wording, type, and order to ensure valid and reliable data collection; devised additional survey questions to address new topic areas and to close previously open-ended questions; and supervised the analysis and write-up of survey results.
- **Market Research for New Buildings Program, 2018.** Acting as principal-in-charge of market research to support program planning and decision making for Energy Trust of Oregon's New Buildings Program. Providing corporate-level oversight of research to document participants' project experiences and insights, based on interviews with owners/developers, architects and designers, engineers, design-build firms, and both general and specialty contractors. Oversaw development of a sampling plan that covered all program tracks and options while emphasizing high-priority options (Modeling Assistance and Path to Net Zero) and ensured the interviews provided the widest possible breadth and depth of information.
- **Process Evaluation of Production Efficiency Program, 2018-2019.** Managing a process evaluation of a program that helps industrial companies improve the energy efficiency of their processes. This project is just getting underway. Key research objectives include understanding the current state of energy management practices among industrial customers, assessing the impact of SEM on program participants, estimating the share of the market that has been affected by the program and by SEM specifically, and assessing the effectiveness of several changes to the program's strategic energy management (SEM) services, including the expansion of SEM to small-medium industry, the revision and standardization of the first-year approach and launching of continuous SEM, and the creation of a pool of SEM coaches.

- **Process Evaluation of the New Homes and Existing Homes Programs.** In **2009-2010**, **m**anaged the process evaluation of a program aimed at builders of new residential properties. Documented program successes and identified key motives and barriers relating to builders' participation, as well as a potential critical barrier to builders' long-term adoption of program-promoted measures and energy codes. Examined the role of real estate professionals in promoting the program. In **2013-2014**, managed a process evaluation of a residential energy efficiency program serving customers of multiple electric and gas utilities in two states. The program had just undergone a transition to a new implementation contractor. This evaluation had multiple areas of focus: 1) documenting program processes under the new implementer; 2) assessing the effect of the transition on program stakeholders; 3) assessing coordination between the program administrator and utilities on program marketing; and 4) assessing installation rates of instant savings measures and their effect on other energy saving behaviors.

FORTIS BC

- **Demand Side Management Evaluation Studies, 2017-2018:** Was principal-in-charge for net-to-gross research and a process evaluation of a residential heat pump program in British Columbia, Canada, which surveyed participants and heat pump installers and included a literature review of the program delivery strategies among similar heat pump programs in the region. Let the adaptation of an improved spillover approach, which he had developed for a large C&I portfolio, to this residential program. The approach identified the indirect program influence, via installers, on sales of heat pumps to program nonparticipants. The application of this approach identified electricity spillover savings equivalent to 18% of gross savings in the program.

ILLINOIS DEPARTMENT OF COMMERCE & ECONOMIC OPPORTUNITY

- **Spillover Study, 2016-2018:** Led the development, implementation, and analysis of an online survey of public buildings facilities managers to assess spillover effects from the Illinois Department of Commerce & Economic Opportunity's energy efficiency programs for public sector buildings in Illinois. Managed the development of a survey instrument that followed established state spillover protocols as well as the implementation and analysis approaches. The major challenges of implementing this research project were to establish the population of public sector entities across nine categories of entity (school, community college, municipality, county, township, fire district, library district, park district, and other) and identify sources of knowledgeable contacts (e.g., facility managers) for the entities, which yielded nearly 11,000 contacts for the more than 6,000 public sector entities. A second major challenge was to develop an approach to extrapolating sample results that reflected differences among sample subgroups in sampling ratios obtained, total sample obtained, and total building square footage.

INDEPENDENT ELECTRICITY SYSTEM OPERATOR (PREVIOUSLY ONTARIO POWER AUTHORITY)

- **2009-2010 Cross-Cutting Evaluation of Ontario Power Authority Large Commercial and Industrial Retrofit Incentive Initiatives, 2010-2011:** Led the cross-cutting process evaluation of a large Canadian nonresidential program, both as project manager of a combined process and impact evaluation and as the subcontractor. A key contribution of the evaluations was the assessment of challenges associated with implementation of the same program separately in multiple geographic locations.

- **Cross-Cutting Evaluation of Business Incentive Programs, 2011-2013:** The second evaluation examined the role of energy audits as part of a multifaceted approach to promoting comprehensive upgrades. The evaluation also investigated program effects on province-wide job creation.
- **Cross-Cutting Evaluation of Business Incentive Programs, 2013-2015:** The third evaluation included large and small businesses. For large businesses, the evaluation added an analysis of the strengths, weaknesses, opportunities, and threats (SWOT) of the program portfolio in terms of meeting the province-wide savings targets. The SWOT analysis incorporated findings from the process evaluation, including SWOT-specific questions for program administrator and implementer staff and trade allies, as well as information obtained from a comparative analysis of programs offered in other jurisdictions.

LAWRENCE BERKELEY NATIONAL LABORATORY

- **Better Buildings Neighborhood Program Comprehensive Evaluation, 2012-2015:** Managed the initial stages of a large project with multiple partners to evaluate a program funding 41 grantees throughout the U.S. to implement residential and nonresidential energy efficiency efforts. Provided critical input into all aspects of the process evaluation, including identification of data elements for evaluation, development of tools and plans for data collection and analysis, and preparation of evaluation plans and reports. Managed activities of subcontractors conducting the impact evaluation.

MASSACHUSETTS PROGRAM ADMINISTRATORS AND THE ENERGY EFFICIENCY COUNCIL

- **Massachusetts Building Operator Certification, Evaluation, Measurement, and Verification Process Evaluation, 2015:** Managed the comprehensive review of the education and training programs for eight Massachusetts energy efficiency program administrators that have, currently do, or are considering subsidizing Building Operator Certification (BOC) tuition for their commercial clients. Interviewed program managers and program administrators in Massachusetts and around the country to understand the history of offering tuition subsidies; subsidy quantities and eligibility requirements as well as the program administrators' plans and expectations for them; marketing and outreach channels; coordination with the regional BOC implementers; perceived barriers to recruitment; the level of difficulty of the course, testing, and certification; and whether and how savings are claimed. Interviewed course participants to understand sources of awareness of BOC, factors influencing their decisions about training, perceptions about the training and its benefits, and factors influencing the application for a tuition rebate.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

- **Process Evaluations of NYSERDA Energy $mart Programs, 2009-2010:** Assessed a client's process for developing solicitations for energy-related R&D projects and evaluating the resulting proposals. Integrated feedback from program staff, members of solicitation evaluation panels, and R&D

contractors to identify actions to increase the quantity and quality of responses to solicitations. Evaluated a program that funds training and certification of workers in the energy efficiency workforce. Integrated feedback from program staff, training organizations, trainers, trainees, and employers to assess program success, incorporating Kirkpatrick's four levels of training evaluation into the research design.

- **Clean Energy Jobs, 2016-2018:** Served as principal-in-charge for research to establish market baselines and track progress on success metrics for a NYSERDA clean energy workforce training program. Through partnerships with 12 large, multi-site organizations, NYSERDA is supporting the development of advanced on-site O&M training, apprenticeships, and partnerships, that will include more than 1,500 O&M staff in the first year and then will be replicated throughout additional sites. Research Into Action is establishing baseline levels of program metrics (number of staff trained, certifications, internships and apprenticeships, employee advancement and retention, etc.) and identifying the approaches to curriculum development for program participants and nonparticipants.
- **Work Force Development Path 2, 2017-2022:** Served as principal-in-charge on research for the NYSERDA workforce development program, which supports the development of training for in-house operations and maintenance staff to more efficiently manage commercial buildings, including multifamily dwellings. This research provides information on program progress and on training-related trends in the greater market. Developed a sampling methodology to reach decision makers in target organizations (for example, large institutional organizations and property management firms), which included review of secondary data to determine which buildings likely will have operations and maintenance staff. Implemented a survey of program participants and nonparticipants to track indicators of program progress and identify trends related to those indicators in the market.

NORTHWEST ENERGY EFFICIENCY ALLIANCE

- **BetterBricks Vertical Markets - Market Progress Evaluation Reports, 2003-2010:** Coordinated the activities of multiple evaluation contractors to assess the progress of a multi-year, multi-market commercial-sector market transformation initiative. Developed research plans, guided multiple data collection efforts, and integrated findings to assess progress in the grocery, healthcare, office real estate, design and construction, and building operations markets. Assessed inputs into the program's cost-effectiveness model.
- **Home Builder Survey, 2011:** Managed a survey of homebuilders across three states to estimate the incremental cost of building to a new energy code and to identify and quantify the building measures and standards driving the additional cost. Also assessed attitudes toward code requirements and energy efficiency in general.
- **Evaluation and Tracking of the Building Operator Certification Expansion, 2012-2017:** Managed a three-year progress assessment of a program to train and certify building operators to improve building operation performance and save energy, followed by three additional years of tracking certifications for the sake of claiming energy savings. Led internal staff and an engineering

subcontractor in efforts to characterize the current building operations market, quantify savings-related behaviors, develop a methodology for estimating total energy savings resulting from training and certification, and update annual counts of certified building operators.

- **Top Tier Trade Ally (TTTA) Market Research and Evaluation, 2015:** Managed an evaluation of an initiative to provide advanced training to lighting trade allies in the Pacific Northwest. Led staff in interviewing and surveying program and implementation staff, regional lighting experts, distributors, and contractors and in carrying out secondary research to characterize the existing lighting trade ally market, establish a baseline of trade ally skills, identify training needs, assess training interest and motivators, and measure training outcomes. Provided feedback on the program logic model and for identifying and tracking outcome metrics.
- **Heat Pump Water Heater Evaluation, 2016:** Served as Research Into Action principal-in-charge for research to help the Northwest Energy Efficiency Alliance (NEEA) better understand the regional market for heat pump water heaters (HPWH) by surveying and interviewing contractors and installers to assess the effectiveness of NEEA's engagement with them, estimate the number of contractors who have installed HPWH in the Northwest, and identify where they installed them. In addition to providing high-level review of all project facets, led the development of the complex sampling approach, which took into consideration whether or not installers had participated in a NEEA hot water training as well as their location (state). A particular challenge was identifying the target population, which involved identifying high-likelihood NAICS codes based on known HPWH installers.

PACIFIC GAS & ELECTRIC

- **Process Evaluation for PG&E's 2006-2008 Agricultural and Food Processing Program, 2008:** Managed the process portion of a combined evaluation of in-house and third-party agricultural programs, integrating the findings from more than 40 in-depth interviews to identify program process issues and recommend process changes.

PENNSYLVANIA PUBLIC UTILITY COMMISSION

- **Statewide Evaluation Oversight Contractor for Process Evaluations and Market Studies of the 2014, 2015, and 2016 Energy Efficiency and Conservation Programs in Pennsylvania, 2013-2016:** Managed the firm's activities as the process evaluation lead for a multi-firm team serving as a statewide evaluator. Led the review of process evaluation and net-to-gross estimation plans submitted by multiple evaluation contractors. To ensure consistent execution and delivery of reviews, established review guidelines and a reporting format based on the published evaluation framework. Also led the effort to establish a uniform approach to net-to-gross assessment that is adaptable for use with multiple program, measure, and participant types.

SEMPRA ENERGY (SAN DIEGO GAS & ELECTRIC COMPANY AND SOUTHERN CALIFORNIA GAS COMPANY)

- **Process Evaluations of the SDG&E and SCG 2010-2012 Nonresidential Efficiency Programs, 2011-2013:** Managed process evaluations of five third-party nonresidential energy efficiency programs within two administrator portfolios, including two programs designated as "innovative." Investigated a range of cross-cutting issues, including the role of utility account executives, utility-wide communication and coordination, data tracking, regulatory issues, and integration with the demand-side-management (DSM) portfolio. Identified key barriers to one innovative program's penetration into an underserved market sector and factors leading to the failure of another program's innovative energy efficiency financing approach.

SOUTHERN CALIFORNIA EDISON

- **Low Income Needs Assessment for the California Alternate Rates for Energy (CARE) and Energy Savings Assistance (ESA) Programs, 2018-2019.** Principal-in-charge for research to update the understanding of the scope, size, characteristics, and needs of the low-income households in California that are eligible for CARE and ESA services and will refresh knowledge of household engagement with energy and program services. This research is just getting underway. It will involve surveying IOU customers that are or might be eligible for CARE and who have or have not participated in ESA and interviewing representatives of community-based organizations (CBOs) that serve the CARE-eligible community and ESA contractors. Challenges of this research will be to identify and survey households that may be eligible for but have never enrolled in CARE, alternative fuel-use households, and immigrant populations

STATE OF OKLAHOMA/NEXANT

- **SEP and EECBG ARRA Program Evaluation, 2011-2012:** Managed a project to develop assessments of program satisfaction and free-ridership tailored to a wide range of residential and nonresidential energy efficiency programs and measures. Developed an online survey instrument that allowed interviewers to ask varying mixes of measure-specific satisfaction and free-ridership questions with multiple program participants.

THE NATIONAL THEATRE FOR CHILDREN, INC.

- **Process and Impact Evaluation of the National Theatre for Children "Energized Guyz" Program, 2010-2012:** Managed a two-year evaluation of an in-school theater program to teach energy-related concepts to elementary and middle school students. Evaluated the effects of the program on acquisition of the energy concepts, as well as on behavioral intentions. Developed a test-retest design with several thousand students at randomly selected treatment and control schools. Design controlled for differences among schools in demographic variables. Developed age-appropriate test instruments, analyzed results, and prepared reports and presentations. Managed a three-year study to evaluate the effectiveness of a school-based program to teach elementary and middle school students about energy and energy conservation. Developed a quasi-experimental research design based on stratified random sampling of schools from a treatment population and random sampling of schools from a matched control population. Developed age-appropriate test instruments to assess changes in attitudes, behavioral intentions, and knowledge of key concepts. The research design tested for both immediate and long-term (school year) effects and controlled for the effect of repeat testing.

RESEARCH SKILLS AND ABILITIES

DATA COLLECTION

- Directs all aspects of data collection, including planning, development and pre-testing of open-ended interview guides and quantitative survey instruments; sample size estimation and development of sampling plans that incorporate multiple strata; and creation of customized data tracking tools. Has substantial experience interviewing a range of market actors, including key stakeholders, program staff, utility staff, vendors and other service providers, technical experts, trainers, and program participants and nonparticipants in the residential and nonresidential markets.

DATA ANALYSIS

- Directs and conducts qualitative and quantitative data analysis in varied settings. Uses analysis packages such as *SPSS* for quantitative analysis and *NVivo* for qualitative analysis; develops project-specific spreadsheet-based applications for quantitative and qualitative analysis. Has extensive experience using a wide range of data analytic methods, including multivariate regression, analysis of variance and covariance, and factor analysis, as well as a variety of parametric and nonparametric methods for testing differences in means and proportions. Constructs weighting schemes to adjust for sampling differences among strata. Calculates precision estimates. Estimates market size and level of market penetration. Is skilled in using spreadsheet tools to generate and manipulate lists.

Publications

"Not all Spillover Is the Same – So Don't Treat it That Way!" In *Proceedings of the 2017 International Energy Program Evaluation Conference.* Baltimore, MD: International Energy Program Evaluation Conference.

"From Real-time to Over-time: Developing a Four-year Perspective on an Energy Efficiency Portfolio." Bliss, R., M. McClaren, J. Folks, and E. Kociolek. 2015. In *Proceedings of the 2015 International Energy Program Evaluation Conference.* Long Beach, CA: International Energy Program Evaluation Conference.

"How Is the Neighborhood? Preliminary Results from the Better Buildings Neighborhood Program." Peters, J.S., M.R. McRae, R. Bliss, and E. Vine. 2013. In *Proceedings of the 2013 International Energy Program Evaluation Conference.* Chicago, IL: International Energy Program Evaluation Conference.

"In Search of Asian Ways of Managing Conflict: A Comparative Study of Japan, Hong Kong, Thailand, and Vietnam." Onishi, J., and R. Bliss. 2007. *International Journal of Conflict Management, 17* (3).

Proceedings of the Foundations-World Bank Country Dialogue. Bangkok, Thailand, October 19-20, 2004. Bliss, R.E. 2005. Published by the World Bank. June 2005.

Small Grants Program Workshop: Grantmaking Good Practices and Innovative Approaches to Small-Scale Grantmaking, August 2004. Bangkok, Thailand, February 5-6, 2004. Bliss, R.E. Published by the World Bank. Bangkok, Thailand.

"Resisting Temptations to Smoke: Results from Within - Subjects Analyses." Bliss, R., A.J. Garvey, and K.D. Ward. 1999. *Psychology of Addictive Behaviors,* 13:143-151.

"Gender Differences in the Outcome of an Unaided Smoking Cessation Attempt." Ward, K.D., R.C. Klesges, S.M. Zbikowski, R.E. Bliss, and A.J. Garvey. 1997. *Addictive Behaviors*, 22:521-533.

"The Relationship between Saliva Cotinine Concentration, Cigarette Consumption, and Blood Pressure Among Smokers." Garvey, A.J., K.D. Ward, R.E. Bliss, B. Rosner, and P.S. Vokonas. 1995. *The American Journal of Cardiology*, 76:95-97.

"Effects of Smoking Cessation on Blood Pressure." Ward, K.D., R.E. Bliss, P.S. Vokonas, and A.J. Garvey. 1993. *The American Journal of Cardiology*, 72: 979-981.

"Predictors of Early and Late Relapse Following Smoking Cessation: A Report from the Normative Aging Study." Garvey, A.J., R.E. Bliss, J.L. Hitchcock, J.W. Heinold, and B. Rosner. 1992. *Addictive Behaviors,* 17:367-377.

"Evidence of Transient Heart Rate Change after Smoking Cessation: A Report from the Normative Aging Study." Ward, K.D., A.J. Garvey, and R.E. Bliss. 1992. *Psychopharmacology*, 106:337-340.

"Influence of the menstrual cycle on smoking relapse and withdrawal symptoms." Frye C.A., K.D. Ward, R.E. Bliss, and A.J. Garvey. In: Keefe FJ, editor. *Society of Behavioral Medicine. Thirteenth Annual Scientific Sessions; 1992 Mar 25-28; New York.* Rockville (MD): Society of Behavioral Medicine, 1992:107.

"Changes in Urinary Catecholamine Excretion after Smoking Cessation." Ward, K.D., A.J. Garvey, R.E. Bliss, D. Sparrow, J. Young, and L. Landsberg. 1991. *Pharmacology, Biochemistry, and Behavior*, 40: 937-40.

"The Influence of Situation and Coping on Relapse Crisis Outcomes following Smoking Cessation." Bliss, R.E., A.J. Garvey, J.W. Heinold, and J.L. Hitchcock. 1989. *Journal of Consulting and Clinical Psychology*, 57 (3): 443-9.

"Problems with Thiocyanate as an Index of Smoking Status: A Critical Review with Suggestions for Improving the Usefulness of Biochemical Measures in Smoking Cessation Research." Bliss, R.E., and K.A. O'Connell. 1984. *Health Psychology,* 3 (6): 563-81.

Presentations

"My Cup Spilleth Over: Improved Assessment of Program Spillover Savings." Bliss, R. 2017. International Energy Policy and Program Evaluation Conference, Bangkok, Thailand. November 1-2.

"Frog Princes and Free-Ridership: Contractor Influence in Residential Programs." Folks, J. and R. Bliss. 2016. Behavior, Energy & Climate Change Conference, Baltimore, MD. October 20.

"Findings, Challenges and Lessons Learned from the Evaluation of ARRA-Funded Programs for the Colorado Governors Energy Office." Roy, L. and R. Bliss. 2012. Paper presented at the AESP Annual Conference, February 6-9.

“Use of Live In-School Theater Performance to Teach Energy Concepts to Children.” Bliss, R. 2011. Paper presented at the Behavior, Energy & Climate Change Conference, Washington, DC, November 30-December 2.

“Changing Behavior to Reduce Energy Consumption.” Bliss, R., W. Eames, and E. Parsons. 2011. Paper presented at the North American Association for Environmental Education Conference, Raleigh, NC, October 11-16.

“When Can I Stop Calling? Do the Hard-to-Reach Respond Differently to Surveys?” Bliss, R., and S. Castor. 2011. Poster presentation at the International Energy Program Evaluation Conference, Boston, MA, August 16-18.

“Changing Behavior to Reduce Energy Consumption (Preliminary Results - 2011).” Bliss, R., and W. Eames. 2011. Paper presented at the Utility Communicators International Conference, Seattle, WA, June 8-10.

“Faster Feedback: Real-Time Estimation of Free Riders.” Peters, J., R. Bliss, P. Degens, and S. Castor. 2010. Poster presentation at the Energy Efficiency Global Forum, Washington, DC, May 10-12.

“Influence and Intention as Determinants of Free Ridership.” Degens, P., S. Castor, M. McRae, and R. Bliss. 2009. Poster presentation at the 2009 International Energy Program Evaluation Conference. Portland, OR: International Energy Program Evaluation Conference.

“Physiological Changes after Smoking Cessation: Permanent or Transient Effects?” Ward, K.D., R.E. Bliss, and A.J. Garvey. 1991. Paper presented at the Society of Behavioral Medicine Annual Meeting, Washington, DC, March 20-23.

“Relationships of Age and Other Factors to Relapse Following Smoking Cessation.” Garvey, A.J., R.E. Bliss, and K.D. Ward. 1990. Paper presented at the Gerontological Society of America Annual Meeting. Boston, MA, November 16-20.

“Changes in Objective and Subjective Withdrawal Symptoms Following Smoking Cessation.” Bliss, R. E., A.J. Garvey, and K.D. Ward. 1990. Paper presented at the American Psychological Association Annual Meeting, Boston, MA, August 10-14.

“Predictors of Early Relapse (Symposium, Self-Quitters: Smoking Cessation in the Real World).” Garvey, A.J., R.E. Bliss, and K.D. Ward. 1990. Paper presented at the American Psychological Association Annual Meeting, Boston, MA, August 10-14.

“Changes in Urinary Catecholamine Excretion during Fifteen Days of Smoking Abstinence.” Ward, K.D., A.J. Garvey, R.E. Bliss, and D. Sparrow. 1990. Paper presented at the World Conference on Lung Health, Boston, MA, May 20-24.

“Age-Related Differences in Reasons for Smoking Cessation and Relapse Crisis Precipitants.” Bliss, R.E., J.W. Heinold, K.D. Ward, and A.J. Garvey. 1989. Paper presented at the Gerontological Society of America Annual Meeting, Minneapolis, MN, November 15-18.

"Age-Related Differences in Cotinine Elimination after Smoking Cessation." Ward, K.D., J.W. Heinold, R.E. Bliss, and A.J. Garvey. 1989. Paper presented at the Gerontological Society of America Annual Meeting, Minneapolis, MN, November 15-18.

"Socially Cued Smoking and Relapse." Bliss, R.E., K.D. Ward, and A.J. Garvey. 1989. Paper presented at the American Public Health Association Annual Meeting, Chicago, IL, October 22-26.

"Smoking Relapse in a Within-Subject Design." Bliss, R.E., A.J. Garvey, and K.D. Ward. 1989. Paper presented at the Society for Behavioral Medicine Annual Meeting, San Francisco, CA, March 16-18.

"Time Changes in Reasons for Smoking Relapse." Bliss, R.E. 1988. Paper presented at the American Public Health Association Annual Meeting, Boston, MA, November 13-17.

"The Relationship between Smoking Motives and Relapse Crises." Bliss, R.E. 1987. Paper presented at the American Public Health Association Annual Meeting, New Orleans, LA, October 18-22.

"Coping Strategies, Smoking Motives, and Relapse Crisis Outcomes." Bliss, R.E., A.J. Garvey, and J.L. Hitchcock. 1987. Paper presented at the American Psychological Association Annual Meeting, New York, NY, August 28-September 1.

"Relapse after Smoking Cessation: A Prospective Analysis." Garvey, A.J., J.L. Hitchcock, and R.E. Bliss. 1987. Paper presented at the American Psychological Association Annual Meeting, New York, NY, August 28-September 1.

"Factors Contributing to False Positive Rates in Ex-Smokers' Salivary Thiocyanate." Bliss, R.E., K.A. O'Connell, and M. Gerkovich. 1984. Paper presented at the American Psychological Association Annual Meeting, Toronto, Canada, August 24-28.

Professional Affiliations

- Association of Energy Services Professionals research〉into〉action inc

Mersiha McClaren, Ph.D.

Senior Consultant 2

Work History

- Portland State University: Graduate Research Assistant
- Biomarin Pharmaceutical, Inc.: Research Associate

Education

- Ph.D., Urban Studies: Portland State University, Portland, OR
- B.A., Molecular, Cellular, and Developmental Biology: University of Colorado, Boulder, CO

Dr. McClaren manages and conducts clean energy market characterization and emerging technology research, as well as program or pilot assessments. She studies consumers' behaviors regarding energy efficiency, renewable energy, and electric vehicle transportation choices in an effort to advance knowledge of decision-making models on the adoption of clean energy technologies. For her Ph.D., she studied with Dr. Loren Lutzenhiser, a leading and widely published researcher in the area of energy, behavior, and climate change. She has been conducting research for 13 years, including 10 years in energy efficiency and renewable or clean energy. She specializes in statistical analyses, including regression, cluster, and segmentation analyses; advanced statistical techniques; and mixed method approaches.

Dr. McClaren's dissertation, *Energy-efficiency and Conservation Attitudes: An Exploration of a Landscape of Choices*, addresses how consumers' attitudes toward the environment, cost of energy, and energy independence affect energy-saving behaviors that are relatively simple to do and inexpensive.

Dr. McClaren is a board member of the AESP Pacific Northwest chapter and is currently working on transportation electrification and clean technology commercialization issues.

Representative Experience

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

- **CleanTech Startup, 2017-2018:** Led and managed this study with the objective to document the baseline performance indicators for the initiatives supporting the clean energy entrepreneurial ecosystem and acceleration of the growth of new businesses that serve the New York State clean energy market. Reviewed initiatives' records, interviewed incubator staff, and developed and managed surveys with cleantech startups who were enrolled in the incubator startup programs (participants) and those who were not (nonparticipants).
- **Behavior Strategy Analysis, Phase I, 2012:** Examined behavior change interventions implemented in the New York State marketplace to determine if there were any strategic opportunities for encouraging behavioral change in consumers with respect to energy efficiency and clean energy technologies. Reviewed and catalogued various behavior change interventions in the residential, commercial, industrial, and transportation sectors. Interviewed program managers and directors to assess challenges in developing and/or integrating behavior change interventions into existing

energy efficiency programs. Examined a specific commercial program to determine necessary program changes to assess types of adjustments needed for integrating promising behavior change strategies into existing programs.

- **Behavior Intervention Strategies - Phase II, 2013:** Conducted a behavioral assessment of marketing messages used to increase participation in an industrial program and recommended the integration of behavior interventions into the messages. Conducted one behavior-change workshop for program managers. Workshop included an overview of the use of behavior-change interventions, a nontechnical discussion of theoretical concepts from social science research, and examples of effective behavior-change strategies.
- **Multifamily Performance Program Process Evaluations, Market Assessments, and Market Characterizations, 2013-2014:** Examined behavior change interventions implemented in the New York State marketplace to determine if there were any strategic opportunities for encouraging behavioral change in consumers with respect to energy efficiency and clean energy technologies. Reviewed and catalogued various behavior change interventions in the residential, multifamily, commercial, industrial, and transportation sectors. Assessed specific barriers and opportunities for interventions in the multifamily program and presented findings to the program staff.
- **Work Force Development Path 2, 2017-2022:** Leading and managing research for the NYSERDA workforce development program, which supports the development of training for in-house operations and maintenance staff to more efficiently manage commercial buildings, including multifamily dwellings. This research provides information on program progress and on training-related trends in the greater market. Developed a sampling methodology to reach decision makers in target organizations (for example, large institutional organizations and property management firms), which included review of secondary data to determine which buildings likely will have operations and maintenance staff. Implemented a survey of program participants and nonparticipants to track indicators of program progress and identify trends related to those indicators in the market.

CALIFORNIA ENERGY COMMISSION

- **Evaluation of Electric Bus Training Program, 2017-2018:** Leading the evaluation component of E-Bus Operator Training and Feedback Program (E-Bus Program). Transit fleet operators can incorporate a few electric buses with little impact to daily operations; however, transitioning an entire fleet to electric buses can be disruptive. A transit authority in California has committed to electrifying its 80-bus fleet. For their electric buses to be cost-effective compared to internal combustion, the average fuel economy needs to be 2.0 kWh/mile. The transit agency has partnered with a team to design and implement an E-Bus Program that maximizes E-Bus fuel economy by coupling education and training for E-bus operators with advanced analytics and proven behavior modification strategies.

ENBRIDGE GAS

- **Review of Net to Gross Studies, 2017:** Co-managed and assessed results from the literature review relating to the net to gross adjustments, particularly as they relate to the natural gas utilities' custom C&I programs. Documented key research findings in a report. The report highlighted limitations of the self-report methods, such as over-estimation of free-ridership due to self-selection bias; a tendency to provide a "socially desirable" response to what would have occurred absent the program; the tendency to rationalize past decisions as arising from internal motives; or difficulty envisioning hypothetical alternatives. The report also highlights methodological challenges, such as spillover often not accounted for and, when it is, it is under-estimated. The report also explores the value of using a negotiated value as well as whether conducting net to gross research on a regular basis justifies the cost.

PENNSYLVANIA PUBLIC UTILITY COMMISSION

- **Statewide Evaluation and Net-to-Gross Oversight Contractor for Process Evaluations and Market Studies of the 2014, 2015, and 2016 Energy Efficiency and Conservation Programs in Pennsylvania, 2013-2016:** An auditor of net-to-gross research and process and pilot evaluations done for various utilities in Pennsylvania. The work included evaluating the net savings methodology, reviewing survey and in-depth interview instrument design, and assessing reporting.

ENERGY TRUST OF OREGON

- **Research to Support a Commercial and Industrial Solar Marketing Strategy, 2013:** Explored past and potential solar electric adopters' characteristics; decision-making processes; and reactions to environmental, financial, and other solar messages. Managed all aspects of the study: literature review of solar adoption among commercial and industrial businesses in the U.S. and Oregon, assessment of commercial and industrial solar program data with a goal of identifying the "most likely to consider solar" market segments of solar adopters in Oregon, and analysis of interview data on decision-making processes and reactions to several existing and new solar messages.

FORTH

- **Live Focus Group for EV Roadmap, 2017:** Managed a focus group of early visitors to the Go Forth Electric Showcase located in Downtown Portland Oregon. The focus group explored barriers and motivations to electric vehicle adoption. The group facilitator grounded conference attendees in the real-world challenges facing electric vehicle adoption today.

AVISTA UTILITIES

- **Portfolio Review, 2015:** Analytical lead for the market/process evaluation of Avista's Washington and Idaho residential programs, including HVAC, Water Heat, and Shell programs. Oversaw quality of data collection (including sampling and instrument development), analysis, and reporting. The process evaluations relied on program staff interview data and trade ally, participant, and nonparticipant surveys to address effectiveness of program processes, identify regulatory challenges, document barriers to participation, gather net-to-gross data, and explore future program opportunities. Also, led special study to investigate the rate of change in participation rates and market causes for each program using relevant data from program databases.

CONNECTICUT ENERGY EFFICIENCY BOARD

- **Small Business Energy Advantage (SBEA) Program, 2016-2017:** This project focused on identifying the barriers to implementation of non-lighting projects or projects achieving deeper savings and how the program might overcome those barriers. For the project, developed survey questions, reviewed analysis and reporting, and contributed to the project management. The project included a survey with 21 program stakeholders who were involved in administering the program; 16 of 24 most active contractors who market and deliver the program; 176 program participants (125 through a phone survey and 51 from on-site visits); and 27 nonparticipant customers (through a phone survey). The research identified factors related to contractors' overall success at selling projects and at selling non-lighting measures in particular.

INDEPENDENT ELECTRICITY SYSTEM OPERATOR

- **Cross-Cutting Evaluation of Business Incentive Programs, 2011-2013, 2013-2015:** Developed net-to-gross survey instruments and contributed to reporting.
- **Consumer Program Evaluation, 2012-2013, 2013-2015:** Lead analyst and co-project manager, responsible assessing consumer response to the program initiatives. Consumer research included customer response to the HVAC Incentives program and documented participant and general consumer perspectives on key program performance indicators: program awareness, satisfaction, challenges, and decision-making. Responsible for research plan, quality of data collection (including sampling and instrument development), analysis (including quantitative, qualitative, and net-to-gross estimation), and reporting.
- **Preliminary Marketing Impacts of the saveONenergy AND BE REWARDED Promotional Campaign, 2013:** Employed a quasi-experimental design to test the effectiveness of a residential market campaign on participation in an HVAC and appliance retirement energy efficiency program and one demand response residential program for the Independent Electricity System Operator (IESO, formerly Ontario Power Authority [OPA]). Evaluated findings and assisted in applying the results from this study to project the impact of the marketing campaign in a target population.

LAWRENCE BERKELEY NATIONAL LABORATORY

- **Energy Efficient Services Industry Workforce Needs Assessment, 2008-2009:** Assessed the current and projected capacity of the U.S. energy efficiency workforce. Analyzed primary and secondary data using regression and other prediction methods to develop estimates of future workforce size for the following market segments: energy services companies, implementation contractors, ratepayer program administrators, and manufacturers linked to energy-efficient products.
- **Better Buildings Neighborhood Program Comprehensive Evaluation, 2012-2015:** Developed an analysis plan and database to assess program success for residential programs offered by 41 grantees throughout the U.S. Directed development of success metrics and explanatory variable specifications. Directed complex statistical analyses to identify patterns of success evident across 54 unique programs.

NORTHWEST ENERGY EFFICIENCY ALLIANCE

- **Evaluation of Energy Savings for the BetterBricks Initiative, 2009:** Developed key metrics to assess the adoption of energy-efficient best practices to analyze their impact on a commercial-sector market transformation initiative. This was part of a multiyear effort to encourage leaders in the market to integrate energy efficiency best practices into their business operations. Target sectors included architects, office real estate managers, hospital facility directors, and mechanical contractors.
- **Refrigeration Engineers and Technicians Association (RETA) Certified Refrigeration Energy Specialist (CRES) Product Validation and Market Test, 2015:** Examined market levels program staff could pull to engage refrigeration professionals to become RETA CRES certified. Managed all aspects of the study: work plan development, instrument development, interviews with RETA CRES certified and non-certified individuals, analysis, and reporting.

NORTHWEST ENERGY EFFICIENCY COUNCIL

- **Measuring Behavior Change in Building Operator Certification (BOC), 2014:** Consulted Northwest Energy Efficiency Council (NEEC) on an experimental design to test the effect of two marketing strategies, implemented by NEEC, on renewal rates of Building Operator Certification (BOC).

PACIFIC GAS & ELECTRIC

- **Behavior Demonstration, 2014:** Contributed to higher-level planning of the implementation of the Behavior-based project/program. Developed and contributed to participant journey map, applicable intervention strategies to be considered in the office, retail, hospitality, and food services sector. Worked with the team to assess how different decision-makers would be involved in different sector and for large and small/medium companies.
- **Zero Net Energy Residential New Construction Market Assessment Study, 2013-2014:** Managed market characterization of zero net energy (ZNE) homes in California. Developed research questions, interview, and survey instruments. Managed the development of the sampling strategy and analysis of interview and survey data from various ZNE market actors: homeowners, builders, appraisers, and state policy staff.

SOUTHERN CALIFORNIA EDISON

- **Set-Top-Box Trial (Residential Plug Load Experiment) and Market Potential Assessment, 2014-2015:** Developed technical and achievable market energy savings potential (annual savings and lifetime savings) if the utility would decide to provide an incentive for replacement of inefficient set-top-boxes with 3.0 and 4.1 ENERGY STAR® qualified models. Developed assumptions based on the experimental design and conducted sensitivity analysis by assuming an increase in the number of boxes if customers were to replace the inefficient box.

COLORADO GOVERNOR'S ENERGY OFFICE AND STATE OF OKLAHOMA

- **American Recover and Reinvestment Act (ARRA) and SEP and EECBG ARRA Spillover Estimates, 2011-2012:** For evaluations of two states' energy efficiency program portfolios, developed survey questions to measure participant spillover effects from residential, commercial and industrial projects. For evaluation of heating and cooling programs across several jurisdictions, developed survey questions to measure nonparticipant spillover effects from residential projects. Analyzed spillover rates by project and by program and also directed many spillover analyses. Completed free-ridership analyses for residential, commercial, and industrial energy efficiency and renewable energy program portfolios. Analyzed free-ridership rates by type of energy-efficient upgrade among commercial firms participating in utility programs. Found differences in the rate of free-ridership among participants installing one or two measures and participants installing three or more measures. Other analytical work included evaluating the strengths and limitations of the free-ridership methodologies and testing for significant response differences by data collection method, including assessing free-ridership rates by commercial customers for a utility-sponsored program. Programs included alternative fuels (vehicle conversion and CNG stations), building energy efficiency, renewable energy (solar PV, wind, and ground source heat pump), smart grid, recycling, traffic signals and lighting, and community-based efficiency programs.

RESEARCH SKILLS AND ABILITIES

RESEARCH DESIGN

- Develops study designs to address clients' research objectives and questions.

INSTRUMENT DESIGN AND DATA COLLECTION

- Develops survey and in-depth interview instruments, and performs sample design and weighting. Conducts in-depth interviews, surveys, field observations, and literature reviews.

DATA ANALYSIS

- Skilled in regression-based quantitative analyses, including structural equation modeling and hierarchical linear modeling. Extensive experience with *SPSS* and *MPLUS* statistical packages. Conducts segmentation analysis using cluster algorithms. Proficient in *GIS* analysis using *ArcGIS* software.

Publications (Note Mersiha McClaren was formerly known as Mersiha Spahic)

"Avoiding Being (Too Much of) a Victim of Your Own Success: Mitigating Free-ridership Losses Through Better Spillover Assessment." McClaren, M. and R. Bliss (TO BE PUBLISHED IN 2018). Paper submitted and accepted to be published *In Proceedings of the International Energy Program Evaluation Conference.* Vienna, Austria: International Energy Program Evaluation Conference. June 26-27.

"Home Energy Reports and Program Rebates: A Quantitative Assessment of Customer Engagement." McClaren, M., B. Messer, J. Smith, and P. Schwarz. 2016. *In Proceedings of the American Council for Energy-Efficient Economy Conference.* Pacific Grove, CA: American Council for Energy-Efficient Economy Conference. August 12-17.

"Changing Industrial Energy Behavior Via Education: Case Study of an Energy Efficiency Refrigeration Certification." McClaren, M., S. Phoutrides, N. O'Neil, and M. McRae. 2015. *In Proceedings of the Behavior, Energy & Climate Change Conference*, accessible at escholarship.org. Sacramento, CA: Behavior, Energy & Climate Change Conference. October 18-21.

"Moving the Needle: Measuring the Performance of an Energy Program Promotional Campaign." Schwarz, P., M. McClaren, B. Messer, H. Tse, and P. Bosco. 2015. *In Proceedings of the International Energy Program Evaluation Conference*. Long Beach, CA: International Energy Program Evaluation Conference. August 10-13.

"Not so intractable after all? Lessons from a midstream Energy Efficiency pilot targeting set-top boxes." Dunn, A., M. McClaren, and M. Fischlein. 2015. *In Proceedings of the International Energy Program Evaluation Conference*. Long Beach, CA: International Energy Program Evaluation Conference. August 10-13.

"akAB Theory: Moving from Theory to Application." McClaren, M.S., A. Dunn, and J. Peters. 2013*. In Proceedings of the International Energy Program Evaluation Conference*. Chicago, IL: International Energy Program Evaluation Conference.

"Integrating More Behavior Change Strategies Into a Portfolio." Gonzales, P., J. Peters, M. Spahic McClaren, A. Dunn, and H. Forster. 2013. *In Proceedings of the 2013 Association of Energy Services Professionals Conference*. Orlando, FL: Association of Energy Services Professionals.

"Measuring Diffusion in a Market Transformation Program." M. McRae, M., A. James, A. Kim, and M. Spahic. 2011. *In Proceedings of the International Energy Program Evaluation Conference*. Boston, MA: International Energy Program Evaluation Conference.

Energy Efficiency Services Sector: Workforce Size and Expectations for Growth. Goldman, C., M. Fuller, E. Stuart, J. S. Peters, M. McRae, N. Albers, S. Lutzenhiser, and M. Spahic. 2010. LBNL-3987E. Berkeley, CA: Lawrence Berkeley National Laboratory.

"What Are Consumers Thinking About Energy Today?" Peters, J., M. Spahic, C. Jackson, and S. Lutzenhiser. 2010. *In Proceedings of the 20th Annual Association of Energy Services Professionals National Conference and Exp*o. Phoenix, AZ: Association of Energy Services Professionals.

"Trends in ENERGY STAR® Awareness: Results from Four National Surveys, 2002 – 2008." Jackson, C., J. Peters, M. Spahic, and S. Lutzenhiser. 2009. *In Proceedings of the International Energy Program Evaluation Conference Session, "Counting on Energy Programs: It's Why Evaluation Matters."* Portland, OR: International Energy Program Evaluation Conference.

"Behavioral Assumptions Underlying California Residential Sector Energy Efficiency Programs." Lutzenhiser, L., L. Cesafsky, H. Chappells, M. Gossard, M. Moezzi, D. Moran, J. Peters, M. Spahic, P. Stern, E. Simmons, and H. Wilhite. 2009. White paper prepared for California Institute for Energy Efficiency and the California Public Utilities Commission. San Francisco, CA: California Public Utilities Commission.

Presentations

"Race to the Bottom. Using Advanced Analytics, Operator Training, and Feedback to Improve Electric Bus Fuel Economy." McClaren M.S., and T. Perry. 2017. Presentation at the Behavior, Energy & Climate Change Conference, Sacramento, CA, October 15-18.

"What Is Needed to Build an Expanded Toolbox for Behavior Change," McClaren, M. S., and H. Forster. 2013. Paper presented at the Behavior, Energy & Climate Change Conference, Sacramento, CA, November 17-20.

"Digging Deeper: Differences between Program and Non-Program Appliance Purchasers." Peters, J.S., M. McClaren, A. Dunn, K. Randazzo, C. Chen, and B. Smith. 2012. Paper presented at the Behavior, Energy & Climate Change Conference, Sacramento, CA, November 12-14.

"Revisiting Attitude-Behavior Interactions: A Longitudinal Perspective." McClaren, M.S. 2012. Poster presented at the Behavior, Energy & Climate Change Conference, Sacramento, CA, November 12-14.

"The Art and Science of Segmentation: Replicating Segmentation Findings in the California Residential Market." Spahic, M., J. Peters, C. Edwards, and C. Jackson. 2011. Poster presentation at the Behavior, Energy & Climate Change Conference, Washington, D.C., November 30-December 2.

"2009 Oregon Residential Awareness and Perception Study." Spahic, M. 2010. Brown-Bag presentation of Concepts Underlying Segmentation Processes, presented at the 2010 Quantitative Methods Series, Portland State University, Portland, OR, March.

"2008 Oregon Residential Awareness and Perceptions Study." Spahic, M., J. Peters, and J. Suzuki. 2008. Paper presented at the Behavior, Energy & Climate Change Conference, Sacramento, CA, November 16-19.

Professional Affiliations

- Forth
- American Marketing Association (AMA)
- Association of Energy Services Professionals (AESP) and AESP Northwest

research into action inc

Nathaniel Albers, M.A.
Senior Consultant 1

Work History

- Portland State University: Institute on Aging, Project Manager
- University of Missouri, Institute of Public Policy: Research Analyst

Education

- M.A., Geography: University of Missouri, Columbia
- Certificate, Geographic Information Science (GIS): University of Missouri, Columbia
- B.A., Culture and Conflict Studies: Juniata College, Huntingdon, PA

Mr. Albers provides research and analysis services for market research projects and evaluations of energy efficiency and renewable resource programs. He has 12 years of research experience, including nine years in energy efficiency. Mr. Albers focuses on process evaluations, program theory, the emergence of “green jobs,” and geographic analysis for a wide range of projects. He also has conducted program evaluation, policy analysis, and spatial analysis across a range of subject areas, including energy, healthcare, and public safety. He enjoys the challenge of organizing, analyzing, and presenting data that can inform both program- and policy-related decisions.

Representative Experience

AMEREN MISSOURI

- **Business Electric Energy Efficiency Program Evaluation, 2013-2015:** We are mid-way through a three-year contract to conduct process evaluations of four of Ameren Missouri's business programs. We are assessing the program’s efficiency and effectiveness pertaining to program design, development, administration, and delivery, and are offering recommendations for program improvements. Interviewed retrocommissioning, and audit participants as part of the evaluation.

AVISTA UTILITIES

- **Portfolio Review, 2014-2017:** Coordinated day-to-day process evaluation activities for nonresidential program portfolio in close coordination with staff conducting the residential portfolio evaluation. Developed sampling strategies for surveys of trade allies and program participants and drafted instruments for participant, trade ally, and nonparticipant surveys. Conducted in-depth interview with third-party implementer. Drafted report sections and maintained schedule of evaluation activities.

BONNEVILLE POWER ADMINISTRATION

- **Process Evaluation of the Energy Smart Industrial Program, 2011-2012:** For a process evaluation of a major regional industrial energy efficiency program in the Northwest, developed interview guides for utilities and participating industrial customers to understand how they managed and used custom project and lighting programs. Conducted qualitative and quantitative analysis of utility and participant survey data in order to inform program staff about the barriers to program participation.

CALIFORNIA INSTITUTE FOR ENERGY EFFICIENCY

- **Behavior and Energy White Paper, 2008:** Conducted in-depth interviews with energy efficiency program evaluation experts to identify lessons learned from 30 years of process evaluations of energy efficiency programs.

CALIFORNIA INVESTOR-OWNED UTILITIES

- **Local Government Partnerships (LGP) - Targeted Process Evaluation, 2015-2016:** Contributed to Local Government Partnership categorization and assisted with development of in-depth interview guides for partnership representatives. Conducted in-depth phone interviews with partnership representatives. Analyzed interview data and drafted sections of the final report.

CONNECTICUT ENERGY EFFICIENCY BOARD

- **Small Business Energy Advantage (SBEA) Program, 2016-2017:** Conducted a needs assessment for a process evaluation of the SBEA program and reviewed program data and documentation to prepare a workplan for the evaluation.

EFFICIENCY NOVA SCOTIA

- **Energy and Demand Savings, 2016-2017:** Developed interview guides and survey instruments for a process evaluation of three programs: Strategic Energy Management (SEM), Energy Management Information Systems (EMIS), and Small Business Energy Solutions (SBES) program. Conducted analysis and drafted report sections pertaining to each program.
- **Demand Side Management Process Evaluation, 2017-2018:** Developed interview guides and survey instruments for a process evaluation of two programs: Green Heat and Custom-Retrofit. Conducted analysis and drafted report sections pertaining to each program.
- **Review of Business Development Work, 2017:** Developed interview guides, conducted interviews, and analyzed data about ENS's Business Development work.

ENERGY TRUST OF OREGON

- **Portland Area Regional Food Waste Study, 2009:** Using geographic sampling, identified food processors that could supply food waste for a regional biodigester intended to generate energy for the community. Conducted in-depth interviews with processors to determine quantities and types of available waste.
- **Process Analysis of Efficient New Homes Program, 2009:** Conducted in-depth interviews with program staff, implementation staff, and homebuilders to identify effective methods of encouraging builder participation in two programs designed to increase the number of energy-efficient homes on the market.
- **Fast Feedback Program Rollout: Nonresidential and Residential Program Portfolio, 2010:** Conducted interviews, designed questionnaires, and developed a system to provide rapid and

ongoing feedback to a program's administrator regarding participant satisfaction and free-ridership information across residential, commercial, and industrial programs.

- **Survey of Multifamily Property Owners Regarding Non-energy-related Reasons for Installing or Upgrading Energy-efficient Products or Systems, 2010:** For a process evaluation of a multifamily program, developed questions to determine the non-energy benefits of energy efficiency improvements and to assess their value to multifamily property owners and homeowners.
- **Process Evaluation of Programs in NW Natural Washington Service Territory, 2011-2012:** Conducted in-depth interviews with program staff, implementation staff, and homebuilders to identify effective methods of encouraging builder participation in two programs designed to increase the number of energy-efficient homes on the market.
- **Process Evaluation of the 2010-2012 Existing Buildings Program, 2012:** For an evaluation of a multifamily program, conducted qualitative and quantitative analysis of data from surveys of building owners and managers to determine program effectiveness and identify additional program opportunities.
- **Commercial and Industrial Qualitative Market Research, 2014:** Developed interview guides, conducted interviews with C&I customers and contractors, and conducted qualitative analyses for an Energy Trust research study that explored customer and contractor views about Energy Trust, the effectiveness of information channels used by Energy Trust, how to improve communications, and awareness of Energy Trust resources and support.
- **Air Sealing Pilot, 2015:** Collected data from trade allies and program staff to assess the cost effectiveness of the pilot.
- **Process Evaluation of My Business Marketing Campaign, Energy Trust of Oregon, 2015:** Contributed to development of data collection instruments and participated in feedback sessions. Conducted in-depth interviews with participating trade allies.
- **Existing Multifamily Process Evaluation, 2016-2017:** Conducted interviews with multifamily property managers and owners about their participation in the program and to identify any possible problems with the program noted by participants. Analyzed data and prepared a section of the report.
- **Lighting Tool Market Research, 2018:** Developed interview guides and conducted Interviews with Energy Trust staff and staff from other program administrators about their experience and use of lighting tool calculators. Analyzed data and prepared report for client.

ENVIRONMENTAL DEFENSE FUND

- **Chemical Year of Innovation, 2017-2018:** Conducted interviews with leaders in the development and use of wearable chemical monitors and drafted report that analyzed the interview data. The project aimed to better understand how the market for wearable chemical monitors is developing and what could be done to hasten the development of that market.

FORTIS BC

- **Demand Side Management Evaluation Studies, 2017-2018:** Analyzed trade ally interview data as part of a process evaluation of heat pump programs**.**

ILLINOIS DEPARTMENT OF COMMERCE & ECONOMIC OPPORTUNITY

- **Spillover Study, 2016-2018:** Assisted in development of sample and survey designed to understand spillover among public entities in Illinois. The survey was sent to schools, libraries, municipalities, and other public organizations to understand how much spillover took place as a result of efficiency programs in the state.

INDEPENDENT ELECTRICITY SYSTEM OPERATOR

- **Consumer Program Evaluation, 2013-2015:** Prepared survey instrument, programmed survey, and selected sample of retailers to with varying degrees of involvement in coupon program to better understand any challenges to participating in a coupon redemption program. Worked with the team to develop work plans, data collection instruments, and conducted interviews and surveys with commercial end-users and trade allies, including lighting distributors and designers, key energy service companies' personnel, electrical contractors, and retail personnel.
- **Cross-Cutting Evaluation of Business Incentive Programs, 2015:** Developed interview guides, conducted interviews and surveys, and conducted quantitative and qualitative analysis for an IESO study that characterized the market for high efficiency measures according to contractors/distributors, participants, and nonparticipants.

LAWRENCE BERKELEY NATIONAL LABORATORY

- **Energy Efficient Services Industry Workforce Needs Assessment, 2008-2009:** Conducted more than 150 interviews with representatives of trade unions, educational and training institutions, and professional organizations to determine the size of the energy efficiency workforce in the U.S., explore the educational and training programs that support it, and estimate the size and training needs of that workforce by 2020. Researched related studies and provided analysis for the final report. For a U.S. Department of Energy-funded assessment of the existing and potential energy efficiency workforce, interviewed contacts at training organizations throughout the U.S. about the implementation of relevant programs. Conducted qualitative analysis to determine program effectiveness and inform program staff of opportunities to improve program enrollment and processes.

LOS ANGELES DEPARTMENT OF WATER AND POWER

- **Residential General Population Study, 2015:** Analyzed residential general population survey data for differences between single-family and multifamily residents regarding their awareness and use of energy efficiency programs.

NATIONAL GRID

- **EnergyWise Rhode Island Single Family Process Evaluation, 2016:** Reviewed, revised, and programmed a participant survey. The purpose of the survey was to better understand motivations for using program financing.

NORTHWEST ENERGY EFFICIENCY ALLIANCE

- **Northwest Ductless Heat Pump 2010 - Market Progress Evaluation Report #1, 2011:** Conducted telephone surveys of participating residential customers for a process evaluation of a ductless heat pump pilot program to determine their satisfaction with the technology, their utility's program, and the installers.
- **Food Processing Initiative Market Progress Evaluation Report #8, 2012-2013:** For a market progress report of an initiative to increase industrial food processors' use of Strategic Energy Management, conducted site visits at processors' facilities to identify characteristics associated with program participation.
- **Heat Pump Water Heater, 2016-2017:** Analyzed contractor survey data pertaining to the awareness of and installation of heat pump water heaters in the northwest. Analysis included estimating the number of heat pump water heaters installed over a five-year time frame and understanding barriers associated with installing these water heaters.

NORTHWEST FOOD PROCESSORS ASSOCIATION

- **Process Evaluation of NW Food Processors Association's Green Energy Management System Pilot Program, 2009:** For a process evaluation of the Northwest Food Processors Association's GEMS pilot, interviewed program participants and analyzed interview data to determine GEMS reliability and usability.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

- **New York Energy $mart Process Assessment and Evaluation ENERGY STAR® HVAC, 2003-2012:** Interviewed participating and nonparticipating distributors, manufacturer representatives, and manufacturers to evaluate the implementation of an upstream HVAC program. Conducted qualitative analysis to identify changes in the program's approach to increase program participation and energy savings.
- **Cleaner, Greener Communities Program, 2015:** Designed guides for and conducted in-depth interviews with program staff and municipal stakeholders about the development of regional sustainability plans, implementation of high-profile projects supporting regional sustainability goals, and challenges and best practices for municipal engagement. Contributed to analysis and reporting.
- **Zero Net Energy Market Model and Baseline Estimates, 2015-2016:** Assisted with identifying market metrics related to NZE construction in New York. Contributed to the design of survey instruments. Lead the data collection from architects and builders by scheduling and conducting interviews. Analyzed interview data to contribute to a baseline study about the market for NZE homes in New York.

PACIFIC GAS & ELECTRIC

- **Medical Energy Efficiency Programs Evaluation and Market Assessment, 2008:** Interviewed lighting contractors, architects, and engineers regarding their participation in a program designed to encourage medical facility managers to adopt a comprehensive approach to energy management. Conducted qualitative data analysis to determine program effectiveness and inform program staff of opportunities to increase participation and realize additional energy savings through the program.
- **California Energy Savings Assistance Program Multifamily Segment Study, 2012-2013:** For an analysis of a low-income program, compared national multifamily programs to identify best practices that could be used in the development of a new multifamily component of the program.
- **Residential Solutions Workbook Phase II: Measure View, 2015:** Collected secondary data about energy efficient pool pumps and worked with a team to design a dashboard showing how variations in pool pumps (and other measures) effected energy use.

PACIFIC GAS & ELECTRIC AND SOUTHERN CALIFORNIA EDISON

- **Process Evaluation of Nonresidential Lighting Programs and Residential/Non-Residential Needs Characterization, 2011-2013:** Analyzed data from interviews with active and inactive commercial and industrial lighting program participants to determine differences between the groups and help program staff develop methods to encourage greater participation.

SOUTHERN CALIFORNIA EDISON

- **Energy Leader Partnership Evaluation, 2015:** Conducted in-depth phone interviews with ELP program participants and nonparticipants. Conducted analysis of data and contributed to report writing.

SOUTHERN CALIFORNIA EDISON AND PACIFIC GAS & ELECTRIC

- **Process Evaluation of Nonresidential Lighting Programs and Residential/Nonresidential Needs Characterization, 2011-2013:** Analyzed data from interviews with active and inactive commercial and industrial lighting program participants to determine differences between the groups and help program staff develop methods to encourage greater participation.

UNITED STATES FISH AND WILDLIFE SERVICE

- **Tualatin River National Wildlife Refuge, Initiate Urban Refuge Audience Research Project, 2016-2017:** Participated in the development and facilitation of two workshops that helped define and characterize the neighborhoods and communities served by two wildlife refuges. Work included analyzing and presenting demographic data and contributing to the development of a research plan to guide the USFWS Urban Refuge Program.

RESEARCH SKILLS AND ABILITIES

DATA COLLECTION

- Develops survey instruments, conducts in-depth interviews, collects secondary data, and manages datasets from a variety of sources.

DATA ANALYSIS

- Codes and analyzes qualitative data (typically using NVivo) and quantitative data (using SPSS and Excel). Provides geographic analysis using ArcGIS.

Publications

“Watt’s Next for Nonresidential Lighting Retrofits?” Moran, D., B. Tannenbaum, C. Chen, and N. Albers. 2013. *In Proceedings of the International Energy Program Evaluation Conference*, Chicago, IL. August 13-15.

California Workforce Education and Training Needs Assessment: For Energy Efficiency, Distributed Generation, and Demand Response. Zabin, C., K. Chappele, E. Avis, J. Halpern-Finnerty, J. Peters, N. Albers, E. Gaertner, E. Lindstrom, and J. Carrese. 2011. Berkeley, CA: Institute for Research on Labor and Employment, University of California, Berkeley.

Energy Efficiency Services Sector: Workforce Size and Expectations for Growth. Goldman, C., M. Fuller, E. Stuart, J.S. Peters, M. McRae, N. Albers, S. Lutzenhiser, and M. Spahic. 2010. LBNL-3987E. Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory.

Energy Efficiency Services Sector: Workforce Education and Training Needs. Goldman, C.A., J. S. Peters, N. Albers, E. Stuart, and M. C. Fuller. 2010. Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory.

Deciding to Click It. Organizational Results Research Report. Richardson, L., S. Stokes, and N. Albers. 2006. Jefferson City, MO: Missouri Department of Transportation.

Presentations

“Small Businesses, Big Opportunities.” Panelist at Efficiency Exchange Northwest Conference. Portland, OR: Bonneville Power Administration and the Northwest Energy Efficiency Alliance. May 9, 2017.

“Estimating the Energy Efficiency Services Sector Workforce.” Goldman, C., J.S. Peters, M. McRae, and N. Albers. 2009. Paper presented at the 2009 ACEEE Summer Study on Energy Efficiency in Industry. Niagara Falls, NY: American Council for an Energy-Efficient Economy. July 28-31.

Professional Affiliations

- Association of Energy Services Professionals
- Oregon Program Evaluators Network

Jennifer Loomis, Ph.D.
Consultant 2

Work History

- Portland State University, Sociology Department: Research Investigator, Instructor, Research Assistant
- Center for the Study of Crime and Justice, Colorado State University: Research Assistant
- Center for Fair and Alternative Trade, Colorado State University, Research Assistant

Education

- Ph.D., Sociology: Portland State University, Portland, OR
- M.A., Sociology: Colorado State University, Fort Collins
- B.A., Sociology: Colorado State University, Fort Collins

Dr. Loomis is a social scientist with a background in environmental sociology, qualitative observational research, and social inequality. Prior to joining Research Into Action, she studied the nexus of human-environment interactions, primarily focusing on the management of fresh water resources and food systems. She has engaged in qualitative and mixed-method research in the United States, Peru, and El Salvador. In these locations, she collaborated with community-based organizations to ensure solutions were compatible with the local culture and constraints. She has published articles on issues relating to disaster recovery and social sustainability and presented her work at regional and international conferences. At Research Into Action she uses her analytical and methodological expertise to contribute to energy efficiency program evaluation for the residential and commercial sector as well as market research studies.

Dr. Loomis' dissertation is entitled *Activist Doctors: Explaining Physician Activism in the Oregon Movement for Single-payer Healthcare.*

Representative Experience

AMEREN MISSOURI

- **Business Electric Energy Efficiency Program Evaluation, 2013-2015:** Conducted in-depth telephone interviews with commercial retrofit contractors and participants in the commercial new construction program. Performed analysis and report writing.

CALIFORNIA CENTER FOR SUSTAINABLE ENERGY

- **Energy Efficiency and Sociocultural Analysis, 2015-2017:** Contributed to literature review on topics relating to effective messaging strategies for African Americans, Hispanic Americans, and Chinese-Americans to encourage uptake in the HERO (Home Energy Renovation Opportunity) program. Analyzed data from focus groups conducted with Hispanic and White homeowners to understand their approaches to home improvements. Participated in Technical Advisory Committee phone calls.

CALIFORNIA INVESTOR-OWNED UTILITIES

- **Local Government Partnerships (LGP) - Targeted Process Evaluation, 2015-2016:** Contributed to Local Government Partnership categorization and created in-depth interview guides for program staff and partnership representatives. Scheduled interviews for 50 partnership representatives. Conducted in-depth phone interviews with program staff and partnership representatives. Led analysis of interview data and contributed to report writing. Scheduled and conducted the public debriefing webinar.
- **Work Paper Consulting Project - Plug Load & Appliances Program, 2015:** Interviewed manufacturers of major household appliances, collected secondary data on market research for clothes washers and refrigerators, assisted with data analysis, and contributed to report writing.

CITY OF FORT COLLINS AND PLATTE RIVER POWER AUTHORITY

- **Commercial and Residential Energy Programs Evaluation, 2017:** As part of the process evaluation of Fort Collins Utilities and Platte River Power Authority's portfolio of energy efficiency programs, Jen designed the interview guides and conducted in-depth interviews with program staff, commercial and residential contractors and assessors, retro-commissioning agents, retro-commissioning participants, lighting manufacturers, and lighting retailers. She contributed to the web-survey development for residential participants and non-participants, as well as commercial participants. She performed data analysis and report writing.

CITY OF PORTLAND

- **Building Energy Data Validation, 2017:** To verify the inputs building owners entered into the ENERGY STAR Portfolio Manager as part of the City of Portland's Energy Performance Reporting Policy for Commercial Buildings, Jen helped develop the stratified sample and the computer-aided phone survey. She conducted surveys with building owners, analyzed the data in SPSS and Excel, and did report writing.

DUKE ENERGY

- **Energy Education Programs, 2015-2018:** Jen conducted in-depth interviews with elementary and middle school teachers whose classes learned about energy efficiency concepts via National Theatre for Children performances. She analyzed web-survey data in SPSS and Excel, and contributed to report writing and presentation of findings.

ENBRIDGE GAS DISTRIBUTION, INC.

- **Net-to-Gross Assessment for Natural Gas Demand Side Management, 2017:** Contributed to report writing on net to gross (NTG) methodologies. Topics researched and written about include the importance of measuring and including spillover in NTG calculations, the relative costs and benefits of conducting NTG research, and the use of negotiated NTG values in other jurisdictions.

ENERGY TRUST OF OREGON

- **MPower Pilot Program, 2015:** Conducted interviews with multifamily affordable housing stakeholders and building owner participants, performed data analysis, and contributed to report writing.
- **Existing Multifamily Process Evaluation, 2016-2017:** Contributed to development of data collection instruments and assisted with in-person interviews with program staff and implementation staff. Conducted phone interviews with participants and market experts representing five market segments. Analyzed staff and participant interview data to identify commonalities and differences among market segments.
- **Trade Ally Finder Market Evaluation, 2017:** Served as co-project manager to research ways to improve the effectiveness of Energy Trust of Oregon's Trade Ally Finder website in connecting website visitors with trade allies. Assisted with development a quantitative web-intercept survey and a follow-up in-depth interview guide. Conducted interviews with select survey-takers, analyzed interview data, and contributed to report writing.

FORTIS BC

- **Demand Side Management Evaluation Studies, 2017:** Collected data on several jurisdictions' characteristics including number of electric customers, population density, and climate data to inform selection of comparable jurisdictions. Reviewed selected jurisdictions' heat pump programs to collect data on rebate amount, rebate requirements, financing availability, and program performance.

INDEPENDENT ELECTRICITY SYSTEM OPERATOR

- **2015 Evaluation of 2014 Consumer Program, 2015:** Conducted analysis of survey and group interview data from manufacturers and distributors of commercial and residential HVAC equipment, and contributed to report writing.
- **Cross-Cutting Evaluation of Business Incentive Programs, 2015:** Conducted phone surveys with participating businesses.

LAWRENCE BERKELEY NATIONAL LABORATORY

- **Better Buildings Neighborhood Program Comprehensive Evaluation, 2015:** Assisted in final process evaluation documentation and database management. Interviewed project managers for an in-depth case study of key program strategies, conducted data analysis in *Dedoose*, and contributed to report writing and project presentation.

LOS ANGELES DEPARTMENT OF WATER AND POWER

- **Market Transformation Study, 2015:** Contributed to logic model development, collected baseline market data, provided note-taking during interviews with multifamily affordable housing governmental actors, contributed to development of interview guides, and conducted interviews with market actors and market observers.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

- **Zero Net Energy Market Model and Baseline Estimates, 2015-2016:** Scheduled and conducted interviews with HVAC and Solar PV contractors and representatives of training and certification organizations.
- **Clean Energy Communities, 2017-2019:** As the project manager, duties included designing and overseeing programming of the baseline survey that estimated how many communities had completed one or more of the ten High Impact Actions. During survey administration, ensured completions were facilitating a representative sample of all 1600 communities in New York State. Contributed to analysis in SPSS, report writing, and client interaction. Oversaw development of the year one survey and in-depth interview guide.

NORTHWEST ENERGY EFFICIENCY ALLIANCE

- **Certified Refrigeration Energy Specialist (CRES) Product Validation and Market Test, 2014-2015:** Provided analysis of survey in SPSS and Excel, wrote findings of survey about providers of commercial refrigeration services.
- **Top Tier Trade Ally (TTTA) Market Research and Evaluation, 2016:** Collected background information on trade ally businesses including their service territories, annual sales, and number of employees.
- **Luminaire Level Lighting Controls Pilot – Market Research, 2016-2018:** For commercial and industrial sites enrolled in the pilot and installing integrated lighting controls, created the in-depth interview guides for the lighting designer and key decision-maker. Conducted in-person and phone interviews for one site. Contributed to analysis and reporting.

PACIFIC GAS & ELECTRIC

- **Residential Solutions Workbook – Phases I & II, 2015:** Provided primary and secondary data collection around market trends and energy use of air cleaners.
- **Step Up and Power Down - Commercial Evaluation Plan, 2016-2017:** Interviewed stakeholders from several contributing organizations to document pilot design and evolution. Interviewed some of the most active large commercial participants to understand motivations, challenges, processes, and benefits. Analyzed data from both groups in NVivo and contributed to report writing.

SOUTHERN CALIFORNIA EDISON

- **Energy Leader Partnership Evaluation, 2015:** Contributed to development of work-plan. Built database to select local governments for a matched sample. Designed data collection instruments for program staff, representatives of participating governments, and nonparticipating governments. Conducted in-depth phone interviews with all three populations. Led data analysis and contributed to report writing. Co-managed the budget.

U.S. DEPARTMENT OF ENERGY

ENERGY EFFICIENCY & RENEWABLE ENERGY

- **Small Business Vouchers and Lab-Corps Program Evaluation, 2015-2017:** Provided document review and note-taking for in-depth interviews. Prepared Information Collection Request for compliance with the Paperwork Reduction Act. Served as project manager for a subsequent case studies of successful Lab-Corps project teams. Led selection of Lab-Corps project teams for the case studies, assisted with development of in-depth interview guides for project team Principal Investigators, Entrepreneurial Leads, Industry Mentors, National Lab supervisors, and independent industry experts. Conducted interviews with each of those groups, analyzed data in NVivo, and contributed to case study reporting.

OFFICE OF TECHNOLOGY TRANSITIONS

- **Evaluation Study of the Technology Commercialization Fund, 2017-2022:** Developed the in-depth interview guides to understand baseline conditions, program attribution of changes, and program processes for DOE-level managers and Program Office managers as well as National Lab-level managers including the TCF point of contact and Lab commercialization managers. Conducted baseline, attribution, and process interviews with DOE-level managers and lab-level managers to capture implementation lessons learned and make recommendations to DOE on ways to further improve the TCF investments and outcomes. Performed data analysis in NVivo and contributed to report writing.

RESEARCH SKILLS AND ABILITIES

DATA COLLECTION

- Designed surveys and interview guides in English and Spanish. Collected primary data via participant and nonparticipant observation, surveys, and interviews in English and Spanish. Performed secondary data collection and literature reviews.

DATA ANALYSIS

- Quantitative data analysis with SPSS and Excel. Qualitative data analysis with Dedoose and NVivo.

Publications

“Toward a Socially Sustainable Haiti: The Path Forward.” 2017. Loomis, J., J. Mosquera Becerra, and V. Dujon. Chapter 5 in *International Political Economy: Facing Global Challenges*. Edited by Jonathan Westover. Common Ground Publishing.

“Toward a Socially Sustainable Haiti: The Path Forward.” 2013. Loomis, J., V. Dujon, and J. Mosquera Becerra. *International Journal of Sustainability Policy and Practice*. Vol 8, issue 1.

“Displaced Single Mothers in the Aftermath of Hurricane Katrina: Resource Needs and Resource Acquisition.” 2010. Tobin-Gurley, J, L. Peek, and J. Loomis. I*nternational Journal of Mass Emergencies and Disasters*. Vol. 28, no. 2

“No Como Veneno: Strengthening Local Organic Markets in the Peruvian Andes.” 2009. Loomis, J. and D. Murray. Project evaluation and market analysis for Centro Internacional de la Papa (CIP) and International Development Research Centre (IDRC).

Presentations

"Small Actions Add Up! Engaging Large Organizations in Behavior Change." 2017 Loomis, J. Presented at the 11th Annual Behavior, Energy, and Climate Change (BECC) Conference. Sacramento, CA. October 15-18.

"Engaging Local Governments to Prioritize Energy Efficiency and Climate Action Planning: Lessons from utility-government partnerships." 2016. Loomis, J. Presented at the 10th Annual Behavior, Energy, and Climate Change (BECC) Conference. Baltimore, MD. October 20-22.

"Activist Doctors: Barriers and Motivators to Participation in the Movement for Single-payer Healthcare." 2014. Loomis, J. Presented at the 85th Annual Meeting of the Pacific Sociological Association. Portland, OR. March 27-30.

"Doctors as Activists: Participation in the Oregon Movement for Single-payer Healthcare." 2014. Loomis, J. Presented at the 4th Annual Sociology Graduate Student Organization Conference on Contemporary Issues in Sociology. Portland, OR. March 2014.

"Explaining the US Healthcare Crisis through Humor." 2013. Loomis, J. Presented at the 3rd Annual Sociology Graduate Student Organization Conference on Contemporary Issues in Sociology. Portland, OR. March 2013.

"Towards a Socially Sustainable Haiti: The Path Forward." 2012. Loomis, J. Presented at the 8th International Conference on Environmental, Cultural, Economic, and Social Sustainability. Vancouver, British Columbia, Canada. January 10-12.

"Inequities in Access to Healthy Foods in Portland, Oregon: Implications for Health and Social Sustainability." 2012. Loomis, J. Presented at the 49th International Making Cities Livable Conference. Portland, OR. May 20-24.

Professional Affiliations

- Oregon Program Evaluators Network
- Association of Energy Services Professionals

research into action inc

Elizabeth S. Focella, Ph.D.
Consultant 2

Work History

- Assistant Professor, Director of Attitude and Behavior Change Lab, University of Wisconsin
- Postdoctoral Research Fellow, Department of Health Sciences, University of Missouri

Education

- Ph.D., Psychology, University of Arizona, Tucson, AZ
- M.A., Psychology, University of Arizona, Tucson, AZ
- B.S., Psychology and Sociology, University of Alaska, Fairbanks, AK

Dr. Elizabeth Focella is a social psychologist with expertise in attitudes and behavior change research. She earned a B.S. in psychology and another in sociology at the University of Alaska Fairbanks. She later earned her Ph.D. in psychology from the University of Arizona with a minor in Marketing at the Eller School of Management. Following her doctoral education, she was a postdoctoral research fellow at the University of Missouri's Department of Health Sciences where she conducted research in medical decision making. Prior to joining Research Into Action, Dr. Focella was an assistant professor at the University of Wisconsin Oshkosh, where she directed the Attitudes and Behavior Change Research Lab and taught undergraduate and graduate courses on social psychology, health psychology, and attitudes. Her independent research focused on attitudes and behavior change, chiefly in the areas of health, prejudice and stereotyping, and cognitive dissonance, which she has presented at symposia and poster presentations at national conferences.

Dr. Focella has authored sixteen publications, including those in peer-reviewed psychology and health journals, an encyclopedia entry, and book chapters.

Representative Experience

CITY OF FORT COLLINS

- **Commercial and Residential Energy Programs Evaluation, 2017:** Performed quality assurance on web surveys for residential participants and non-participants. Performed data analysis using SPSS.

ENBRIDGE GAS DISTRIBUTION, INC.

- **Net-to-Gross Assessment for Natural Gas Demand Side Management, 2017:** Contributed to report writing on net to gross methodologies. Critiqued validity of self-report methods using psychological theories and relevant research.

SOUTHERN CALIFORNIA EDISON

- **Time of Use Opt-in Pilot Evaluation, 2017-2018:** Analyzed a set of surveys to assess the effectiveness of marketing and educational materials on customer satisfaction with and understanding and acceptance of TOU rates. This research involves surveying and analyzing over 60,000 survey responses across a year and a half.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

- **Clean Energy Communities, 2017-2019:** Contributed to data cleaning and organization for metric development using SPSS. Contributed to metric development for measuring progress toward completing high-impact actions among local governments.
- **Clean Energy Jobs, 2017-2019:** Scheduled and conducted interviews with HVAC and Solar PV contractors and representatives of training and certification organizations.

EFFICIENCY NOVA SCOTIA

- **Training and Development, 2017-2018:** Conducted an in-depth literature review and in-depth interviews with staff to assess best practices for training and development. Contributed to report writing.

U.S. DEPARTMENT OF ENERGY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

- **Case Studies, 2017-2019:** Conducted in-depth interviews with lab personnel to prepare a case study on an Energy I-Corps (formerly, Lab-Corps) project team technology that has made progress toward commercialization. Contributed to report writing.

Publications

Ad Hoc Reviewer for Journal of Experimental Social Psychology, Journal of Health Disparities Research and Practice, Cultural Diversity and Ethnic Minority Psychology, Death Studies, and SAGE Open Medicine.

“Prejudice and stereotyping in healthcare.” Focella, E.S. (in press). In K. Sweeny & M. Robbins (Eds.). Wiley Encyclopedia of Health Psychology. Wiley.

“On the usefulness of narratives: An interdisciplinary review and theoretical model.” Shaffer, V. A., E.S. Focella, A. Hathaway, and B.J. Zikmund-Fisher. 2017. *Annals of Behavioral Medicine.*

“What is the story with narratives? How using narratives in journalism changes health behavior.” Shaffer, V. A., L.D. Scherer, E.S. Focella, A. Hinnant, M.E. Len-Rios, and B.J. Zikmund-Fisher. 2017. *Health Communication*. doi: 10.1080/10410236.2017.1333562

“Could physician use of realistic previews increase treatment adherence and patient satisfaction?” Focella, E.S., V.A. Shaffer, and B.J. Zikmund-Fisher. 2016. Medical Decision Making. doi: 0272989X16634086

“Debiasing affective forecasting errors with targeted, but not representative, experience narratives.” Shaffer, V. A., E.S. Focella, L.D. Scherer, and B.J. Zikmund-Fisher. 2016. *Patient Education and Counseling*. *99*(10), 1611-1619. doi: 10.1016/j.pec.2016.04.004

“Vicarious hypocrisy: Bolstering attitudes and taking action after exposure to a hypocritical in-group member.” Focella, E.S., J. Stone, N.C. Fernandez, J. Cooper, and M. Hogg. 2016. *Journal of Experimental Social Psychology* 62. 89–102. doi:10.1016/j.jesp.2015.09.014

“Racial/ethnic differences in the use of primary care providers and preventive health services at a Midwestern university.” Focella, E. S., V.A. Shaffer, E.A. Dannecker, M.J.Clark, and L. Schopp. 2015. *Journal of Racial and Ethnic Health Disparities* 1-11. doi: 10.1007/s40615-015-0148-1

“Confrontation and beyond: Examining a stigmatized target's use of a prejudice reduction strategy.” Focella, E.S., M.G. Bean, and J. Stone. 2015. *Social and Personality Psychology Compass* 9(2), 100-114. doi: 10.1111/spc3.12153

“Documenting nursing and medical students’ stereotypes about Hispanic and American Indian patients.” Bean, M.G., E.S. Focella, R. Covarrubias, J. Stone, G.B. Moskowitz, and T.A. Badger. 2014. *Journal of Health Disparities Research and Practice, 7*(4), 14-22.

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“Thanks for asking: Self-affirming questions reduce backlash when stigmatized targets confront prejudice.” Stone, J., J. Whitehead, T. Schmader, and E. Focella. 2011. *Journal of Experimental Social Psychology, 47*(3), 589-598. doi: 10.1016/j.jesp.2010.12.016

“Post decisional self-enhancement and self-protection: The role of the self in cognitive dissonance processes.” Stone, J. and E. Focella. 2010. In C. Sedikides & M. Alicke (Eds.), The handbook of self-enhancement and self-protection (pp. 192-210). New York, NY: Guilford Press.

Selected Presentations

“Are patients biased against minority physicians? Evidence that patients’ bias predicts evaluations of their physicians.” Focella, E.S. and V.A. Shaffer. Talk presented at the annual meeting of the Society for Medical Decision Making, St. Louis, Missouri: October 2015.

"Sexualized breast cancer awareness advertisements impact women's self-objectification and health behavior." Focella, E.S., V.A. Shaffer, and J. Arndt. Talk presented at the annual meeting of the Society for Medical Decision Making, Miami, Florida: October 2014.

"Vicarious hypocrisy: Bolstering attitudes and taking action after exposure to a hypocritical in-group member." Focella, E.S., J. Stone, N.C. Fernandez, J. Cooper, and M. Hogg. Symposium presented at the annual meeting of the Society of Personality and Social Psychology, Austin, Texas: February 2014.

Professional Affiliations

- Society for Personality and Social Psychology
- Social Personality and Health Network

research into action inc

Jane S. Peters, Ph.D.

President | Owner | Executive Consultant

Previous Work History

- Barakat & Chamberlin, Inc.: Principal, Project Director
- ERC Environmental and Energy Services Co., Inc.: Manager, Senior Analyst

Education

- Ph.D., Urban Studies: Portland State University, Portland, OR
- A.B., Psychology: Occidental College, Los Angeles, CA

Awards

- International Energy Program Evaluation: 2013 Lifetime Achievement Award Recipient

Dr. Peters has more than 35 years of experience in energy-related program process and performance measurement and program evaluation research and training, customer research, market assessment, strategic planning, organizational analysis, and process re-engineering. She is well-known for her qualitative research, including process and market evaluations, focus group moderation, and quantitative assessment of behavioral and indirect impacts. As an environmental psychologist, she is particularly interested in determining how best to design and implement programs that spur individuals and organizations to reduce their energy use and their impacts on climate change.

She has conducted research in the following program areas: industrial, commercial/institutional, residential, low-income, agricultural, mid-market, mass market, research and development, residential and nonresidential demand response, and project-specific programs.

Dr. Peters was a member of the team that developed the 2006 Evaluation Protocols and 2001 Framework for Planning and Assessing Publicly Funded Energy Efficiency for the California Public Utilities Commission. She co-authored the definitive 2011 white paper, Reconsidering What We Measure, which sought to determine if the Awareness, Knowledge, Attitudes, and Behavior (akAB) concepts that underlie most residential programs are being measured effectively. Her 2009 white paper, Process Evaluation Insights on Program Implementation for the California Institute for Energy and Environment, addresses lessons learned from years of process evaluations of energy efficiency programs. She regularly presents research papers at national conferences and hearings. She also has written three books on evaluation for the Electric Power Research Institute (EPRI), and numerous other publications.

Dr. Peter's dissertation is entitled *Integrating Psychological and Economic Perspectives on Energy Consumption: The Determinants of Thermostat Setting Behavior.*

Representative Experience

PROGRAM EVALUATION

- **Advanced Energy Community:** On a team spanning technology developers, university social science researchers, developers, SDG&E, the City of San Diego, and others, we are developing an innovative and replicable approach for accelerating the deployment of Advanced Energy Communities, targeting a low and moderate income neighborhood served by SDG&E. Directing our firm's support to the engineering and community engagement teams, and leading the case study and metric development/estimation tasks. The engineering team is considering all applicable advanced energy solutions, including community solar, rooftop solar, fuel cells, combined heat and power, and advanced thermostats.
- **Program Rollouts and Pilots:** Directed repeated process evaluations of residential, commercial, and industrial programs 6, 12, 18, and 24 months after launch. **Result:** Early evaluations helped refine program designs and implementation processes, and facilitated attainment of program goals.
- **Fast Participant Feedback:** Managed a pilot study to determine the best method (paper, phone, or web survey) to collect feedback on program satisfaction and free-ridership on recently completed residential and nonresidential projects. **Result:** Identified best methodology and managed rollout of the methodology to the client's portfolio of programs.
- **Combined Process and Impact Evaluations:** Managed combined process and impact evaluations, and managed process evaluations of multiple nonresidential and agricultural programs. Examined free-ridership, the program's effect on job creation, the effect of repeat participation on project size, the effectiveness of free direct installation of equipment as a "wedge" into an underserved market segment, and challenges associated with separate implementation of the same program in multiple geographic locations. Directed process evaluation research for a combined process and impact evaluation of a utility's residential and nonresidential program portfolio over multiple years.
- **Demand Response:** Directed process evaluations of a set of demand response pilot programs that used a mixture of in-home displays, day-ahead notification, and automatic curtailment devices. Research included focus groups and post-event surveys to identify curtailment strategies and remaining barriers. Directed process evaluations of five programs designed to encourage nonresidential customers to reduce their energy use at critical peak periods, either by paying for curtailment capacity or installing enabling technologies. Compared responses to identify patterns among curtailment program participants regarding size, location, and prior demand response experience. **Result:** Identified the strategies employed to participate in curtailment events; explored the roles and effectiveness of third-party curtailment service providers in these programs.
- **Loan Funds and Financing:** Directed three process evaluations of energy efficiency loan programs that sought to increase penetration of energy efficiency measures for commercial and residential customers. Examined the role of these programs in supporting the broader efficiency portfolio and made recommendations for program design. **Result:** Identified factors leading to the failure of the innovative financing approach. National program: Examined the development of different financing

approaches and compared the effect for a variety of residential and commercial program opportunities.

- **Better Buildings Programs:** Directed a four-year evaluation of the U.S. Department of Energy's Better Buildings Neighborhood Pilot Program, including impacts, process, and market analyses. Key evaluation issues included determining attribution and lessons from the pilots that could be applicable to future effects. For a separate study, developed program theory and logic documents for a diverse set of Better Buildings pilots in California. Tailored an established method assessing program satisfaction and free-ridership to a wide range of residential and nonresidential energy efficiency programs and measures. Developed an online survey instrument to solicit answers to varying mixes of measure-specific satisfaction and free-ridership questions with multiple program participants.
- **Workforce Development:** Directed evaluations of programs that support training and certification of workers in the energy efficiency workforce. Integrated feedback from program staff, training organizations, trainers, trainees, and employers to assess program success, incorporating Kirkpatrick's four levels of training evaluation into the research design. These included targeted training programs for refrigeration and building operator certification, and a more general program that targeted workforce training for multiple skill areas.
- **Research and Development (R&D):** Designed and directed an evaluation of a client's process for developing solicitations for energy-related R&D projects and evaluating the resulting proposals. Assessed solicitation development at portfolio and solicitation-specific levels to identify the effects of procedures on proposal submission. **Result:** Identified actions client could take to increase the quantity and quality of responses to solicitations.
- **Environmental Research:** Directed a process evaluation of a program that engaged scientists and other environmental policy researchers in the creation and dissemination of scientific research on the environmental effects of power production. **Result:** Identified key sources of information and elements of credibility, assessed perceptions of attendees of an annual conference, and characterized the experiences of the scientists under contract to complete specific research projects.
- **Impact Verification Audit:** Directed a three-year verification audit of nonresidential, residential, and limited-income energy efficiency programs. Developed a spreadsheet system to calculate verifiable savings from inputs and client-supplied algorithms automatically, and to update cumulative summary results with each year's data. Result: Identified key causes of unverified data and made recommendations to improve data quality.
- **Residential and Commercial HVAC Markets:** Directed the process evaluation of a Performance Tested Comfort Systems program for residential heat pumps. Client published the report on its website, along with actions it took in response to recommendations that included simplifying the program, improving the program website, providing increased technical support to contractors, and improving quality assurance activities. Directed evaluation assessing program effectiveness in engaging HVAC manufacturers, their representatives, and distributors to promote energy-efficient

product models. Directed an evaluation of a new initiative for commercial HVAC contractors to ensure that their maintenance contracts complied with nationally recognized standards.

- **Home Performance:** Directed the process and market evaluation of a long-running Home Performance program to assess market effects and identify continued opportunities for program improvements. Designed and directed four waves of process evaluation research to inform a Home Performance pilot program that relies on building science and Home Performance contractors to deliver comprehensive packages of measures. Evaluated the ability of general contractors and subcontractors to partner and work together. Assessed the effectiveness of the financing component. Identified motives and barriers to participation and evaluated the effects of contractor training, incentive structures, and verification protocols on project volume. In other work, evaluated three clusters of Better Buildings projects focused on innovative marketing and outreach efforts intended to drive participation in a statewide whole-house program.
- **Home Energy Efficiency Rebates:** Led an evaluation of statewide programs for two utilities, including a process evaluation of the Home Energy Efficiency Rebate (HEER) program; a market characterization for end-use appliances included in the HEER program; an assessment of program opportunities for miscellaneous plug loads; and a general population survey of residential customers' attitudes, knowledge, awareness, and behavior (akAB).
- **Higher Education:** Directed process evaluation activities identifying key indicators of effectiveness for a large, multifaceted program to improve the efficiency of university facilities through building commissioning, retrofits, and staff training. Articulated and documented the program logic and theory assumptions. Worked closely with impact evaluators to develop free-ridership and net-to-gross estimates. In other work, evaluated a program targeting private colleges and universities.
- **Mobile Home and Multifamily Retrofit:** Through in-depth interviews with key market actors, program staff, and multifamily building owners, completed process evaluation activities for multifamily retrofit and mobile home programs across two program cycles.
- **Limited-Income and Low-Income:** Coordinated process evaluation activities for a program to replace refrigerators and lighting in limited-income homes. Identified issues associated with recruiting and engaging multifamily property owners, the sensitivity of income qualification, and the deployment of direct-install strategies. Also directed a mixed-methods process evaluation of a large, statewide low-income energy efficiency program. For that project, activities included interviews with key contacts at the utilities and contracted implementation, outreach, and marketing organizations; surveys of participants; focus groups with program staff; ride-along observations with field crews; and a presentation of evaluation design and findings at public workshops. In addition, directed surveys and interviews with weatherization agencies, service providers, and participants in a low-income program. Assessed issues regarding program design and coordination, and the program's effects on the providers' businesses, workforce availability and development, and occupants' health and safety.
- **Efficient Site-Built and Manufactured Homes:** Managed consecutive process evaluations of a program aimed at builders of new residential properties. Documented program successes and

identified key motives and barriers related to builders' participation, as well as a potential critical barrier to builders' long-term adoption of program-promoted measures and energy codes. Examined the role of real estate professionals in promoting the program.

- **Large Commercial, Industrial, and Agricultural:** Directed multiple evaluations for programs focused on obtaining energy savings from large customers, including those in the manufacturing, agriculture, food processing, retail, commercial real estate, and hospital sectors, and the utility customers of a power marketing agency. Assessed program interventions to encourage process efficiency improvements among industrial participants. Examined effectiveness of program components, such as energy service company-driven performance contracting, per-unit-of-production process efficiency incentives, engineering and audit support, and wholesale energy rate credits.
- **Industrial Production Efficiency:** Directed multiple process evaluations of three industrial programs targeting large energy savings from production process improvements. Activities included interviews with technical service providers, end-use customer contacts, and program administrator and implementation staff.
- **Portfolio Evaluations:** Directed process evaluations of numerous program administrators' efficiency portfolios, including all programs or programs targeting a particular sector. Served as lead investigator for process evaluations, market characterizations, and market assessments of a state power authority's energy efficiency programs over more than 10 years. In one study, examined third-party nonresidential programs, investigating a range of cross-cutting issues, including the role of utility account executives, utility-wide communication and coordination, data tracking, regulation, and integration with the demand side management portfolio. Also directed a cross-program analysis of 25 small-scale, innovative energy efficiency and demand response programs spanning all sectors and market areas. This project involved developing logic models and identifying cross-program implementation issues and lessons learned, working closely with utility staff to assess the continuing need for each program, and identifying practical recommendations for portfolio enhancements. For one portfolio evaluation, this work included analysis of program attribution, non-energy benefits, free-ridership, net-to-gross savings, greenhouse gas effects, and direct employment effects.
- **Feed In Tariffs:** Directed evaluations of two residential and commercial feed-in tariff solar electric (photovoltaic, or PV) installation pilot programs. Conducted an assessment of the opportunities for solar thermal programs in a Midwest state. Led an evaluation of an end-user PV program that relied on training and certification to improve the acceptance of PV systems among customers. Compared the effectiveness and cost of various training and certification approaches to identify best practices.
- **Customer Sited Solar PV**: Directed a variety of projects addressing solar photovoltaics including a study on effective messaging to gain participants in a solar maintenance program, four process evaluations of customer sited PV including review of customer satisfaction, assessment of contractor certification effects on installation quality. Assessed market opportunities for engaging with commercial customers on customer sited PV.
- **Other Process Evaluations:** Led an evaluation of a federal power administrator's fish and wildlife law enforcement efforts. The project included study components on fish predation by a fish biologist

and law enforcement agents, training by a law enforcement specialist and education specialist, as well as focus groups and interviews with state and tribal law enforcement agencies throughout the service territory. Led an evaluation of the vegetation management program for a federal power administrator by examining the policies and enforcement strategies to reduce herbicide use and maintain clear transmission pathways.

LOGIC THEORY/MODELS AND PROCESS FLOW DIAGRAMS

- **Logic Theory/Models and Process Flow Diagrams:** Directed logic theory and model development in stand-alone projects and as part of broader research. In particular, directed program theory and logic model development for a cross-program analysis of 25 small-scale, innovative energy efficiency and demand response programs spanning all sectors and market areas. Projects included development of logic diagrams for: a statewide program administrator's commercial-sector portfolio; a public utility's residential portfolio; ARRA-funded Better Buildings pilots; business and consumer electronics programs; a local governments program; K-12-college educational programs; a loan fund program; new construction, small commercial lighting, and large commercial programs; and a large, multi-faceted program to improve the efficiency of university campuses through building commissioning, retrofits, and staff training. Directed development of process flow diagrams for a statewide efficiency portfolio, a statewide low-income program, and a utility's residential portfolio. Also directed the development of program theory and logic models for ten technology and market development energy efficiency programs and five resource acquisition energy efficiency programs.

MARKET CHARACTERIZATION AND MARKET RESEARCH

- **Business and Consumer Electronics:** Directed an in-depth research project to study the market for eight business and consumer products. Identified key contacts and interviewed more than 50 industry leaders. Drafted individual product "briefs" that described market trends, penetration rates for energy-efficient technologies, marketing practices, attitudes regarding energy efficiency, relevant energy standards, and an assessment of barriers and opportunities.
- **Appliances/Plug Load:** Directed market research and assessed potential program strategies for four residential appliances. Assessed opportunities to improve product efficiency, and described the product supply chain, barriers to efficiency in the market, expected baseline efficiency in the anticipated program start year, and key market trends. Provided these in dashboards for program planners to use.
- **Commercial Buildings Initiative Baseline Studies:** Developed baseline estimates of market efficiency characteristics. Interviewed architects and engineers to assess baseline attitudes and knowledge of energy efficiency and determine the frequency of their use of energy-efficient design practices. Interviewed school administrators and staff who make design decisions for new schools to document their baseline attitudes and knowledge of energy efficiency and energy-efficient building practices.

- **Commercial-Sector Market Transformation:** Directed multiple evaluations assessing the progress of multi-year, multi-market commercial-sector market transformation initiatives for the schools, grocery, healthcare, office real estate, design and construction, and building operations markets. Over five years, developed repeated baselines characterizing organizational and market energy efficiency practices. Identified barriers to and explored strategies for increasing commitment to energy efficiency. Assessed attainment of market transformation goals and contributed to development of additional program strategies.
- **Microelectronics:** Interviewed manufacturers and users of dendritic polysilicon to determine their awareness of the polysilicon feedstock materials market, interest in continuous feed recharge, and the diffusion of Teardrop polysilicon. Interviewed microelectronics workshop participants to document transmission of the workshop's energy efficiency ideas to their employers and to assess the demand for additional workshops.
- **Agricultural Sector:** Interviewed irrigators to assess their awareness and use of weather, evapotranspiration, and soil-moisture data sources for irrigation scheduling; to determine their use of, and the market for, subsurface drip irrigation in the Northwest; and to assess the economic, technological, and other trends that might affect the market for soil-moisture-sensing equipment. In other work, documented the structure, goals, history, and performance of a program to increase the efficiency of irrigation pumping systems. Assessed the market penetration of a program designed to encourage the adoption of energy-efficient equipment in the year subsequent to major storm damage in an agricultural area of the Northeast.
- **New Home and Multifamily Decision-Making:** Investigated and quantified the role of energy cost savings in decisions regarding the purchase of a new home. Devised stratified sampling plan and post-sampling data weights to adjust for a participant population that did not reflect market share on a key demographic variable. Identified and quantified non-energy benefits of energy efficiency upgrades in multifamily residences. Identified the most common types of property improvements; the influence on owners' decisions by tenants' requests, potential energy savings, and competitor/peer influence; and the impact of energy efficiency upgrades on tenancy, income, and property value. Estimated the economic benefit of energy efficiency upgrades.
- **Baseline and Market Characterization Studies:** Designed and directed survey research to assess customer experiences with and market acceptance of new technologies for potential resource acquisition in the residential, commercial, and small industrial sectors. Incorporated engineering estimates and modeling data into a technology potential study. Conducted market research to understand new construction and building operation practices.
- **Consumer Attitudes and Behavior Studies:** Directed five large-scale household surveys that assessed consumers' attitudes toward and behaviors related to energy use, disposal of household hazardous chemicals, and alternative or "green" products. Developed sampling strategies. Designed survey instruments to measure: consumer familiarity with existing programs; energy perceptions and related behaviors; motivations and barriers to taking energy-saving actions; and consumers' views of, and interest in, renewable energy. Used univariate and multivariate analyses to identify

market predictors and establish baselines for new initiatives. Research supported the design, marketing, and implementation of programs and campaigns.

- **Segmentation Studies:** Developed segmentation profiles for residential customers based on energy consumption patterns; relevant attitudinal, perception, and behavior variables; and demographic characteristics. Identified and characterized market segments useful for program design and marketing campaigns of new energy efficiency initiatives. Used regression, factor, and cluster analyses to assess residential customers' survey data in conjunction with billing data. Conducted studies annually for four years; replicated prior segmentation profiles based on behavioral, attitudinal, and demographic variables. Also, conducted segmentation study addressing hazardous waste disposal practices and needs.
- **Longitudinal Residential Market Trends:** Examined national behavioral and attitudinal trends regarding energy efficiency, energy conservation, and demand response by assessing longitudinal residential survey data collected biennially 2002 - 2012. Explored statistically significant relationships to determine notable changes in behavioral and attitudinal trends.
- **New Technologies, Distributed Generation, Renewable Energy, and "Green Power":** Conducted market research and program process evaluations in support of photovoltaic (PV) installations and of installations of distributed generation systems incorporating combined heat and power with power generation from microturbines, fuel cells, organic Rankine cycles, reciprocating engines, and large steam and gas turbines. Also led a study to determine the magnitude, type, and availability of industrial food waste generated within a metropolitan area. This waste might be diverted from landfills to reduce emissions of greenhouse gases, provide a carbon-neutral source of methane for power generation and nutrient-rich compost, and potentially reduce food processors' disposal costs and increase revenue through the sale of what otherwise has been considered waste material. Conducted research on ground-source heat pumps, residential ductless heat pumps, microturbines using biofuels, and residential customers' preferences for green power.
- **Pulp and Paper Market Segmentation:** Using secondary data obtained from specific mill websites or industry directories, assessed the structure of the pulp and paper market in the Pacific Northwest and developed a market segmentation strategy based on likely responsiveness to program offerings. Examined the energy efficiency-, sustainability-, and renewable energy-related certifications obtained by the pulp and paper mills.
- **Trade Ally Surveys:** Directed the update and analysis of two annual surveys of trade allies for a client's entire program portfolio. Reviewed more than 100 survey questions to improve question wording, type, and order to ensure valid and reliable data collection; devised additional survey questions to address new topic areas and to close previously open-ended questions.
- **Transportation Sector:** Conducted real-time focus group for Forth EV Roadmap conference in 2017 and 2018. Used questions from audience to provide real time responses. Conducted market research that demonstrated that car sharing was a viable option for Portland, Oregon in 1998. Car sharing has been active in Portland since that study demonstrated the viability of the opportunity, and state transportation funds were committed to initiate the service. The research has been cited

by other communities seeking funds for establishing car sharing, which has become a viable transportation option in many communities in the U.S. Conducted research to identify potential value of mobility center for Portland.

BEHAVIORAL IMPACTS AND MARKET EFFECTS

- **Residential Decision-Making:** Coauthored a white paper for the California Public Utilities Commission to develop an understanding of the relationship between awareness, knowledge, attitudes, and behavior (akAB) as a decision-making framework for energy efficiency products. Subsequently, developed a set of items for each construct through validity tests and then tested the validity and usefulness of the akAB framework with an energy-efficient products program and two whole-house energy efficiency programs.
- **Commercial Efficiency Behavior Metrics:** Developed and estimated metrics assessing the behavioral impacts of a commercial-sector market transformation initiative, a multi-year effort to encourage leaders in four market sectors to integrate energy efficiency best practices into their standard business operations.
- **In-School Energy and Conservation Program:** Directed a three-year study to evaluate the effectiveness of a school-based program to teach elementary and middle school students about energy and energy conservation. Developed a quasi-experimental research design based on stratified random sampling of schools from a treatment population and random sampling of schools from a matched control population. Developed age-appropriate test instruments to assess changes in attitudes, behavioral intentions, and knowledge of key concepts. The research design tested for both immediate and long-term (school-year) effects and controlled for the effect of repeat testing.
- **Residential Behavioral Impacts and Experimental Design:** Directed a collaboration consisting of researchers, utility staff, an advisory group conducting an economic analysis (on price response), and a behavioral research group on a unique time-of-use rate analysis. Collaborated on the design of a multi-pronged approach that included economic, social, behavioral, and experimental research components. Drafted the research proposal and directed the two-year implementation of these components to test the impact of passive and active information on customer response. Designed and implemented three survey waves and managed data streams, working with both the utility and the research team.
- **Home Energy Audits/Assessments:** In collaboration with a university and a national laboratory, directed a project to assess residential customers' interest in comprehensive home assessments. Interviews focused on homeowners' pre- and post-audit perspectives on required upgrades and on the influence of a home energy score. Assessed the impact of home assessment reports on homeowners' energy upgrade decisions.
- **Market Effects for Whole House and Multifamily Performance Programs:** Directed the market effects research for a whole-house performance program and a multifamily performance program to assess whether changes in practices among market actors had been influenced by the program to provide services to the market outside of the program. For another project, led the team conducting

a market effects study of a national ARRA-funded program that supported whole-building upgrades through grants to 41 grantees across the U.S.

- **Medical and Microelectronics Sectors:** Directed in-depth research into medical-sector and microelectronics markets and programs. Assessed progress of programs in attaining market transformation and comprehensiveness goals.
- **Education and Training Programs:** Directed process evaluations – including curricula review, logic modeling, and development of key performance indicators – for three educational programs. Assessed an efficiency educational program offered through children's museums and its impact on children's energy-using behaviors. Assessed educational programs for architects and building operators and their impacts on energy-using behaviors. For each program, assessed the suitability, effectiveness, and overall value of the training.
- **Behavior-Change Research:** Catalogued a state energy entity's active behavior-change projects, conducted a gap analysis to identify opportunities for further behavior-change research, and assisted in the development of behavior-change projects and approaches to address the identified gaps. Also provided evaluation oversight for a state energy authority's behavior research field pilots intended to influence energy-related behaviors and reduce energy use across a variety of sectors. The behavior pilot studies included projects in college computer labs, classrooms, and dormitories; hotels; single-family homes and multifamily buildings; and private office buildings.
- **Emissions Reductions Studies:** Worked as a subcontractor on a project to study the nationwide barriers to business investment decisions regarding emission reduction technologies. Provided support for focus groups with truck fleet purchasers for small- and medium-sized trucking companies in three states, and for grocery store refrigeration system purchases in three states; and for data-centers in two regions of the country. Tasks included reviewing the focus group moderator's guide and acting as the group moderator.

BEST PRACTICES AND BENCHMARKING

- **Best Practices and Lessons Learned:** Regularly embeds best practice research into formative process evaluation efforts. This comparative research has informed evaluations of financing and loan programs, compact fluorescent lighting programs, large comprehensive programs (such as standard performance contracting), and the training component of photovoltaic programs.
- **National Energy Efficiency Best Practices Study:** Through extensive comparative research and documentation, developed best practice reports for four program areas as part of a nationwide best practices study of 18 different energy efficiency program types, including: residential lighting, single- and multifamily weatherization, and training and education. Catalogued program approaches and accomplishments. The project's analysis identified best practices.
- **Portfolio Benchmarking:** Directed comparisons of three client program administrators' energy efficiency program portfolios' budgets and energy savings to those for the leading national and regional portfolios. Compared utilities' results data per key effectiveness metrics to understand utility cost per kWh/Therm saved by the program. Identified best practices for short- and long-term

program performance. Identified and obtained the cooperation of benchmark partners, interpreted assumptions underlying statistics in diverse reporting documents, cleaned and analyzed data to support analogous interpretations, and created a report comparing utilities per important metrics of effectiveness.

- **Process Evaluation Meta Review:** Conducted in-depth interviews with evaluation experts to identify lessons learned from 30 years of process evaluations of energy efficiency programs. Presented the findings at several venues and in a published report.
- **Solar Incentive Program Design:** Directed a study to investigate approaches taken by 12 photovoltaic programs to develop a capable installer workforce. Identified lessons learned. Conducted a statistical analysis of predicting program performance.
- **Residential Whole Building:** Identified programs in the U.S. and Canada that have goals of encouraging nonresidential customers to take a whole-building, comprehensive approach to energy efficiency. Conducted in-depth interviews with program managers to identify lessons learned.
- **Lighting:** For a study of best practices in lighting, conducted expert interviews and a literature review. Produced detailed best practice findings on three lighting program types: direct installation (residential), direct mail (residential), and trade ally networks (commercial and residential). Resulting report included detailed diagrams illustrating the relationship of best practices to one another, and to desired program outcomes and/or market barriers.
- **Existing Building Commissioning:** Studied seven highly regarded nationwide retrocommissioning programs and identified key lessons learned and best practices.

PLANNING AND POLICY SUPPORT

- **Evaluation Support:** Provided technical assistance and other consulting to the staff of multiple energy organizations, utilities, and the U.S. Department of Energy regarding process evaluation. Tasks included overall evaluation strategy, development and review of evaluation plans, and evaluation training.
- **Organizational Analyses:** Directed multiple projects assessing program administrators' organizational structure, policies, and reporting pathways to improve credibility and effectiveness of research products procured by the program administrators, compared internal evaluation practices with standard practices at several peer organizations. Key data collection activities included stakeholder interviews and an assessment of best practices at several similar comparison organizations. Analyzed findings against selected criteria to assess opportunities for improvement.
- **Energy Efficiency Workforce Size and Needs Assessments:** Assessed the current and projected U.S. workforce capacity in the energy efficiency industry and the education and training needed to build workforce capacity to meet various scenarios of increased funding for energy efficiency. The research involved 250 in-depth interviews. Analyzed primary and secondary data using regression and other prediction methods to develop estimates of future workforce size for different market segments.

- **Measurement and Verification Protocols:** Co-led a team to review and update a federal power administrations' measurement and verification (M&V) protocols, and assess its M&V needs and opportunities to improve existing protocols. Contributed to the development of a decision tree and tool library to support appropriate application of M&V methods.
- **Long-Term Planning and Portfolio Assessment:** Served on the team that prepared plans for several program administrators to identify best practices and lessons learned for all aspects of their program portfolios. Informed a planning process through targeted literature review and interviews with contacts at other utilities in order to understand energy efficiency planning, program selection, incentive levels, and the organizational strategies of the conservation departments of comparable utilities.
- **Technical Potential, New Construction, and Energy Service Preferences:** Conducted market research to understand residential and nonresidential technical potential, new construction and building operation practices, and energy service preferences. Led studies in support of program design and market transformation efforts.
- **Home Energy Labeling:** Managed two projects using targeted, in-depth interviews and online surveys to examine Washington State and Oregon real estate professionals' views and use of "green/energy-efficient" home labels, including how and when real estate agents discuss energy efficiency with clients during the buying and selling process.
- **Enhanced Inspection Planning:** In support of a utility's efforts to establish performance metrics for all of the programs in its portfolio, directed the development of key metrics for tracking the performance of program activities and measuring outcomes.
- **Focused Assessments:** Completed research on specific program approaches, including compact fluorescent acquisition strategies, photovoltaic installation training programs, ENERGY STAR® appliance marketing, and hard-to-reach customers in order to identify lessons learned and to inform future program design.
- **Transportation Policy:** Interviewed stakeholders and utility contacts to assess the benefits of and reporting burden associated with Washington State's fuel mix disclosure law.

Prior Experience – Barakat & Chamberlin 1991-1996; ERC International, 1982-1990

Designed, planned, managed, and implemented a variety of the firm's market and customer research projects related to utility product market assessment, product and service design, marketing, and pricing. Provided performance measurement, policy analysis, statistical analysis, and survey and behavioral research. Representative projects include:

MARKET ASSESSMENT

- Conducted a programmatic assessment of market potential for an innovative energy services program for a Midwestern utility based on a pilot test in one community.
- Analyzed the energy-efficient equipment marketplace to assist in the final design of a Southwestern electric utility's $80 million demand-side-management (DSM) financing program. Categorized

energy efficiency investments, described the energy-efficient product purchasing process, and analyzed customers' investment decision-making criteria.

CUSTOMER RESEARCH

- Designed and implemented a qualitative customer research project for an electric utility exploring customer interest in "futures contracts" for retail energy services.
- Developed customer site-visit research techniques to assist electric utilities in evaluating new services; and customers' needs, preferences, and willingness to pay for these services.
- Conducted strategic site visits with large commercial and industrial customers for three utilities developing new project and services strategies.
- Conducted more than 100 focus groups – with residential, commercial, and industrial customers; trade allies; and utility staff – to assess response to market changes, market needs, and product and service design.
- Supervised more than 1,000 phone and email surveys of customers and trade allies to assess market and customer response to products and services offered by electric utilities.

ORGANIZATIONAL ANALYSIS AND PROCESS RE-ENGINEERING

- Conducted strategic benchmarking studies for several utilities, comparing competitive business practices in areas such as product offerings and sales force compensation for a DSM initiative.
- Directed incentive verification audits for a Southwestern utility submitting documentation for cost recovery in two different years.
- Conducted a process assessment of a data-tracking and reporting process for a Northeastern utility, including a benchmarking study of comparable data-tracking efforts.
- Conducted a process re-engineering study for a Southern utility embarking on a competitive market strategy.
- Conducted a process evaluation of four research and demonstration settings, including the management structure, communications, and contracting processes for two West-Coast utilities.

PERFORMANCE MEASUREMENT AND PROGRAM EVALUATION

- Developed and conducted training workshops on process and market evaluation techniques and applications, and a workshop on the use of CLASSIFY in evaluations for the Electric Power Research Institute (EPRI) and the Wisconsin Center for Demand-Side Research.
- Conducted process evaluations in research and demonstration settings, including the management structure, communications, and contracting process for research and demonstration projects for two West Coast utilities.
- Evaluated demand-side bidding programs, including a 50-MW program at a Rocky Mountain utility, a 20-MW project at a California utility, and an in-depth analysis of the demand-side portion of an integrated bidding program in New York.

- Examined the process, organizational, and communications issues associated with four different resource acquisition strategies for a Northwestern utility.
- Conducted process evaluations of a variety of utility programs, including thermal energy storage, residential audit, and commercial audit programs for a Texas utility; an industrial program for a Northwestern utility; and large commercial and industrial retrofit and new construction programs for two Southwestern utilities.
- Conducted comprehensive evaluations of a small commercial/industrial retrofit program for a Northeastern utility; a residential program that included weatherization, new construction, and appliance rebates for two Midwestern utilities; and low-income programs for several utilities.

STRATEGIC PLANNING

- Developed strategic market research plans for two utilities preparing for competition.
- Prepared performance measurement plans for more than one dozen utilities, including comprehensive evaluation plans as part of DSM planning studies, specialized plans for mature and start-up programs, and detailed program-specific plans.
- Provided ongoing technical support to utilities to develop performance measurement strategies and implement evaluation plans.
- Provided technical support to the DSM Program Office, Electric Generating Authority of Thailand.

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"Applied Performance Measurement for Hard to Measure Programs." Presented at the Affordable Comfort Conference. Chicago, IL. Affordable Comfort Institute. April 1999.

"Measuring Change: Lessons Learned." Presented at the Affordable Comfort Conference. Madison, WI. Affordable Comfort Institute. May 1998.

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Workshops and Training Seminars

Beyond Evaluation 101: Process and Market Evaluation. With M. McRae and L. Dethman. International Energy Program Evaluation Conference. Baltimore, MD, August 2017; Amsterdam, Netherland, June 2016; Long Beach, CA, August 2015; Chicago, IL, August 2013; Boston MA. August 2011; Portland, OR. August 2009; Chicago, IL. August 2007.

Elements of Behavior Change and Energy Efficiency Programs. With Anne Dougherty and Meghan Bean. Association of Energy Services Professionals. Orlando, FL. February 2015.

Evaluation of Market Transformation Programs. With David Cohan and Joanna Morin. American Council for and Energy Efficient Economy, Market Transformation Conference. Washington, DC. April 20, 2015.

Behavior Program Evaluation: Integrating Evaluation into Behavior Programs. With Meghan Bean, and Anne Dougherty. Behavior Energy and Climate Change Conference. Washington, DC. December 2014.

Introduction to the Principles of Research and Evaluation. Association of Energy Services Professionals Training Course, With M. McRae. Portland, OR. October 2010.

Process Evaluation for Energy Programs. For Energy Research Institute of State Planning Development Commission, Beijing, China. January 2003.

EPRI 1995 Performance Measurement Workshop. With D. Violette et al. Denver, Co. November 1995.

Product Development and Marketing. W. LeBlanc, G. Collins, and S. Schick. Western Energy and Communication Association. Irvine, CA. September 14-15, 1995.

Process/Market Evaluation. With K. Van Liere. Seventh International Energy Program Evaluation Conference. Chicago, IL. August 1995.

Using CLASSIFY in Program Evaluation. With D. Linewebber. EPRI-EUMRC Marketing Symposium Conference. Marina del Rey, CA. November 1994.

EPRI 1994 Program Evaluation Workshop. With D. Violette, et al. Denver, CO. November 1994.

Improving DSM Effectiveness through Consideration of Commercial Customer Needs: Using Commercial CLASSIFY in Evaluation. Workshop sponsored by the Wisconsin Center for Demand-Side Research. Oconomowok, WI. February 1994.

EPRI 1993 DSM Evaluation Workshop. With M. Evans, M. Goldberg, D. Violette, K. Van Liere, P. Jacobs, and H. Misuriello. Santa Fe, NM. November 1993.

Lecturer: Overview of Program Evaluation/Process Evaluation and Impact Evaluation and Measurement Issues. Demand-Side Management: Principles and Applications, An Intensive One-Week Training Seminar. Sponsored by the Demand-Side Management Training Institute. San Francisco, CA. November 1993.

DSM Process Evaluation. With K. Van Liere. Chicago, IL, August 1993; Milwaukee, WI, February 1993, and Fond du Lac, WI, November 1992.

EPRI Process Evaluation Seminar. With P. Spinney, Boston, MA, June 1992, and with K. Van Liere, Palm Beach, FL. October 1992.

DSM Program Evaluation Training. Workshop for the Electric Generating Authority of Thailand. Bangkok, Thailand. September 1992.

DSM Program Evaluation Training Workshop. With A. Goett. Barakat & Chamberlin. Toronto, ON. June 1992.

DSM Program Evaluation Training Workshop. For the PSCo Collaborative. Denver, CO. May 199l.

Training & Certifications

- Expert Testimony: Regulatory Proceedings
- AESP, Led Team Training: Evaluation, Measurement, and Verification (EM&V)
- IEPEC: Led various energy efficiency training programs
- Services Marketing Institute – Certificate (1995)
- Message Retention for Adult Training – Certificate (1992)

Professional Affiliations

- American Association for Public Opinion Research
- American Evaluation Association
- American Marketing Association
- Association of Energy Engineers
- Association of Energy Services Professionals
  - Board of Directors (1996-1999)

  - Chair, Evaluation Standards Subcommittee of the Monitoring & Evaluation Committee (1990-1993)
- International Energy Program Evaluation Conference
  - Member, Conference Planning Committee (1996-present)
  - Treasurer (2003-2013)
  - President (2015-2017)
- Solar Energy Association of Oregon
  - Board Member (1981-1984; 1996-2002)

SEC INTERROGATORY #40

INTERROGATORY

[B/6/3] Please provide a detailed list of all studies of NTG carried out by the expert, divided between empirical studies (self-report surveys, etc.) and non-empirical studies (jurisdictional reviews, etc.). Please provide links to all of the listed studies. Please identify the personnel of the expert that were involved in each study, and their roles.

RESPONSE

Research Into Action has done evaluation research, including NTG research, since its founding in 1996, and its president, Jane Peters (one of the report's authors) has done evaluation research for more than 35 years. Of about 500 projects in Research Into Action's project database, 188 are characterized as program (including impact or process) evaluations, many of which have involved NTG research. It would be impractical to compile a detailed list of all studies of NTG carried out by the company or by Dr. Peters.

The following are examples of projects in which Research Into Action either conducted NTG research as a sole contractor or a subcontractor or led a team that conducted NTG research for programs in the nonresidential sector. Dates in parentheses indicate the year the report was submitted:

- NorthWestern Energy's portfolio of electric and gas residential and nonresidential energy efficiency and renewable energy programs (2012, 2013). The 2013 report available here: http://puc.sd.gov/commission/dockets/gaselectric/2012/ge12-001/vol1.pdf
- Energy Trust of Oregon's energy efficiency programs for commercial buildings (2009). Available here: https://www.energytrust.org/wp-content/uploads/2016/11/Evaluation_2006-2007_EB_Prog.pdf
- The Independent Electricity System Operator's. IESO, formerly the Ontario Power Authority) program commercial portfolio (2011-2016). Available here: http://www.ieso.ca/sector-participants/conservation-delivery-and-tools/evaluation-measurement-and-verification
- The State of Colorado's Governor's Energy Office's (GEO) residential, commercial, and industrial energy efficiency programs (2012). Available here: http://hermes.cde.state.co.us/drupal/islandora/object/co%3A20831/datastream/OBJ/view

Witnesses: R. Bliss
J. Peters

- Ameren Missouri commercial lighting spillover (2016, 2017). Reports available here:
https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936007290
https://www.efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936095356
- Southern California Gas Company's High Opportunity Projects and Programs pilot (ongoing, no report yet).
- Fort Collins (Colorado) Utilities' and Plate River Power Authority's residential and commercial energy efficiency and renewable energy programs (ongoing, no report yet).

The following is a summary of related work done in addition to the above primary NTG research:

- In 2007, Research Into Action provided testimony to the Montana Public Service Commission to present details about a process evaluation and market assessment we had conducted for NorthWestern Energy, which included estimates of free-ridership and spillover values. Our testimony helped NorthWestern Energy meet its regulatory requirements.
- In 2008, Research Into Action worked with Energy Trust of Oregon to develop and test a new self-report method for estimating free-ridership that mitigates the biases in previous approaches. This approach (which is described in our report to Enbridge) also is briefer than, and eliminates the subjectivity often found in, previous methods. We have since conducted several research projects for Energy Trust, relating to this new method. In 2009, we conducted a pilot test across the phone, web, and paper delivery modes. In 2010, we helped Energy Trust roll out the method in its full suite of residential, C&I, appliance recycling, and renewable programs. We adapted the pilot survey instrument to multiple programs and measure groups and collected and analyzed the survey data. We have applied this method in several evaluations (see below), and we currently are initiating a project to assess the feasibility of shifting from phone to web survey for this approach.
- In 2010, Research Into Action provided consulting to Nova Scotia Power Inc. on developing a protocol for the assessment of free-ridership, spillover, and net-to-gross calculations for energy efficiency programs for the Province.
- In 2015, Research Into Action led the development of a method of assessing lighting spillover savings in the commercial sector for Ameren Missouri. This method improves on previous approaches by combining information from trade allies and customers to generate assessments of program influence on sales that are specific to varying lighting sales channels. Research Into Action has since used this approach in successive evaluations of that program and has applied

this approach to residential sales of heat pumps for FortisBC (2018).

- From 2013 through 2016, Research Into Action was a member of the Statewide Evaluator team for the State of Pennsylvania. As part of our activities, we provided guidance on the establishment of statewide NTG methodologies, including both free-ridership and spillover assessment approaches.

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #41

INTERROGATORY

[B/6/3] Please provide a detailed list of all negotiated NTG results in all jurisdictions in which the expert was the manager or facilitator of the negotiation. Please provide details of the role of the expert. Please identify the personnel of the expert that were involved in each process, and their roles.

RESPONSE

Research Into Action has not served as the manager or facilitator for negotiated NTG values.

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #42

INTERROGATORY

[B/6/3, p. 12] Please explain how randomized control trials identify and quantify the influences that result in energy efficiency savings.

RESPONSE

Randomized control trials ("RCTs") do not necessarily identify and quantify all the influences that result in energy savings. As normally conducted, they identify and quantify the program-attributable energy savings, as that is theoretically the only difference between the treatment and control group.

Using a RCT to assess the savings for a particular program would randomly assign customers to either a program participation (treatment) group or non-participation (control) group. The energy consumption of both groups would be assessed twice. For each member of the treatment group, the energy consumption would be assessed for some period (typically 12 months) before and after program participation. For each member of the control group, the energy consumption would be assessed for two comparable periods.

Since, by definition, the members of the control group do not participate in the program, there is no single event or specific span of time to define the before and after time periods. In such cases, measures must be taken to identify a range of before and after time periods for the control group that is comparable to the range defined by program participation in the treatment group. For example, each member of the control group may be randomly assigned a date that is within the range of the dates of participation of the treatment group.

For each member of both groups, the difference between the energy consumption during the before period and during the after period would be calculated. The mean difference between before and after would then be compared for the treatment and control groups. The difference between the treatment and control groups in the difference between before and after (the "difference of differences") would represent the net effect of treatment.

For example, if for each member of the treatment group, we subtract the after treatment consumption ("Ta") from the before treatment consumption ("Tb"), we would get a value indicating the change in energy consumption after treatment (Tb - Ta). If we take the

Witnesses: R. Bliss
J. Peters

mean of those differences, we get a value indicating the mean change in energy consumption M(Tb - Ta). Doing the same for the control group gives us the mean change in energy consumption over the comparable time period, M(Cb - Ca). Then, subtracting the mean change in consumption for the control group from the mean change in consumption for the treatment group, M(Tb - Ta) - M(Cb - Ca), gives us the amount of energy savings attributable to the program.

Since the assignment to one group or another is random, there is no systematic bias that would result in certain types of customers' being more likely to be in one group rather than the other. Thus, any difference between the two groups in the mean before and after consumption should reflect only the difference that defined group membership: program participation or non-participation.

Of course, even though customers are assigned to the two groups randomly, it is possible that by pure chance, the two groups nevertheless differ on one or more characteristics other than program participation. For example, possibly – again, purely by chance – a higher percentage of the members of one group live in a part of the utility territory that achieved warmer daytime temperatures or colder nighttime temperatures during the period of study, compared to the other group. Because of this, a well-designed RCT study would track such data as well as any other factors that might affect energy consumption, such as household size, family size, or income. The analysis would then statistically control for the effects of such variables on energy consumption. Such an analysis would adjust the mean changes in energy consumption – M(Tb - Ta) and M(Cb - Ca), above – so that the resulting figure represents the savings that resulted from program participation, above and beyond any other differences between the two groups.

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #43

INTERROGATORY

[B/6/3, p. 14] Please explain why research results are not listed as one of the sources of information for negotiated values. Please explain how commissions deem values, or parties negotiate values, if they don't have any empirical research on which to base their analysis.

RESPONSE

Research Into Action ("RIA") did not intend to suggest that empirical research cannot or should not be used in deeming or negotiating NTG values. RIA identified the following as sources of information for negotiated NTG values:

- Literature review of other NTG studies from similar jurisdictions
- Structured expert judgement
- Market sales data analyses
- Top-down or macroeconomic models of data on programs and target markets
- Engineering estimates

Both literature review of other NTG studies from similar jurisdictions and market sales data analysis are sources of empirical research. RIA also stated that:

> jurisdictions may use evaluations of programs and measures that include assessments of free-ridership and spillover. These evaluations may use some combination of the aforementioned methods to determine NTG and then, rather than conducting NTG research monthly or annually, rely on the deemed NTG values for a longer period of time.

Although not stated explicitly here, such evaluations may include research conducted in the jurisdiction for which negotiated NTG values are being considered.

It is important to understand that RIA's cautions regarding NTG research relate not only to concerns about bias. Another important concern is the reliability of the NTG estimates from a given sample in a given year. Section 4 of the RIA report (filed as part of this proceeding) showed that NTG research can lack precision, such that estimates using the same methodology can produce variable results from sample to sample.

As RIA noted in the report's conclusions and recommendations, the assessment of input from applicable research should include an assessment of the quality of the

Witnesses: R. Bliss
J. Peters

research that is being reviewed, including efforts taken to reduce the self-report biases identified in our report. An example of such efforts is the Energy Trust of Oregon self-report free-ridership assessment, which may mitigate the bias toward higher free-ridership involved in asking program participants what they would have done without the program (the “counterfactual assessment”) by also asking about the influence of the various program interventions. Finally, RIA noted that inputs to the negotiated NTG value should include any available market data or macroeconomic analyses.

SEC INTERROGATORY #44

INTERROGATORY

[B/6/3, p. 14] Please confirm that the deemed approach also means there is a lack of insight into program design elements that affect program effectiveness. Please describe the rationale of jurisdictions that use the deemed approach but still require NTG studies.

RESPONSE

Research Into Action ("RIA") did not mean to suggest that the deemed approach means there is a lack of insight into program design elements that affect program effectiveness. (RIA could not find any passage stating that.) While applying the same deemed or negotiated value over multiple years will not identify changes over time in program effectiveness, should such changes occur, using deemed or negotiated NTG values does not preclude doing research that will speak to program effectiveness. Such research could include the type of assessments used to calculate NTG values. It may also include a wide range of process evaluation activities.

While NTG research may be done to provide insight into program design elements that may affect program effectiveness, such results should be understood to provide qualitative rather than quantitative information. For example, a NTG value of 0.6 for one program compared to 0.8 for another does not mean that one program can take credit for only 60% of the incented savings while the other program can take credit for 80% of the savings, but that there is evidence that the first program possibly may not be as effective as the second program at bringing about energy savings. The rationale for using a deemed approach while still requiring NTG studies is that the deemed approach provides a more stable basis to claim net savings, to assist in cost-effectiveness assessment and program planning, while NTG research provides qualitative information on program effectiveness. More detailed information yet can be obtained through a well-designed and -executed process evaluation.

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #45

INTERROGATORY

[B/6/3, p. 18] Please describe any research or analysis into the potential that respondents would be influenced to avoid implying "I took your money but I would have done it anyway" view, and thus would give answers to minimize their perception as free riders.

RESPONSE

This question references the section of the Research Into Action ("RIA") report that addresses the socially desirable response bias. The discussion implies that the socially desirable response – the one that survey respondents assume would be most socially acceptable – is that they would have taken the energy efficiency action even without program support. This is based on the assumption that, in the current social environment, recognition of the need to be energy efficient is the socially desirable attitude.

The School Energy Coalition's question suggests that an alternative interpretation is that the socially desirable response would be, "I would not have taken the utility money if I had not needed it." It is reasonable to ask whether this is a likely alternative. However, there are reasons to consider it unlikely.

First, there is much evidence to support the idea that the "green" response is in most cases the socially desirable response. Recent research indicates that about three-quarters of Canadians are "concerned about environmental issues" and believe that "conserving energy is very important" (Pyman and Pammett 2013; Gandalf Group 2013). Recent research by the Pew Research Center (2017) shows that three-quarters of Americans agreed that "the country should do whatever it takes to protect the environment[1]." Research reported by a variety of sources (Cooper 2011; Gfk Roper 2011; NMI 2014) found large majorities, ranging from 59% to 95%, stating preferences for energy efficient products and the companies that manufacture them. Even political conservatives appear, on average, to value reducing carbon emissions, although not to so great an extent as do liberals (Gromet, Kunreuther, and Larrick. 2013).

Beyond the above, there are reasons that respondents in general likely would not be

[1] Although some of the research we cite is based on surveys of United States residents, evidence (Pyman and Pammett 2013; Pew Research Center 2004) indicates that Canadians are generally more concerned about environmental issues than are Americans

Witnesses: R. Bliss
J. Peters

concerned about taking utility incentives even if they would have carried out the efficient upgrade without the incentive. Offers of discounts and rebates are a common part of modern consumer culture (see Silk 2010, for example). One online source cites numerous market studies indicating that 90% or more of consumers normally use coupons (Carter 2017). While RIA did not identify academic research directly addressing the question of attitudes toward taking unneeded discounts, it is hard to imagine that most people would hesitate to accept discounts for products they would buy if the discount were not available[2]. RIA is not arguing that a coupon for, say, paper towels is the same thing as a $300,000 incentive to carry out a custom equipment upgrade. The point is that the consumer culture conditions individual attitudes to accept discounts even when they may not be needed.

Another factor that would lessen or prevent any guilt about taking program incentives is the awareness that those incentives are funded, at least in part, by ratepayer dollars. Businesses may, thus, believe that they are entitled to the incentives as they helped fund them. In fact, RIA has had equipment contractors report to us that they use that reasoning as a way of selling efficient equipment upgrades.

Finally, it is considered best practice for survey research to be done by an independent, third-party organization that does not report individual responses to the client and to communicate that information in every survey contact. This should reduce, if not eliminate, any concern by the respondent about taking the utility incentive.

Sources Cited:

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Gandalf Group. 2013. Energy Efficiency and Canadians – National Opinion Research for CEEA. Prepared for the Canadian Energy Efficiency Alliance, April 12, 2013. http://energyefficiency.org/wp-content/uploads/2013/04/CEEA-Survey-Gandal-2013-4-12.pdf

[2] There has been considerable academic research on attitudes toward discounts and rebates, just none that RIA noted on this specific question.

Witnesses: R. Bliss
J. Peters

GfK Roper. 2011. The Environment: Public Attitudes and Individual Behavior – A Twenty-Year Evolution. Report by GfK Roper for SC Johnson Company, 2011. http://www.scjohnson.com/Libraries/Download_Documents/SCJ_and_GfK_Roper_Green_Gauge.sflb.ashx

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Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #46

INTERROGATORY

[B/6/3, p. 21] Please provide the basis for the statement " Large C&I programs often work with larger customers over a long period of time – sometimes, for a decade or more – to identify and catalog available energy efficiency projects".

RESPONSE

This statement reflects common knowledge within the large C&I evaluation community based on communication with program implementers, contractors, and program participants. Recognition that long-term relationships exist between efficiency programs and major customers, and of the effects of such relationships, has a fairly long standing. Thornsjo, Squires, and Bach (2003) argued that project influences may include "any educational effects (subliminal or otherwise) from long-term relationships with their utility."

More recently, the State and Local Energy Efficiency Action Network (SEEAction 2014) identified maintenance of steady, multi-year relationships with individual customers as a "key factor" for success of state industrial energy efficiency programs, noting that all successful programs of that type have employed that strategy. According to the authors,

> It takes time and a steady relationship for program personnel to understand company circumstances and needs, and for company personnel to understand what a program can offer them. Projects tend to be identified over time, as circumstances change and opportunities arise.

Recognition of the above facts led Kelly and Rogers (2016) to identify developing long-term relationships as one of ten tips for designing good industrial programs, stating that such programs "must provide a consistent contact person and establish a level of credibility and trust with industrial customers to enable joint identification of opportunities and analysis of savings."

Sources Cited:

Thornsjo, M., Squires, P., and Bach, H.R. 2003. Evaluating Attribution in a Business Markets Program. Proceedings of the Energy Program Evaluation Conference, pp. 433-442. Seattle, 2003. (A copy has been attached for reference*).*

Witnesses: R. Bliss
J. Peters

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Witnesses: R. Bliss
J. Peters

Evaluating Attribution In A Business Markets Program

Mark Thornsjo, Summit Blue Consulting, St. Paul, Minn., USA
Patricia Squires, Enbridge Gas Distribution, Inc., Scarborough, Ont., Canada
H. Robert Bach, Engineering Interface, Ltd., North York, Ont., Canada

ABSTRACT

This paper describes the method, results and conclusions of a study of the influences Enbridge Gas Distribution's business markets program has had on commercial, industrial and multi-residential customers. The study was done to help determine Enbridge's shareholder financial incentive for the program by estimating the level of program-driven attribution, including both free riders and participant spillover. Initial review of previous attribution findings and the method used previously for determining attribution suggested an opportunity to improve the program's attribution estimates by altering the dimensions of the attribution estimation, the design of the survey used to determine the estimate inputs, and scoring of survey responses to obtain a more robust estimate.

The research assessed the 2001 and 2002 program years in light of a program audit process recently concluded for the 2000 program year. A customer survey process was developed that refined both previous attribution survey designs and incorporated additional market perspectives by including the perspective of field sales staff as a legitimate class of market actors. Another approach, to reduce memory-loss and self-acclaim biases, was to recreate the customer project decision and Enbridge relationship context.

The effort included interviews with customers of a statistical sample of projects implemented in program years 2001 and 2002. Interview responses were used to estimate program influence for each project interviewed, with overall survey responses compiled to estimate the level of attribution. Looking to the future, the survey process may be used as the basis for on-going customer attribution surveying to improve the quality of information concerning customers' project decisions and the utility's influence.

Introduction and Background

Enbridge Gas Distribution is a large natural gas distribution utility headquartered in the Toronto, Ontario area, serving 1.3 million residential and 200,000 commercial and industrial customers. Enbridge has operated a demand-side management (DSM) program for its customers since 1995, according to a provincial government mandate issued in 1993. The program is operated as a resource-acquisition (vs. a market-transformation) program and so its impact accounting focuses primarily on the energy savings achieved by program participants.

As part of the broader context of natural gas restructuring and a shift to performance-based regulation, in late 1998 a financial incentive mechanism was approved to allow Enbridge's shareholders to share in the benefits of DSM. The resulting shareholder incentive mechanism instituted in 1999 is a shared-savings design, which rewards or penalizes Enbridge depending on achievement of actual net benefits relative to a budget net benefits baseline. A significant result of implementing this Shared-Savings Mechanism (SSM) design was that the approach to evaluating Enbridge's DSM programs changed. The approach had been primarily oriented to tracking and verification of program participation and efficiency measure installation. With its net-savings design, the SSM has expanded the scope of evaluation because its calculation implicitly reflects the influence of Enbridge's programs on customer participation and overall level of energy savings. Thus, part of determining the dollar amount of the SSM involves estimating the level of free ridership and spillover (components that allow for adjusting gross estimates of savings), with which to adjust the level of the SSM award.

Enbridge works with a DSM Consultative group that advises the Company on its DSM strategies, evaluations and, since 1999, the SSM. When the SSM was implemented the role and function of the Consultative changed, becoming more decision-oriented. One activity that has been undertaken that directly affects the SSM calculation is a general audit of Enbridge's draft annual DSM Evaluation Report.

The first such audit was concluded in 2002 and addressed the fiscal 2000 (F2000) program. Of the audit's various findings, perhaps the most critical was that about half the custom-type large commercial and industrial customer energy efficiency projects subsumed under the business markets programs were found to be free riders.[1] Because the program audit found such a significant free rider level, with the methodological and statistical uncertainties cited by the audit, and because the audit did not estimate participant spillover, Enbridge decided to conduct a study of the F2001 and F2002 programs' attribution, including an assessment of both free riders and spillover.

This paper presents the method, results and conclusions of the study undertaken by Enbridge to update the program audit's attribution estimates.

Method

Introduction

Attribution has proven to be one of the most methodologically challenging issues in the field of energy efficiency impact and cost-benefit assessment. This is partly because attribution is relatively unimportant in most of the economy: if one sells a widget it makes no difference how the customer was influenced or what they would have done otherwise. One simply assumes that because the sale got made and the sale is profitable, the product or service, and associated marketing and sales efforts, must have had a sufficient influence. Granted, product managers do not last long if they cannot figure out how to maintain influence, but rarely is free-ridership examined explicitly and/or adjustments made as a result when evaluating product or service profitability. Spillover in such markets is pure "gravy" and obviously adds to the profitability of the product line.

In the DSM field, though, attribution has gained criticality because shareholder financial incentives such as Enbridge's depend on attribution estimates for their determination – even if, as some jurisdictions have ruled, the estimate is based on assuming net-to-gross ratios (the outcome of applying attribution factors) to be 100% unless information is produced to the contrary.[2] Three basic approaches have evolved to address attribution:

- Quantitative statistical research using billing analysis of participants and non-participants; used for estimating overall market effects as well as intra-program effects
- Qualitative research using survey-generated self-reports of participants and, in some cases, non-participants; may include additional perspectives of involved other market actors
- Hybrid research methods using some combination of quantitative and qualitative approaches

[1] The estimates were produced by a qualitative customer survey process commissioned by the Consultative and paid for by Enbridge. See Method section for discussion of the audit's survey method compared to the current study's approach.
[2] See, for example, Raab & Violette (1994) and Nanduri (2001). Also, throughout the 1980's and 1990's Northern States Power Company used for its DSM financial incentive a default assumption of 100% net-to-gross until evaluation work demonstrated otherwise.

For this study we chose a purely qualitative approach that used in-depth interviews as the basis for collecting information on program influences. We chose this approach for a number of reasons:

- Similarity with and to build upon the general approach used in the F2000 program audit
- The target market is large commercial and industrial customers and custom-type projects, meaning that billing analysis would be more difficult, and with potentially high uncertainty in results[3]
- The nature of the customers involved, their decision processes and the length of time since many of the projects being addressed were commissioned
- Limited research resources, which limited the sample design and size and so further exacerbated the potential uncertainty of a quantitative approach
- Findings from previous research which indicates that a well-designed self-reporting approach can produce results as robust as those from more quantitative approaches[4]

This study dealt only with SSM adjustments (i.e., it was not a market transformation study) so there was no need to conduct quasi-experimental or other analyses of the program's overall market effects. Thus, no attempt was made to address non-participants and broader market effects other than for understanding how the interview sample compared to the customer population.

Previous Methods

Enbridge historically had been assuming a 10% free rider effect across all business markets custom projects. This basic assumption reflected the need to recognize some level of free ridership, but was criticized as being too simplistic and likely too low a level. The DSM Consultative group advised Enbridge that the estimate should be updated using a more empirical approach, and included such an effort as part of the broader F2000 program audit.

The F2000 program audit process to estimate free ridership was a first step to go beyond the general assumption Enbridge had been using for free riders. The F2000 audit employed a qualitative approach for estimating free ridership, conducted in two steps. It began with an independent engineer's detailed review of selected project files to identify the project makeup and verify projects' energy savings realization rates. This first-round process concluded with an in-depth interview with the customer whose project was being examined by the auditing engineer, and used a battery of questions relying on customer self-reports about the nature of the program's influence.

A second round of interviews was conducted with a small, but statistically drawn sample of customers in each of three segments: commercial, industrial and multi-residential. The same types of self-reporting questions were asked of this statistical sample so that the results could be extrapolated to the population of business markets custom projects. Questions addressed a variety of decision making issues, past and current energy efficiency practices and the relationship with Enbridge. For example, customers were asked about satisfaction with measures installed and whether similar measures would be considered in the future. Other questions asked if measures would be considered without Enbridge program assistance, the likelihood the measures taken would have been taken without Enbridge's program incentive and to what relative extent and timing (to address partial and delayed free ridership), and what made the customer start thinking about taking the measures. In all, 19 questions were asked around the attribution issue, including two concerning participant spillover which were not used subsequently in the final attribution estimate.

[3] See discussion in Cavalli, Torok & Richardson (1999) regarding concerns over case viability due to billing data problems.
[4] See, for example, Seiden & Platis (1999) and Torok, Cavalli & O'Drain (1999).

In fact, only a portion of the 17 free ridership questions in the F2000 audit appear to have been used to score each customer's free ridership, though qualitative consideration was given to the responses to the entire question set, to direct additional probing. In addition, a battery of 6 questions about gas price spikes and their effect on energy efficiency measures taken was asked in the middle of the interview, after some initial questions about what the customer had done historically in energy efficiency but before the "final" free rider questions that were the actual basis of the free rider score for each customer. One cannot fully know the response-biasing effect of inserting questions about gas price spikes' influence, and both having a number of such questions and inserting them immediately before the "final" free rider questions (those used to score free ridership). In our opinion there likely was an influence on interview responses about the influence of prices versus the influence of Enbridge on customers deciding to take the actions they did. As well, in reviewing the semantic construction of the interview questions and the way the responses were scored,[5] some doubt arose as to the validity of the final free rider scores. Added to this uncertainty was the basic statistical uncertainty of the small sample, although we acknowledge that the stratification method used helped minimize the sample's statistical uncertainty. Finally, we noted that the F2000 audit made no estimate of spillover effects, either participant or non-participant.

F2001/2002 Method

Given these methodological concerns for the F2000 audit, this study of F2001/2002 projects worked to improve upon the F2000 audit work. As with the F2000 program audit, there were substantial bias issues to address in using the selected approach to this study of the F2001/2002 program. To address our concern that over-reliance on customer self-reports would unduly bias the research findings in favor of high free ridership rates, we instituted three strategies that, to our knowledge, have not been used *together* in program evaluation.[6] One strategy was to add a second perspective to that of the customer alone by interviewing the Enbridge Energy Solutions Consultants (ESCs). This augmentation brought in the observations of ESCs under the assumption that they are a legitimate, if also biased, class of market actors. As such, their perspective should be considered, though tempered to offset the bias their responses carried.

A second strategy was to reconstruct the context and situation at the time the custom project was being developed so that the extant biases of lost memory and self-acclaim could be partly offset. This situation reconstruction, done as a prologue to the interviews with each customer, utilized available program information and ESC knowledge regarding the target projects and historical relationship with Enbridge. We consciously included the situation reconstruction as a counter to what we term "memory loss" and "self-acclaim" biases. These biases result from customers not recalling the full extent of the catalytic effect Enbridge's programs and ongoing general customer relationship management efforts have had. This includes the influences Enbridge has had on the trade community, who in turn influence customers. This third-party attribution effect was recognized by the F2000 audit, but it did not address the effect otherwise.

A third bias-reducing strategy employed directed the way the interview guide used to survey customers and ESCs was designed, the questions used and the scoring of responses. The strategy was to break down the customer decision process and Enbridge customer relationship management process into components that would not elicit overly patronizing responses, and that as much as possible elicited

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[5] I.e., focusing on "final" free rider questions and effectively declaring each project to be either 0% or 100% free rider, with some adjusting for partial and delayed effects.

[6] We credit the F2000 program audit's suggestion to obtain additional market perspectives, in particular that of customer service representatives. Also, other research has pointed out the value of multiple lines of evidence. Xenergy (2002) and Tiedemann (1999).

factual observations instead of judgmental opinions. We also avoided asking questions about price spikes and other significant outside influences, as we felt such questions would bring even more biases into play and that those influences in most cases would be adequately incorporated in customers' interview responses without calling them out for special attention.[7]

The study also addressed participant spillover, though more simplistically than it addressed free rider effects. Participant spillover was included for symmetry reasons, because just as other influences can affect the level of Enbridge's program influences, so, too, can Enbridge's influences persuade customers to take additional actions that ought to be given credit in the SSM calculation. The F2000 audit implicitly acknowledged this in the questions asked of customers, and other financial incentive-related evaluations have rightly incorporated this factor.[8]

Sample Design

Because the SSM depends implicitly on impact data this research keyed on projects as the sampling unit. To identify the group of projects to study we selected a sample of 34 F2001 and F2002 projects stratified by market segment (industrial, commercial and multifamily), with approximately half the projects coming from each year.[9] We slightly over-sampled larger projects to capture as much of the total impact as possible within the limited resources allowed for the study. This resulted in over 1/3 of the total program impacts being included in the sample. The resulting sample has a +/-20% accuracy and 90% confidence interval.

Interview Development

The interview development reflected an underlying program logic theory of change and its associated indicators, and reduced the need to rely on the traditional, but simplistic approach of simply asking customers what they would have done absent the program.[10] In all, eighteen questions were used to assess free ridership and one for spillover.

The survey interview guide consisted of three parts. The first part involved identifying information available from Enbridge's program files and ESC staff, and then working that information into a form useable in the customer interviews. This part included a battery of questions to be asked of ESCs concerning the genesis and interaction of projects with Enbridge marketing and technical support. For example, a question asked about the general context of Enbridge's relationship with the customer as evidenced by education efforts to build program awareness, energy audits provided that help identify project opportunities, and even distribution and merchant services that help ingratiate customers to Enbridge's DSM offerings. Other questions asked about project-specific support services and trade partner involvement with the project. This aspect of the survey process was implemented to provide an additional market actor perspective, that of Enbridge's sales staff (and, indirectly, trades' perspective). It was also necessary to help build a picture of the project genesis, because there could have been up to

[7] Our experience in other in-depth interview research, especially in probing about why an energy manager makes the project decisions they do, has repeatedly seen respondents bring up such issues without specific prompting. This strongly indicates they consider major other influences in their responses to what they do and why they do it.
[8] We would agree, however, that non-participant spillover is not an appropriate factor to include in the SSM calculation, though it can be appropriate for examining societal effects of programs.
[9] The programs supporting custom projects did not experience significant structural changes throughout the F2001-2002 period.
[10] That question was indeed asked, but not until other indicators had been explored so as to avoid prejudicing the respondents' answers to the various indicator questions.

two years since the project was commissioned, so that the customer could better recall the nature of their interaction with Enbridge and the program influences.

The second part of the interview guide turned to the customer side, as a prologue to asking about the project specifically. In this opening part of the customer interview, the customer was asked about historical energy conservation policies and practices, recollections of Enbridge energy efficiency marketing and sales efforts, a discussion of the background information obtained from the ESC interview and whether the customer has found Enbridge's programs and supporting services helpful in managing energy.

The third part of the interview guide focused in on the project itself. Here, questions were designed considering likely program/customer intervention points and the kinds of information being exchanged and decisions made, as well as points of satisfaction and dissatisfaction that would indicate program influence. For example, it asked about information presentations to customer management and the decision outcome of such presentations. It asked whether Enbridge or other incentives were received and what influence on project economics those had. Enbridge's help in selecting technologies, trade support and provision of supporting Enbridge services such as billing histories and energy audits were also questions asked. Questions of impact scope and timing addressed the issues of partial and delayed free ridership, and the traditional "what if no program" question was asked (as was a question about "what if programs were discontinued"). This part also included a question about spillover within the customer's facilities, asking whether they were taking efficiency actions in addition to the target project because of their experience with the project.[11]

The interviews with Enbridge ESCs and customers were conducted during December and January, 2002-2003. Recruiting was highly successful and resulted in non-response from customers representing only 4 projects. After reviewing the non-responding projects' program information, we concluded a non-response comparison was not needed.

Interview Process

The interview process began with selecting prospective cases randomly from a pool of 60 projects sampled from the F2001 and F2002 program years, though with interview case selection done to maintain the segment and savings-proportionate characteristics of the sample pool.[12] Once selected, customers were recruited to sit for an interview, with a commitment made to take no longer than 30 minutes unless the customer wished to provide a longer interview. Once recruited, the interviewing contractor reviewed the Enbridge files on the project and interviewed the Enbridge sales person associated with the project to obtain the interview prologue information and survey the Enbridge person about their observations of various energy services provided to the customer.[13] Then the customer interview was conducted, responses noted and transferred to a spreadsheet database for subsequent attribution scoring and analysis.

This process yielded a very high response rate due to successful recruiting techniques, the commitment to minimize customers' time, and apparently high interest (mostly positive) by customers in providing feedback on their program experience. To address non-response profile concerns, two questions were reserved from the interview guide to be asked of those declining interviews. These were never used because three of the four refusals were situations where contact calls were never returned and so no opportunity arose to ask the control questions. Given the high response rate and the known

[11] A question about impact realization relative to expected impact level also was asked, to address gross realization rate. For brevity that issue is not addressed in this paper.

[12] This was never a major issue in case selection as only 4 replacement cases were ever needed, and suitable replacements were available from the sample pool.

[13] This approach is very similar to that employed in work reported by Goldberg & Scheuermann (1997).

characteristics of non-respondents, however, we concluded there likely are no significant non-response biases in play. In all the interviews conducted there were very few questions that went unanswered, so missing data were not a concern, either.

In all, 38 attempts were made and 34 interviews completed (89% completion rate) during the interview period which ran from mid-December 2002 through mid-March 2003.

Attribution Scoring

The scoring scheme we developed reflected a holistic view of program influence by adding together in a weighted fashion the various components of the project history, implementation decision and relationship with Enbridge. In this construct we took the underlying position that in estimating free ridership and spillover, customers are neither wholly isolated from program influences, nor are they wholly influenced by the program, and indeed the scoring of free ridership never resulted in any case being either 100% or 0% free rider. Thus, the scoring method was to build a cumulative picture of free ridership, based on multiple stakeholder perspectives and kinds of influence. Both customer self-reports and Enbridge staff observations were utilized to develop information for assessing free ridership.

Scores for free riders and spillover were determined by associating responses to individual questions with a range of influence.[14] For example, most free rider questions were scored on a three-level basis of 0%, 50% or 100% free rider *for that question*. Spillover was determined by a single question. Free rider scores across all responses were grouped by type of interaction or influence. The groups were weighted judgmentally to avoid over- or under-counting various influence sources and to reflect (again, qualitatively) the relative importance of the various dimensions of influence, so that no one dimension would unreasonably dominate the overall free rider picture for that project. Interview responses were grouped into six weighted scoring groups to address the various dimensions of program influence:

1. Enbridge Staff Perspective (20% weight)
2. Customer Historical Efficiency Practices and Enbridge Relationship (15% weight)
3. Value of Project-related Information, Services and Incentives (30% weight)
4. Project Technical Relationship (10% weight)
5. Likely Alternative Actions (25% weight)
6. Scope/Timing Situation (to account for partial and delayed free ridership; separate 25% weight given, with result used as final adjustment to the free rider score)

The group weights were determined by considering each group's relative importance in the overall market (including past customer practices and Enbridge program efforts) and the customer decision environment. They also were determined in part by the way the individual question scores were designed, whereby free rider percentages were similarly specified in a simply understood manner, yet would not yield reasonable overall results without some weighting to put them in context with the other groups. Within groups, questions are assumed to have equal weights because of uncertainties in the nature of influence dynamics – influence can be effected through any of the means identified by the various questions. Item scoring generally follows a trinary (three-way) logic for methodological simplicity (i.e., 0/50/100% free ridership for a given question response), with grouping and group weighting used to combine item scores.

The Scope/Timing situation group weight is independent of the other weights because it is used to adjust the FR % after the other scores have been determined. It is set at 25% because of how the

[14] Gross impact realization rates, again not addressed in this paper, were similarly determined.

individual question responses in the group are set up, whereby unreasonably high results occur with greater weighting, yet lower weighting would fail to account sufficiently for scope and timing effects.

To ensure robust results, two scoring approaches were undertaken, one more conservative than the other. This was accomplished by interpreting the interview responses either more or less critically in terms of the role Enbridge's influence played in both general customer awareness building and specific project development and efficiency measure incorporation.

Results

The results derive from the combination of a refined qualitative research approach, solid field execution of the interviews and a holistic attribution scoring approach that expanded the previous scope to include spillover. Perhaps not surprisingly, the results thus differ from those of the F2000 program audit.

Free Riders

The results of the interviews, when scored using the component logic described above, showed significantly lower free rider rates than the F2000 program audit result. Using the two-level scoring approach, this study found savings-weighted average free rider levels of 29% and 38%, while the F2000 program audit found nearly 49% free ridership (range of estimate was 45%-52%).

The F2000 program audit also included an analysis of alternative scenarios for free ridership, where an assumption was made to provide full credit for contractor-initiate projects, full credit for delayed free riders or both credits combined. The resulting free rider estimate ranged as low as 32% when both credits were applied, which approaches the results found in this study.

Given the +/-20% statistical uncertainty of the small sample used in this study, one can reasonably conclude that the 29%/38% free rider levels could range widely, and up to nearly as high as the F2000 program audit results indicated. While we acknowledge this large uncertainty, the information that resulted from the interviews suggests more influence of the program than what might be inferred by free rider estimates in the range suggested by the F2000 program audit. For example, the majority of customers stated they had had a long history of interaction with Enbridge's efficiency programs, and that they had been working with trade partners with whom Enbridge in turn has had long-term relationships with (for example, in providing training to customers). Even the direct responses of many interviewees to the simplistic question "What is the probability you would have undertaken this project otherwise" tended to give Enbridge more credit than the similar question asked in the F2000 audit survey.

Participant Spillover

Analysis of the survey results suggested a savings-weighted participant spillover rate of 12% of project impacts.[15] This result is driven in part by the simplifying assumption used in the scoring design that keyed off customer responses about how much their project experience encouraged them to take similar or other efficiency measures at the target facility or their other facilities. Depending on the response spillover was assumed to range from 0% to 20% of project impacts.[16] Because of the

[15] Again, the F2000 audit did not estimate participant spillover.
[16] That is, if a customer saved 100,000 cubic meters of gas in the project the intra-customer spillover could range from 0 to an additional 20,000 cubic meters of gas saved. We did not attempt to measure non-participant spillover.

assumption basis of this estimate, we suggest using the result as part of the bounding analysis to adjust the overall net impact of the program, e.g., to reduce the free rider estimate by upwards of 12%.

Conclusions and Future Direction

This study found lower free ridership levels than the preceding audit of the F2000 program. Whether the difference is due to the way the qualitative interview method was applied, whether it is due to basic statistical uncertainty or whether it is due to real changes in free ridership rates over program years, is not apparent. However, from our experience planning, managing and evaluating programs and because Enbridge's program did not change substantially from 2000 through 2002, it is most likely that the difference is due to the way the method was applied and the results scored. This conclusion suggests a need for further comparative efforts with similar types of attribution research, though the current study benefited from years of efforts both by the study team and others in understanding important survey design components, such as what questions are appropriate to ask, how to ask them and how to minimize the inevitable biases they contain.

We did find that the free ridership bounding analysis performed both in this study and in the prior audit work produced an overlapping range, which suggests a possible consensus somewhere in that range that could be acceptable for deciding a fair and reasonable incentive amount. We also found evidence of significant spillover. Thus, there is support for making an adjustment to the SSM for both free riders and spillover for the F2001/2002 program, with a lower free rider percentage than found by the F2000 audit.

Of particular interest in the project was the use of survey strategies that explicitly acknowledge customer biases. Self-reporting approaches to estimating attribution, especially free ridership, are fraught with biases that give customers more credit for taking initiative on their own, uninfluenced by the program – what we have called memory-loss and self-acclaim bias. We concluded that such biases are so significant that an explicitly offsetting strategy is necessary to neutralize them. Thus, we instituted the unique features of tapping ESC knowledge and observations of program interaction and general customer relationships, and also a briefing to the customer as a prologue to the interview. The results likely offset at least some of these potential biases.

Lessons learned from this experience include trying to evaluate attribution as soon as possible during the course of when projects are being planned, developed and built. This can and should address not only project-direct support but also more general customer relationship factors that over long periods of time can influence customers' overall energy efficiency culture and future decisions to proceed with a given project. After all, when a customer states they would have done a given project regardless of the program's existence, they usually are not acknowledging any educational effects (subliminal or otherwise) from long-term relationships with their utility.

Additionally, to better estimate these critical attribution factors, we suggest instituting an ongoing, semi-real-time evaluation process to capture selected indicators of program influence. Enbridge is currently considering practical ways to do this which will minimize internal staff efforts and separate potentially conflicting attribution measurement interests. In particular, Enbridge is considering ways to enumerate activities it undertakes to support projects, and also a customer survey to be administered as the project is being commissioned.

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SEC INTERROGATORY #47

INTERROGATORY

[B/6/3, p. 23] Please provide a copy of the Cadmus 2017 report referred to.

RESPONSE

We should have cited that report as Cadmus 2012, not Cadmus 2017. The report was published in 2012 but accessed from the internet in 2017. We have included the report as an attachment to this response.

Witnesses: R. Bliss
J. Peters

THE CADMUS GROUP, INC.

FINAL REPORT

Assessment of Energy and Capacity Savings Potential in Iowa

February 28, 2012

Prepared by:

The Cadmus Group, Inc.
Energy Services Division
720 SW Washington Street, Suite 400
Portland, OR 97205
503.467.7100

In collaboration with
Nexant, Inc., and
First Tracks Consulting

Prepared for:

The Iowa Utility Association

Prepared by:
The Cadmus Group, Inc.

In collaboration with:
Nexant, Inc.
First Tracks Consulting

720 SW Washington Street
Suite 400
Portland, OR
Tel: 503.467.7100
Fax: 503.228.3696

An Employee-Owned Company
www.cadmusgroup.com

Corporate Headquarters:
57 Water Street
Watertown, MA 02472
Tel: 617.673.7000
Fax: 617.673.7001

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EXECUTIVE SUMMARY

Chapter 35 of the 1999 Iowa Administrative Code (199 IAC 35) sets forth the Iowa Utility Board (IUB) rules to implement legislation enacted in 1990 and modified in 1996, requiring Iowa's investor-owned utilities to "file with the Board an assessment of the potential for energy and capacity savings from actual and projected customer usage by applying commercially available technology and improved operating practices to energy-using equipment and buildings."

In compliance with this requirement, the Iowa Utility Association selected, through a competitive bidding process, The Cadmus Group, Inc., (Cadmus) and its sub-contractors Nexant, Inc. (Nexant), and First Tracks Consulting (First Tracks), to assess the remaining potential for energy and capacity savings within the service territories of Iowa's three largest investor-owned utilities. Referred to collectively as "the Utilities," Alliant Energy Corporation (Alliant, electricity and natural gas), Black Hills Energy (Black Hills, natural gas only), and MidAmerican Energy Company (MidAmerican, electricity and natural gas) serve approximately 72% of Iowa's electric customers and 85% of the state's natural gas customers.

Study Scope

This study builds upon five previous assessments of potential in Iowa, conducted since 1989, particularly the most recent (2008) study, led by Cadmus (formerly, Quantec, LLC).[1] The assessment builds upon the substantial primary data collection activities from the 2008 study, updating the data based on recent studies commissioned by the Utilities, DSM achievements of the Utilities in the intervening years, and current customer and load forecasts. This information was supplemented with data from several secondary data sources. The compiled data provided a complete characterization of both the current state of energy consumption in the Utilities' service area and the landscape forecast in the absence of future DSM.

Although this study addresses the same overall objectives as the 2008 assessment, the two studies differ in individual components considered, reflecting the changing landscape of demand-side management (DSM), both in Iowa and across the nation. Table 1 shows key components of each study. The 2012 study excluded the earlier study's primary data collection, assessments of new non-AMI demand response and renewable resources, and review of code compliance, while adding an assessment of market potential for energy efficiency.

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1 *Assessment of Energy and Capacity Savings Potential in Iowa*, prepared for the Iowa Utility Association, prepared by Quantec, LLC, Summit Blue Consulting, Nexant, Inc., A-TEC Energy Corporation, and Britt/Makela Group, February, 2008.

Table 1. Key Components of 2008 and 2012 Assessments

Study Component	2008 Assessment	2012 Assessment
Primary Data Collection	✓	
Energy Efficiency—Technical Potential	✓	✓
Energy Efficiency—Economic Potential	✓	✓
Energy Efficiency—Market Potential		✓
Demand Response—Potential from Expansion of Legacy Programs	✓	✓
Demand Response—Potential from AMI-Enabled Options	✓	✓
Demand Response—Potential from New Programs without AMI	✓	
Renewable Resources	✓	
Effects of Free-ridership and Spillover	✓	✓
Code Compliance	✓	

The resources and technologies considered in this assessment are informed by the Chapter 35 rules and discussions with the Utilities and stakeholders. Assessments of DSM potential are naturally influenced by prevailing rules and considerations, as well as factors such as weather, customer demographics, and economic assumptions that will lead to differences between study results. Therefore, the results of potential studies may not be readily comparable across jurisdictions. The following points related to this study's scope should be considered in comparing results to other potential assessments:

- Emerging technologies (deemed not commercially available at the time of this study) are excluded from technical and economic potentials, but included in market potentials.
- Early replacement of end-use equipment is not considered in this assessment; equipment is assumed to be upgraded at the time of natural replacement.
- As the assessment covers 10 years, there may be remaining potential for long-lived equipment beyond the study's time horizon.
- Active generating options, such as renewable and combined heat and power (CHP) are excluded from the assessment.
- The identified technical and economic potentials represent gross savings and some measures may not be appropriate for inclusion in utility programs due to potentially high freeridership rates.

Although emerging technologies, equipment early replacement, and on-site generation are excluded from the technical and economic potential, this should not preclude the Utilities from considering these options in their program offerings.

Energy Efficiency

Technical and Economic Potentials

The energy-efficiency assessment quantified the amount of energy that could be saved in the Utilities' service territories from 2014 to 2023. The assessment included efficient technologies and practices widely commercially available at the time of the study,[2] accounting for known

[2] The market potential scenario considers emerging technologies.

changes in codes and standards, technical limitations (technical potential), and societal cost-effectiveness (economic potential).

Table 2 shows forecasted[3] 2023 baseline electric sales and potential by sector. Study results indicate 8,446 GWh of technically feasible electric energy-efficiency potential by 2023, the end of the 10-year planning horizon, with approximately 6,872 GWh of these resources proving cost-effective. Identified economic potential represents a reduction of 19% of forecasted load in 2023. The residential sector represents the largest portion of technical and economic potential, at 42% and 40%, respectively. The commercial sector represents the second-largest contributor to technical and economic potential, at 32% for each, while industrial potential accounts for 26% and 28% of technical and economic potential, respectively.

Table 2. Technical and Economic Electric Energy-Efficiency Potential (Cumulative in 2023) by Sector

		Technical Potential		Economic Potential	
Sector	Base Case Sales (MWh)	MWh	% of Base Sales	MWh	% of Base Sales
Residential	9,197,928	3,548,837	39%	2,772,993	30%
Commercial	7,857,412	2,702,650	34%	2,181,608	28%
Industrial	18,293,266	2,189,166	12%	1,910,047	10%
Total	**35,348,606**	**8,440,653**	**24%**	**6,864,648**	**19%**

Table 3 presents 2023 forecasted baseline natural gas sales and potential by sector.[4] As shown, study results indicate over 37 million therms of technically feasible natural gas energy-efficiency potential by 2023. The estimated economic potential of 25.5 million therms amounts to 24% of forecasted load in 2023, and over 2 million peak day therms.

Table 3. Technical and Economic Natural Gas Energy-Efficiency Potential (Cumulative in 2023) by Sector

Sector	Base Case Sales (Thousand therms)	Technical Potential		Economic Potential	
		Thousand Therms	% of Base Sales	Thousand Therms	% of Base Sales
Residential	671,594	274,172	41%	175,823	26%
Commercial	335,581	92,129	27%	73,649	22%
Industrial	62,616	5,591	9%	5,280	8%
Total	**1,069,791**	**371,892**	**35%**	**254,752**	**24%**

As with electric potential, the residential sector represents the largest portion of technical and economic potential, at about 74% and 69%, respectively. Almost all remaining potential lies in the commercial sector, with a small portion (5.3 million therms) deriving from industrial applications.

3 Forecasted sales have been based on baseline forecasts developed by Cadmus, as described in Section 1, and do not necessarily match official utility forecasts.

4 As specified in the Chapter 35 rules, gas transport customers are excluded from the analysis.

Market Potential

Assessment of market potential, a new component of this study, examined savings that might be achievable under an aggressive acquisition scenario where:

- Utilities offer incentives of 100% of incremental measure costs;
- Financing is available to further address first-cost barriers; and
- Additional economic potential becomes available from emerging technologies.

To address the first aspect, Cadmus analyzed publicly available data on recent energy-efficiency experiences for IOUs across the nation, conducting regression analysis to estimate relationships between increased incentive spending and savings levels achieved. Based on this analysis, and beginning with the Utilities' 2010 program activity, up to 90% and 65% of electric and natural gas economic potential, respectively, may be achievable, over the 10-year study horizon. However, acquisition of these resources would require significantly higher utility expenditures than those currently occurring in Iowa or elsewhere in the nation.

To assess financing's potential effects, Cadmus reviewed available literature regarding the success of such programs. It is important to note this financing would only apply to a subset of measures included in the economic potential, namely those with full costs differing from incremental costs. The research indicates the availability of financing, in addition to 100% incentives, likely will not significantly impact measure adoption.

Finally, Cadmus researched measures not currently widely available commercially, but that are expected to become available over the next five to 10 years. In most cases, these measures represent incremental improvements over measures already included in the technical and/or economic potential identified in this study. The analysis found emerging technologies may increase electric market potential by up to 3%, with no impact expected on natural gas potentials.

Results of the market potential analysis are intended to provide a realistic upper bound to the estimates of economic potential and do not necessarily represent "program" potential or utility targets. The estimated savings may be realized through market transformation or improved codes and standards and may not be available or suitable for inclusion in utility program offerings. For example, the electric potential includes a substantial amount of savings from LEDs and CFLs replacing minimum standard bulbs. However, if the new lighting standards cause CFLs to become the de facto standard, the amount of savings available for utility DSM program acquisition could be greatly reduced.

Comparison to 2008 Assessment

While the 2008 Assessment utilized the best available information at the time, much has changed over the past four years and, thus, many data and assumptions have been updated in this study. The key differences are these:

- Updated utility sales, customer, and avoided cost forecasts;
- Changes in building codes and equipment standards; and
- Increased measure saturations due to utility program accomplishments.

The 10-year technical and economic electric and natural gas potentials from each study, by sector, are presented in Table 4 and Table 5, respectively. As shown, electric technical potentials have decreased, largely driven by updated codes and standards, particularly with regard to residential lighting. However, due to increased electric avoided costs, the fraction of technical potential deemed cost-effective has increased, and system-wide electric economic potentials have increased by only 1% above 2008 levels. The natural gas technical potential has similarly decreased, with decreased avoided costs contributing to a corresponding decrease in economic potential.

Table 4. Comparison of 10-Year Electric Technical and Economic Potentials

	Technical Potential (GWh)		Economic Potential (GWh)	
Sector	2008 Assessment	2012 Assessment	2008 Assessment	2012 Assessment
Residential	4,937	3,549	3,215	2,773
Commercial	2,695	2,703	1,563	2,182
Industrial	2,136	2,189	1,999	1,910
Total	**9,767**	**8,440**	**6,777**	**6,865**

Table 5. Comparison of 10-Year Natural Gas Technical and Economic Potentials

Sector	Technical Potential (Thousand Therms)		Economic Potential (Thousands Therms)	
	2008 Assessment	2012 Assessment	2008 Assessment	2012 Assessment
Residential	265,320	274,172	186,540	175,823
Commercial	132,240	92,129	90,130	73,649
Industrial	8,970	5,591	8,970	5,280
Total	**406,530**	**371,892**	**285,640**	**254,752**

Demand Response

The 2008 Assessment estimated demand savings potential for a variety of demand-response program options, including firm (e.g., residential direct load control [DLC]) and non-firm (e.g., critical peak pricing) strategies. In addition to actual potential estimates, the study resulted in two key findings:

1. Large overlap occurs between eligible populations for similar programs, and implementing new programs may affect participation in demand-response programs currently offered by the two electric utilities.
2. Regarding billing systems in place in 2008, the study did not allow for implementation of price-based options, such as real-time or critical peak pricing. However, these strategies could become feasible if and when the Utilities move to an Advanced Metering Infrastructure (AMI).

Based on these findings, the Utilities have continued to offer their long-running, successful Residential DLC and Nonresidential Interruptible programs in their 2009–2013 Energy Efficiency Plans (EEPs). Building on the conclusions drawn from the 2008 Assessment, this study focused on two questions:

- What potential exists for expansion of utilities' current demand response programs?
- What opportunities would be available if and when utilities implement an AMI?

Expansion of Legacy Programs

As both electric utilities have operated successful demand response programs for many years, the assessment of demand response potential primarily focused on establishing the upper bounds of customer participation, based on the experience of utilities offering similar programs. Cadmus gathered data on comparable programs from across the nation to develop possible expansion scenarios for each of the current demand response programs.

The 2010 program accomplishments, 2008 study results, and potential under each scenario for Residential Direct Load Control (DLC) and Nonresidential Interruptible programs are shown in are shown in Table 6 and Table 7, respectively.

Table 6. Forecasted Residential DLC Impacts in 2023 (MW)

		10-Year Potential			
		2008 Study	2012 Study		
Utility	2010 Program Achievements	Base Case	Base Case	Moderate Expansion	Aggressive Expansion
Alliant	33	53	35	37	46
MidAmerican	31	72	32	35	43

Table 7. Forecasted Nonresidential Interruptible Impacts in 2023 (MW)

		10-Year Potential			
		2008 Study	2012 Study		
Utility	2010 Program Achievements	Base Case	Base Case	Moderate Expansion	Aggressive Expansion
Alliant	264	291	296	304	354
MidAmerican	193	170	238	422	492

As shown, based on updated benchmarking data, estimates of available 10-year potential for the Residential DLC program have decreased from those presented in the 2008 Assessment. Nonresidential Interruptible expansion scenarios indicate potential has increased since the 2008 Assessment, though it should be recognized that decisions around appropriate levels of load to hold under contract are heavily influenced by utilities' unique objectives and resource needs.

AMI-Enabled Options

Analysis of AMI-enabled demand programs was a qualitative exercise, given data quantifying impacts of AMI-enabled programs has been drawn almost exclusively from utility pilot programs, and may not be appropriate for extrapolation to larger markets. Consequently, potential energy and demand savings related to AMI cannot be reliably quantified at this time. Nevertheless, this study outlines a number of potential options that may provide viable savings sources if Iowa electric utilities implement AMI.

From initial pilot results, AMI appears to expand demand reduction capabilities of residential demand response programs, though the extent of this expansion remains to be seen, as program persistence issues have not been thoroughly studied. Additionally, studies of the reliability and security of these programs and enabling technologies remain in progress. Further, how AMI-enabled programs and traditional programs overlap, and how demand savings may shift, still must be understood before specific estimates of demand reduction can be determined.

From improving operability rates of existing DLC programs to offering new demand response programs to customers, who otherwise would not sign up for traditional DLC programs, AMI will likely expand utilities' demand reduction capabilities.

Assessment of the Net-to-Gross Ratio

In addition to estimating energy and capacity savings potential, the 2008 assessment investigated the use of net-to-gross (NTG) adjustments, specifically freeridership and spillover effects.[5] The assessment defined the freeridership and spillover concepts, discussed the background and policy implications of these concepts, and provided examples of studies that attempted to measure their magnitudes. The study concluded with a recommendation that Iowa's investor-owned utilities (IOUs) assume an NTG ratio of 1.0 across all programs for the energy-efficiency plans implemented during the 2009–2013 program cycle.

This report provides additional and more recent information to update findings from the 2008 study, seeking to determine whether the recommended NTG ratio of 1.0 remains appropriate.

As part of the current research, Cadmus reviewed treatment of freeridership and spillover in 32 jurisdictions, relying on regulatory filings, technical planning materials, and evaluation reports. The review resulted in the following key findings:

- Methods for measuring NTG elements are inexact. Despite considerable technical progress in measurement techniques for freeridership, spillover, and market effects, concerns exists about the potential bias in these methods and the reliability of their results.
- NTG estimates tend to have small impacts on the societal cost test (the basis for economic analysis of energy-efficiency programs in Iowa), and, therefore, likely do not affect cost-effectiveness of measures and programs.

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5 *Assessment of Energy and Capacity Savings Potential in Iowa—Appendix G,* prepared for the Iowa Utility Association, prepared by Quantec, LLC, Summit Blue Consulting, Nexant, Inc., A-TEC Energy Corporation, and Britt/Makela Group, February, 2008.

- Many jurisdictions have assumed an NTG ratio of 1.0 at the portfolio level.
- Of the 32 jurisdictions surveyed, freeridership is considered in most (60%), participant spillover in 11 (34%), and nonparticipant spillover in nine (28%). The incidence of cases where only freeridership is assessed suggests an asymmetrical treatment of spillover and freeridership effects. Should spillover be included, it is likely many NTG ratios will be near or greater than 1.0. More than two-thirds of all evaluation studies reviewed in a recent best-practices study had a NTG value of approximately 1.0.

Given these findings, it appears reasonable that gross savings be used as the basis for reporting and target compliance. However, utilities should design effective programs that minimize freeridership. This entails: (1) regularly monitoring the saturation of measures within their own service areas and in other jurisdiction; and (2) using this information to revise their programs and their incentive structures periodically.

1. GENERAL APPROACH AND METHODOLOGY

This assessment relies on industry best practices, analytic rigor, and flexible and transparent tools to accurately estimate the potential for energy and capacity savings in the Utilities' service territory between 2014 and 2023. This section outlines each step of the assessment process, with results presented in the following sections, and supplemental material provided in the accompanying appendices.

Energy Efficiency

This study distinguishes between three distinct types of energy-efficiency potential:

- **Technical potential**[6] refers to savings available from adoption of energy-efficiency measures and practices, considering physical constraints to installation, but not cost-effectiveness or market barriers. Measures must be widely commercially available and proven at the time of the study, and the study assumes equipment will be upgraded during natural replacement or through new construction.
- **Economic potential** serves as a subset of technical potential, containing only measures with a benefit-to-cost ratio greater than or equal to 1.0, based on the Iowa Societal Cost Test (as defined in the Chapter 35 Rules).
- **Market potential** represents a realistic upper bound to potential savings from cost-effective efficiency programs that could be achieved offering incentives up to 100% of incremental cost, availability of financing to cover additional up-front costs, adoption of emerging technologies, and other best practices for efficiency programs.

This section describes methods and data sources used to estimate each type of potential.

Base Case Forecasting

Estimating energy-efficiency potentials begins by establishing an accurate baseline forecast of energy sales in the absence of future demand-side management (DSM) activity. While each utility officially forecasts sales by rate class, this analysis requires forecasts at an end-use level, fully capturing effects of changing codes and standards. As such, utility customer forecasts have been combined with detailed end-use level data on equipment saturations, fuel shares, penetrations of efficient equipment, equipment replacement rates, and known codes and standards, producing alternate baseline forecasts from which to assess potential.

Characterizing base-case conditions requires extensive data collection. As this assessment did not include primary data collection, Cadmus began by cataloguing data collected and developed during the 2008 assessment. For end uses and segments, where the Utilities offered rebates for efficient equipment, Cadmus used data from the Utilities' DSM tracking databases to update saturations of efficient equipment. For example, the previous assessment included on-site visits to count light sockets and measure current compact fluorescent lamp (CFL) saturations. Since then, Alliant and MidAmerican have aggressively pursued savings from CFLs, considerably

6 This definition is analogous to the "phase-in technical potential," described in the Chapter 35 Rules.

increasing this saturation. For each utility, the number of bulbs rebated was used to calculate a per-customer increase in saturation. These adjustments to current saturations of efficient equipment proved critical to avoid overstating remaining potential.

Additionally, the importance of accurately accounting for changes in codes and standards over the planning horizon cannot be overstated. Not only do these changes affect customers' energy consumption patterns and behaviors, but they establish which energy-efficiency measures will continue to produce savings over minimum requirements. This study captures current efficiency requirements as well as those enacted, but not yet taking effect.

The base case forecast particularly accounts for:

- Iowa's adoption of the 2009 International Energy Conservation Code (2009 IECC) for new construction;
- Provisions of the Energy Independence and Security Act of 2007 (EISA), affecting general service lighting and motors;
- The Department of Energy's 2009 rulemaking, setting standards for commercial fluorescent lighting, beginning in 2012; and
- Recent federal standards relating to residential heating, cooling, water heating, and appliances.

Creating a Database of Energy-Efficiency Measures

To estimate technical, economic, and market potentials for energy efficiency, this study relies on an extensive database of efficient equipment and practices. Measures considered in this study drew upon:

- Measures currently offered by the Utilities;
- Those included in regional and national database (e.g., California DEER and ENERGY STAR®); and
- Cadmus' internal library, compiled through our extensive experience conducting similar studies.

After compiling the initial list of measures, a qualitative screening process, as specified in the Chapter 35 rules, eliminated certain types of measures from consideration. Qualitative screening criteria included:

- Commercial availability;
- Applicability to Iowa's climate; and
- Effects on demand during peak periods.

The measures qualitatively screened out of the technical and economic potentials assessment, along with applicable sector, fuel, and reason for exclusion, are shown in Table 8. Emerging technologies were assessed as part of the market potential analysis.

Table 8. Measures Failing Qualitative Screening

Sector	Fuel	Measure	Reason for Exclusion
Both	Electricity	Advanced Modulating HVAC Compressors	Emerging technology.
Both	Electricity	Heat Pump Dryers	Emerging technology.
Both	Electricity	Water Heaters - Tankless	Increased peak demand
Commercial	Electricity	Active Chilled Beam Cooling with DOAS	Emerging technology.
Commercial	Electricity	LED Replacement of Linear Fluorescent	Emerging technology.
Commercial	Electricity	Ventilation and Energy Recovery	Emerging technology.
Commercial	Electricity	Advanced Rooftop Packaged AC	Emerging technology.
Commercial	Electricity	Hot-Humid Rooftop Unit with Dual Enthalpy	Emerging technology.
Commercial	Electricity	Liquid Desiccant Hybrid AC	Emerging technology.
Residential	Electricity	Advanced All-Climate Heat Pump	Emerging technology.
Residential	Electricity	Hot-Dry Air Conditioners	Emerging technology.
Residential	Electricity	Multifamily Building Best Practices	Emerging technology.
Residential	Electricity	On-Demand Recirculation Pumps	Emerging technology.
Residential	Electricity	Optimized Residential Duct Work	Emerging technology.
Residential	Electricity	Robust Central Air Conditioners	Emerging technology.
Residential	Electricity	Water Heaters - Add-On Heat Pump	Emerging technology.
Residential	Electricity	Water Heaters - Ground Source Heat Pump	Emerging technology.
Residential	Electricity	Water Heaters - Northern Climate Heat Pump	Emerging technology.
Residential	Natural Gas	High-Efficiency Gas Fired Rooftop Unit	Emerging technology.
Residential	Natural Gas	Water Heaters - Condensing Tankless	Emerging technology.
Residential	Natural Gas	Water Heaters - Non-Condensing Gas Hybrid	Emerging technology.

For each measure passing the qualitative screen, Cadmus compiled several types of data necessary to fully characterize each measure. Whenever possible, these data drew upon Iowa-specific sources, such as primary data collection from the 2008 assessment, utility tracking databases, or other studies performed by utilities. When Iowa-specific data were not available, Cadmus utilized the most appropriate regional and/or national sources, tailoring the data to Iowa, when possible.

Each measure had the following key data elements:

- Efficient and baseline equipment, labor, and O&M costs;
- Annual energy savings;
- Effective useful life;
- Technical feasibility; and
- Current saturation.

For modeling energy-efficiency potential, measures were separated into two distinct classes:

- ***Equipment measures*** save energy by upgrading the efficiency of end-use equipment at the time of that equipment's replacement (e.g., high-efficiency gas furnaces). In the absence of early replacement of functional equipment, equipment turnover and replacement rates are defined by the equipment's average effective useful life. In a study spanning 10 years, long-lived equipment may not completely turnover during the planning horizon, and additional opportunities may exist beyond the study's close.
- ***Retrofit measures*** save energy by reducing end-use consumption without replacing end-use equipment. Such measures include: insulation, faucet aerators, and lighting controls. This study assumes these measures, in existing construction, have been installed in equal amounts during each of the 10 years. Retrofit measure installation rates in new construction are defined by the utilities' new construction forecasts.

Estimating Technical Potential

Technical potential represents total energy saved from all measures, only adjusting for physical constraints. For example, high levels of wall insulation can be placed in a certain percentage of homes, and, of those, a certain share may already have this insulation in place. Consequently, technical potential would only include technically feasible homes without measures in place.

Another important technical potential aspect assumes installation of the highest-efficiency equipment wherever possible. For example, this study examined SEER 14.5, 15, 16, and 18 central air conditioners in residential applications, with technical potential assuming that, as equipment fails or new homes are built, customers will install SEER 18 units, regardless of costs. Competing retrofit measures have been treated the same way, assuming installation of the highest-saving measures where technically feasible.

In estimating technical potential, one cannot merely sum up savings from individual measure installations, as significant interactive effects can result from installation of complementary measures. For example, upgrading a furnace in a home where insulation measures have already been installed can be expected to produce less saving than in an un-insulated home. The analysis of technical potential accounts for two types of interaction:

- **Interactions between equipment and non-equipment measures:** As equipment burns out, technical potential assumes it will be replaced with higher-efficiency equipment, which reduces average consumption across all customers. Reduced consumption causes non-equipment measures to save less than they would have, had the equipment remained at a constant average efficiency. Similarly, as non-equipment measures are installed, savings realized by replacing equipment decrease.
- **Interactions between non-equipment measures:** Two retrofit measures applying to the same end use may not affect each other's savings. For example, installing a low-flow showerhead does not affect savings realized from installing a faucet aerator. Insulating hot water pipes, however, would cause the water heater to operate more efficiently, thus reducing savings from either measure. The method in this assessment accounted for this interaction by "stacking" interactive measures—iteratively reducing baseline

consumption as measures are installed, thus lowering the savings from subsequent measures.

While theoretically, all retrofit opportunities in existing construction (often called "discretionary" or "instantaneous" resources) could be acquired in the study's first year, this would skew the potential for equipment measures, and provides an inaccurate picture of measure-level potential. Therefore, the study assumes realization of these opportunities in equal annual amounts over the 10-year planning horizon. Applying this assumption, natural equipment turnover rates, and other adjustments described above, annual incremental and cumulative potential is estimated by utility, fuel, sector, segment, construction vintage, end use, and measure.

Estimating Economic Potential

Economic potential represents the subset of technical potential that is deemed cost effective. Consistent with Chapter 35's definition of the Societal Cost Test,[7] a measure can be deemed cost-effective if its present-value benefits meet or exceed its present-value costs. The measure's cost results simply from the difference in upfront costs between the measure and the baseline technology. In some cases (such as retrofits), the cost used equals the measure's full cost.

Calculating a measure's societal benefits proves far more complex, relying on significant economic and load data such as:

- **End-use load shapes.** End-use consumption patterns by costing period are applied to electric and natural gas measures, capturing the time-differentiated value of energy savings and determining the amount of savings during peak periods.
- **Externality factors.** As specified in the Rules, an externality factor is applied to avoided energy and capacity costs, accounting for societal costs of supplying energy. This factor adds an additional 10% to electric avoided energy and capacity benefits, and an additional 7.5% to natural gas energy and capacity benefits.
- **Line losses.** Line losses represent energy lost between the generator and the customer meter. Thus, energy and capacity savings at the customer meter are grossed up, capturing the true value of savings. Such values vary by utility, fuel, and sector, and may differ for energy and demand.
- **Societal discount rate.** As specified in the Rules, the societal discount rate equals the 12-month average of the 10-year and 30-year Treasury Bonds rates at the time of this study, which uses a nominal discount rate of 5.63% for all utilities.
- **Utility avoided energy costs** are utility-specific projections of energy generating or purchasing costs. Electric costs are analyzed by season, weekday/weekend, and on- and off-peak periods, whereas natural gas costs are assessed monthly.

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7 This study did not assess other standard cost-effectiveness tests. The Utilities will consider these perspectives in developing the 2014–2018 Energy Efficiency Plans.

- **Utility avoided capacity costs** are utility-specific projections of the cost of supplying energy during peak periods, which is assumed to be the system peak hour for an electric utility, and the system peak day for a natural gas utility.
- **Values of other resources.** Some measures save non-energy resources, such as water or detergent. Value for these resources have been determined and applied consistently across utilities.

These data have been combined with measure-level data to calculate a variety of benefits for each measure. The benefits, described as follows, have been added and compared to the measure's costs to determine whether the measure proved cost-effective from the societal perspective:

- **Energy benefits:** The present value of conserved energy over a measure's life, calculated by applying the appropriate line loss and externality factor to avoided energy forecasts, spreading over the measure's load shape, and discounting back to present terms using the societal discount rate. For measures saving electricity and natural gas (e.g., insulation in homes with a gas furnace and central air conditioner), benefits from both fuels have been considered.
- **Capacity benefits:** The present value of conserved capacity over a measure's life, calculated by applying the appropriate line loss and externality factor to avoided capacity forecasts, and multiplying by the measure's savings in the peak period, and discounting back to present terms using the societal discount rate. As with energy benefits, for measures saving electricity and natural gas (e.g., insulation in homes with a gas furnace and central air conditioner), benefits from both fuels have been considered.
- **Non-energy benefits:** The value of applicable non-energy benefits, such as water or detergent, considered over the measure's life, and discounted back to present terms using the societal discount rate.

As evident from the information sources and methods used to quantify societal benefits, the measures' cost-effectiveness varies between utilities, based on projections of energy and capacity costs and line loss values. As such, this study calculated cost-effectiveness separately for each utility, leading to differences in economic potential, presented later in this report.[8]

Based on the results of the cost-effectiveness analysis, and using the same method described in the technical potential section, above, an alternate sales forecast the annual incremental and cumulative potential for each cost-effective measure has been calculated.

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[8] Differences in economic potential across utilities are a function of customer characteristics and current saturations of end uses and efficiency measures.

Assessing Market Potential

Market—or achievable—potential generally is defined as the portion of economic potential expected to be reasonably achievable over the course of the planning horizon, given certain assumptions regarding market barriers and behavioral factors that may inhibit consumers' participation in utility-sponsored energy-efficiency programs. In this assessment, market potential is defined more narrowly, as the amount of savings that might be achieved, assuming: incentive payments up to 100% of incremental measure cost; financing availability; exemplary program design and implementation practices; and emergence of new technologies, currently not widely available in the marketplace.

Methods for estimating achievable potential vary across potential assessment studies. These methods fall into three general categories.

1. The first group of methods (such as those used in assessments of energy-efficiency potential in California) is based on a conventional market diffusion model, and assumes first-cost as the primary participation barrier. In this approach, market potential is hypothesized to depend on the return from energy-efficiency investments, and the effects of incentives on enhancing that return. Due to limited data available to establish the empirical relationship between consumers' expectations about returns on investments, this relationship often must be hypothesized.
2. The second group of methods typically rely on self-reports to determine consumers' willingness to participate in energy-efficiency programs. The approach involves asking a representative sample of potential participants about their willingness to adopt a measure or participate in a program, under given incentive amounts—generally expressed as a fraction of the incremental measure cost. These studies result in a demand curve for conservation measures, which relates willingness to participate as a function of respondents' shares of incremental measure costs.
3. Benchmarking, used in this assessment, provides the third method for determining market potential. This method incorporates certain elements from the first two method groups, but primarily relies on historical market penetration achieved by a representative sample of relevant programs to determine what might be achievable over a longer term.

In this assessment, Cadmus relied on the empirical statistical relationship between program expenditures (both incentive and non-incentive) and energy savings, based on historical performance data for a representative sample of utility-sponsored electric and natural gas programs in various jurisdictions. Cadmus used analysis results to estimate the likely maximum market potential for utility-sponsored electric and natural gas programs in Iowa under the study's specific assumptions. Data sources and analytic methods follow below, with results presented in Section 3.

The Effects of Increased Incentives

Form 861 of the Energy Information Administration (EIA) served as the primary data source for assessing electric market potential, providing energy savings, program expenditures, revenues, and retail sales reported by approximately 75 investor-owned utilities from 2004 through 2010.[9]

As natural gas utilities do not report energy-efficiency program results in universal datasets similar to EIA Form 861, Cadmus compiled publicly available documents from utilities and other program administrators reporting annual energy-efficiency results to create a comparable dataset. Performance data for 2010 programs for 14 portfolios were included in the analysis. The 14 selected portfolios represented those most relevant for informing market potential for Iowa utilities, using the following criteria:

- Portfolios operating for at least three years.
- Serving territories with at least 10 quadrillion Btu of annual sales.
- Portfolios in "Northern Tier" states, with climates most similar to Iowa. (As a practical matter, this criterion eliminated only two southern California utilities and one New Mexico utility from the data set.)
- Portfolios providing publicly available data, which, at a minimum, included the following information:
  - Natural gas spending separated from electric spending;
  - Spending differentiated between incentives and other costs; and
  - Annual energy savings.

Given these criteria, Cadmus developed a list of 14 portfolios spanning nine states, as shown in Table 9, below.

For each utility and program administrator listed in Table 9, data on natural gas sales, revenue, and average rates were collected from EIA Form 176, normalizing savings and spending across service areas of different sizes.

Using these data, Cadmus developed regression equations to estimate effects increased incentives would have on portfolio-level electric and natural gas savings for Iowa utilities. Data on current program activity and incentive spending were derived from the utilities' 2010 Annual Reports.

[9] Although Form 861 contains data for a larger number of utilities and a longer time series, back to 1999, the information tends to be incomplete and lack some variables of interest for this study.

Table 9. Natural Gas Utility Portfolios Included in the Benchmarking Analysis

Utility/Program Administrator	State
Pacific Gas & Electric	California
Public Service Co. of Colorado	Colorado
Yankee Gas Services	Connecticut
Connecticut Natural Gas	Connecticut
Southern Connecticut Gas	Connecticut
Avista Corp	Idaho
National Grid	Massachusetts
NStar	Massachusetts
Northern States Power	Massachusetts
Questar	Utah
Puget Sound Energy	Washington
Avista Corp	Washington
Cascade Natural Gas	Washington
Wisconsin Focus on Energy	Wisconsin

Effects of Financing Availability

Offering incentives covering full incremental costs may not be sufficient to offset first-cost barriers for all measures. For example, if a customer with low insulation levels chooses to upgrade to insulation exceeding minimum building code, a utility incentive may only cover costs above and beyond code-required levels. In this case, remaining cost could be substantial. Cadmus reviewed secondary literature on the success of financing programs to quantify the effect this option could have on market potential.

It should be noted that, in many cases, measures have the same full and incremental costs. Moreover, for equipment replacement, the study assumes equipment would be upgraded per its natural replacement cycles, and baseline costs would be incurred, regardless of whether an efficient unit would be installed.

Effects of Emerging Technologies

As specified in the Chapter 35 Rules, only measures commercially available were included in the technical and economic potential. However, the market potential is designed to include measures expected to become commercially available and cost-effective within the next five to 10 years, as these measures could provide savings over the course of the next round of EEPs. While these measures will increase available potential, their effects cannot merely be added to the identified economic potential for two reasons:

- First, many of these measures will supplant existing technologies; so only the incremental increase in efficiency creates new potential.
- Second, due to interactive effects, these measures will reduce potential from other measures included in the technical and economic potential. That is, emergence of a more efficient heat pump not only supplants the potential attributed to currently available technologies, but will reduce the potential attributable to shell measures.

To determine impacts on market potential, Cadmus developed a list of emerging measures drawn from secondary sources, such as DOE and ACEEE, providing estimates of efficiency levels and savings. Cadmus then determined how these measures overlapped with measures already considered in the study, and estimated incremental savings and potential from the emerging technologies. For measures without a complementary choice within the measure list, Cadmus apportioned estimates of national long-term potential to the Utilities' territory.

Demand Response

The 2008 Assessment estimated demand savings potential for a variety of demand-response program options, including firm (e.g., residential direct load control [DLC]) and non-firm (e.g., critical peak pricing) strategies. In addition to actual potential estimates, the study resulted in two key findings:

1. Large overlap occurs between eligible populations for similar programs, and implementing new programs may affect participation in demand-response programs currently offered by the two electric utilities.
2. Billing systems in place during the 2008 study did not allow implementation of price-based options, such as real-time or critical peak pricing. However, these strategies could become feasible if and when the utilities move to an Advanced Metering Infrastructure (AMI).

Based on these findings, the utilities continued to offer their long-running, successful Residential DLC and Nonresidential Interruptible programs in their 2009–2013 Energy Efficiency Plans (EEPs). Building on the conclusions drawn from the 2008 Assessment, this study focused on two questions:

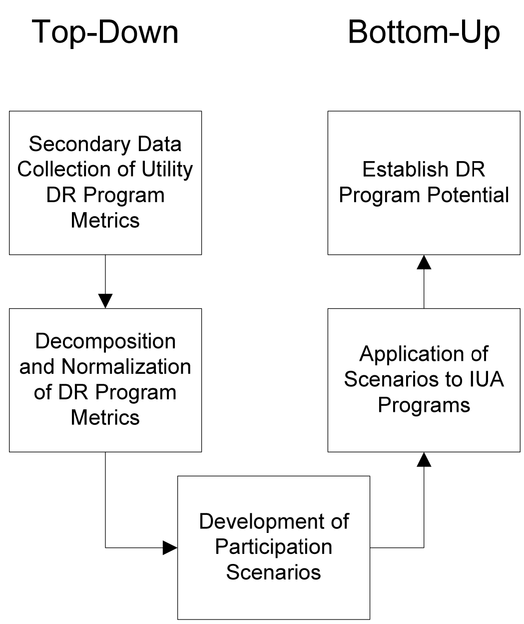
- What potential exists for expansion of utilities' current demand response programs?
- What opportunities would be available if and when utilities implement an AMI?

The methodology for assessing these questions follows this section.

Expansion of Legacy Programs

As both electric utilities have operated successful demand response programs for many years, the assessment of demand response potential primarily focused on establishing the upper bounds of customer participation, based on the experience of utilities offering similar programs. After developing a database of participation data from other, comparable utilities, a bottom-up methodology established the estimated market potential. Figure 1 illustrates the general process.

Figure 1. General Demand Response Potential Assessment Methodology



Secondary Data Collection and Analysis

The key metrics used to compare utility programs (and, subsequently, to estimate remaining potential) were current participation levels. As customer counts, peak loads, and program impacts can vary greatly across utilities, identified metrics sought to normalize for these effects. For residential DLC programs, "participation" was defined as the percentage of eligible customers (for example, residential customers with central air conditioners) currently enrolled in the program. Nonresidential interruptible programs used a metric of the percentage of nonresidential demand during the system peak under contract.

While calculating these participation rates for Iowa utilities proved relatively straightforward, greater difficulty resulted in collecting data on other utilities' program achievements due to reporting differences. Data on utility program achievements, customer counts, and peak demand derived from an array of sources, including:

- Federal Energy Regulatory Commission (FERC) 2010 Assessment of Demand Response and Advanced Metering Demand Response Survey Data;
- United States Energy Information Administration (EIA) Database;

- Utility integrated resource plans (IRP);
- Utility annual reports; and
- Utility demand response program evaluation reports.

Based on data collected from these sources, participation rates, defined above, were calculated for each utility program, based on 2010 data (with the most recent data available, in most cases).

Participation Scenario Development

Data collected indicated wide ranges of participation rates across utilities. The programs at the extremes (extremely high or low participation) were reviewed in additional depth, and some were removed as outliers, based on unique program differences or unreliable data.

Calculated participation rates allowed establishment of two potential expansion scenarios:

1. **Moderate expansion:** The amount of potential available if Iowa utilities' participation rates increased to the upper quartile of the reviewed utilities.
2. **Aggressive expansion:** The amount of potential available if Iowa utilities' participation rates increased to industry-leading participation rates.

These scenarios were compared to a "baseline" scenario, where Iowa utilities continued at current participation levels.

Under each expansion scenario, assumed participation rates were applied to Iowa utility customers, loads, and per-participant impacts to identify demand savings to be realized.

Though demand response strategies primarily focus on reducing demand during peak periods, reduced demand can also translate into energy savings. However, such energy savings cannot be calculated by merely multiplying demand impacts by an event's duration, as this neglects some or all demand may have shifted to off-peak periods, rather than be avoided entirely.

For example, in a central air conditioning DLC program, energy savings occur during the curtailment event, but temperatures in homes rise, and units must work harder after the event to achieve the desired temperatures. Similarly, if a commercial customer sheds load by temporarily adjusting processes (such as slowing production or shutting down some portion of a facility), it may have to increase production or use more of its facilities following an event. This phenomenon, commonly called "snapback," must be captured to reliably quantify energy savings attributable to these programs.

Quantifying snapback for a given demand response program proves quite difficult, as variations between demand response strategies and differences in participating customers can greatly impact snapback effects. For example, a region's temperature fluctuation greatly affects snapback. In climates where temperatures remain relatively high after the end of an event, a demand response program generally experiences a higher snapback amounts. If an event ends at a time of day when temperatures begin to decline, the snapback would be lower. Similarly, customers enrolled in nonresidential interruptible programs may retain on-site generation capabilities, and experience no snapback effects.

Consequently, Cadmus reviewed secondary data on observed and assumed snapback effects for utilities across the nation, providing estimates of the likely energy-savings range that could be realized from these demand response strategies.

AMI Enabled Demand Response

While the prevalence of AMIs has increased significantly since 2008's Assessment, few utilities have established AMI-specific demand response programs. Existing offerings primarily remain in pilot forms, and do not offer data that could be reliably extrapolated to quantify available potential for large-scale programs. Thus, this study presents a qualitative assessment of how utilities currently use AMI to reduce system peaks, and anticipates opportunities that may emerge in the next several years, if Iowa utilities implement AMI.

Freeridership and Spillover

This task largely updated the 2008 Assessment, reviewing current practices for assessing freeridership and spillover, and determining how jurisdictions across the country accounted for these effects. To provide a robust and complete assessment for use in future decisions regarding treatment of NTG in Iowa, and to provide the Utilities with recommendations for methods regarding mitigation of freerider effects, Cadmus conducted a thorough review of commission orders, legislative mandates, energy-efficiency program evaluations, and assumed values from jurisdictions across the nation, as described in Section 5.

2. ENERGY EFFICIENCY: TECHNICAL AND ECONOMIC POTENTIAL

Scope of Analysis

The assessment of energy-efficiency resources primarily sought to produce reasonable estimates of savings available in each utility's service territory over a 10-year planning horizon (2014-2023), thus informing creation of the 2014–2018 EEPs. Technical and economic potential for residential, commercial, and industrial[10] sectors were assessed separately for each utility, divided by fuel type. Within each utility's sector-level assessment, the study further distinguished among market segments or industry types, and their respective applicable end uses. Analysis included: 10 residential segments (existing and new construction for single-family, multifamily, manufactured, low-income single-family, and low-income multifamily); 24 commercial segments (12 building types within existing and new construction); and 18 industrial segments.

Analysis began by assessing the technical potential for 359 unique electric and 155 unique gas energy-efficiency measures passing the qualitative screening process, as described in Section 1 (and shown in Table 10), representing a comprehensive set of electric and natural gas energy-efficiency measures applicable to Iowa's climate and customer characteristics.

Table 10. Energy-Efficiency Measure Counts

Sector	Electric Measure Counts	Natural Gas Measure Counts
Residential	132 unique, 632 permutations	61 unique, 281 permutations
Commercial	164 unique, 1,580 permutations	71 unique, 657 permutations
Industrial	63 unique, 255 permutations	23 unique, 92 permutations

This list included measures analyzed in the 2008 Assessment (which may be active in current utility programs), and new measures that have become commercially available over the past five years. Considering all permutations of these measures across applicable customer sectors, market segments, fuels, and end uses, resulted in customized data, compiled and analyzed for over 4,000 measures. Appendix A.2 describes all measures analyzed, and Appendix A.3 presents technical details and economic potential for all permutations.[11]

The remainder of this section is organized into two parts:

- A summary of resource potentials by fuel; and
- Detailed sector-level results.

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10 The industrial sector includes sales and potential for agriculture and street lighting.
11 Economic potential in Appendix A.3 has been aggregated to the state level.

Summary of Results: Electricity

Table 11 and Table 12 show forecasted[12] 2023 baseline electric sales and potential by utility and sector, respectively. Study results indicate 8,446 GWh of technically feasible electric energy-efficiency potential by 2023, the end of the 10-year planning horizon, with approximately 6,872 GWh of these resources cost-effective. Identified economic potential amounts to 19% of forecasted load in 2023.

Savings have been based on forecasts of future consumption, absent utility program activities. While consumption forecasts account for past savings each utility has acquired, estimated potential is inclusive of—not in addition to—current or forecasted program savings.

As shown in Table 11, though utility-specific technical and economic potential are a function of baseline sales, they are roughly comparable, when analyzed in percentage terms. Differences in technical potential as a percent of baseline sales are driven by differences in distributions of customers by segment, and other utility-specific customer characteristics. In addition to these differences, economic potential varies due to differences in utility avoided energy and capacity costs.

Table 11. Technical and Economic Electric Energy-Efficiency Potential (Cumulative in 2023) by Utility

Utility	Base Case Sales (MWh)	Technical Potential			Economic Potential		
		MWh	% of Base Sales	MW	MWh	% of Base Sales	MW
Alliant	15,465,326	3,839,043	25%	926	3,294,806	21%	803
MidAmerican	19,883,278	4,601,610	23%	1,110	3,569,842	18%	885
Total	**35,348,604**	**8,440,653**	**24%**	*	**6,864,648**	**19%**	*

* Due to differences in timing of utility system peaks, demand impacts could not be aggregated across utilities.

[12] Forecasted sales have been based on baseline forecasts developed by Cadmus, as described in Section 1, and do not necessarily match official utility forecasts.

Table 12 provides each sector's technical and economic potentials. The residential sector represents the largest portion of technical and economic potential, at 42% and 40%, respectively. The commercial sector represents the second-largest contributor to technical and economic potential, at 32% of each, while industrial potential accounts for 26% and 28% of technical and economic potential, respectively.

Table 12. Technical and Economic Electric Energy-Efficiency Potential (Cumulative in 2023) by Sector

Sector	Base Case Sales (MWh)	Technical Potential		Economic Potential	
		MWh	% of Base Sales	MWh	% of Base Sales
Residential	9,197,928	3,548,837	39%	2,772,993	30%
Commercial	7,857,412	2,702,650	34%	2,181,608	28%
Industrial	18,293,266	2,189,166	12%	1,910,047	10%
Total	**35,348,606**	**8,440,653**	**24%**	**6,864,648**	**19%**

Table 13 shows the electric measures with the highest expected 10-year technical potential, and whether each is cost-effective in all, some, or no applications.

Table 13. Top Electric Technical Measures and Cost-Effectiveness Results[13]

Sector	Measure Name	Cost-Effective Applications
Residential	LED	All
Commercial	Fluorescent Reduced Wattage	Some
Industrial	Integrated Plant Energy Management	All
Residential	TV - ENERGY STAR	Some
Residential	ECM Motor - Air Conditioner/Electric/Gas Furnace	All
Industrial	High Bay Fluorescent High Output Packages	All
Commercial	Daylighting Controls	Some
Commercial	LED Lamp Package	All
Commercial	Induction Lighting Package	Some
Commercial	Retro-Commissioning	Some

Cost-effectiveness varies by utility due to differences in avoided costs, but can also differ by segment or construction vintage due to differences in savings and/or incremental costs. As shown, residential and commercial lighting measures represent six of the top 10 electric technical measures, with additional large savings opportunities for industrial plan energy management, ENERGY STAR televisions, efficient motors, and retro-commissioning. All of these measures were deemed cost-effective in at least some applications, with half economic in all instances.

[13] Measure-by-measure economic potential is provided in Appendix A.3.

Table 14 compares identified 10-year technical and economic electric potentials to results from the 2008 Assessment.

Table 14. Comparison of 10-Year Electric Technical and Economic Potentials

Sector	Technical Potential (GWh)		Economic Potential (GWh)	
	2008 Assessment	2012 Assessment	2008 Assessment	2012 Assessment
Residential	4,937	3,549	3,215	2,775
Commercial	2,695	2,703	1,563	2,182
Industrial	2,136	2,195	1,999	1,916
Total	**9,767**	**8,446**	**6,777**	**6,872**

Residential potentials, both technical and economic, have declined, primarily driven by utility program activity as well as changes in minimum building codes and equipment standards. While the commercial sector has seen increased efficiency requirements, technical potentials have risen marginally compared to the 2008 Assessment due to availability of new advanced technologies, such as LED lighting. Economic potentials saw greater increases, driven by increased electric avoided costs and declining measure costs for certain measures. Industrial technical potential also increased in the 2012 assessment, while economic potential showed a marginal decrease.

Summary of Results: Natural Gas

Table 15 and Table 16 present 2023 forecasted baseline sales and potential by sector and utility, respectively.[14] As shown, study results indicate over 37 million therms of technically feasible natural gas energy-efficiency potential by 2023, the end of the 10-year planning horizon. The identified economic potential of 25.5 million therms amounts to 24% of forecasted load in 2023 and over 2 million peak day therms.

As with electric potential, technical and economic potential result as a function of baseline sales, and are roughly comparable across utilities when analyzed in percentage terms. Again, differences are driven by utility customer characteristics and avoided costs.

Table 15. Technical and Economic Gas Energy-Efficiency Potential (Cumulative in 2023) by Utility

Utility	Base Case Sales (Thousand therms)	Technical Potential			Economic Potential		
		Thousand Therms	% of Base Sales	Peak Day Thousand Therms	Thousand Therms	% of Base Sales	Peak Day Thousand Therms
Alliant	267,040	90,767	34%	732	61,574	23%	515
Black Hills	169,983	60,754	36%	486	42,507	25%	348
MidAmerican	632,769	220,371	35%	1,785	150,670	24%	1,262
Total	**1,069,791**	**371,892**	**35%**	**3,003**	**254,751**	**24%**	**2,125**

14 As specified in the Chapter 35 rules, gas transport customers are excluded from the analysis.

Table 16 provides each sector's technical and economic potentials. As with electric potential, the residential sector represents the largest portion of technical and economic potential, at about 74% and 69%, respectively. Almost all remaining potential lies in the commercial sector, with a small portion (5.3 million therms) from industrial applications.

Table 16. Technical and Economic Natural Gas Energy-Efficiency Potential (Cumulative in 2023) by Sector

Sector	Base Case Sales (Thousand therms)	Technical Potential		Economic Potential	
		Thousand Therms	% of Base Sales	Thousand Therms	% of Base Sales
Residential	671,594	274,172	41%	175,823	26%
Commercial	335,581	92,129	27%	73,649	22%
Industrial	62,616	5,591	9%	5,280	8%
Total	**1,069,791**	**371,892**	**35%**	**254,752**	**24%**

Table 17 shows the natural gas measures with the highest estimated 10-year technical potential, and whether each is cost-effective in all, some, or no applications.

Table 17. Top Natural Gas Technical Measures and Cost-Effectiveness Results

Sector	Measure Name	Cost-Effective Applications
Residential	Duct Sealing	Some
Residential	Window Upgrades	None
Commercial	Retro-Commissioning	Some
Residential	Infiltration Reduction	All
Residential	Insulation - Basement Wall	All
Residential	Insulation - Attic/Ceiling	Some
Residential	Insulation – Floor	None
Residential	Home Energy Management System	Some
Residential	Water Heater - Tankless	None
Commercial	Green Roof	None

Cost-effectiveness varies by utility due to differences in avoided costs, but can also differ by segment or construction vintage due to differences in savings and/or incremental costs. As shown, most of the top measures are improvements to residential building shell, with commercial retro-commissioning also representing a large amount of technical potential. Only two of the top 10 measures are cost-effective in all applications, whereas four do not pass the economic screen in any instance.

Table 18 compares identified 10-year technical and economic natural gas potentials to results of the 2008 Assessment.

Table 18. Comparison of 10-Year Natural Gas Technical and Economic Potentials

Sector	Technical Potential (Thousand Therms)		Economic Potential (Thousands Therms)	
	2008 Assessment	2012 Assessment	2008 Assessment	2012 Assessment
Residential	265,320	274,172	186,540	175,823
Commercial	132,240	92,129	90,130	73,649
Industrial	8,970	5,591	8,970	5,280
Total	**406,530**	**371,892**	**285,640**	**254,752**

Economic potentials for all sectors have decreased in this assessment, largely due to significantly lower avoided energy costs.

Detailed Results

Residential Sector: Electricity

Residential customers in Iowa account for about one-quarter of forecasted electricity retail sales. The single-family, manufactured, multifamily, and low-income dwellings comprising this sector present a variety of potential savings sources, including: equipment efficiency upgrades (e.g., air conditioning, refrigerators); improvements to building shells (e.g., insulation, windows, air sealing); and increases in lighting efficiency (e.g., CFLs, LED interior lighting).

As shown in Table 19, based on resources included in this assessment, residential sector electric economic potential is estimated at 2,775 GWh over 10 years, corresponding to a 30% reduction (33% for Alliant and 28% for MidAmerican) in 2023 residential consumption,/

Table 19. Residential Sector Electric Energy-Efficiency Potential by Utility (Cumulative in 2023)

Utility	Base Case Sales (MWh)	Technical Potential			Economic Potential		
		MWh	% of Base Sales	MW	MWh	% of Base Sales	MW
Alliant	3,852,109	1,485,069	39%	443	1,275,181	33%	399
MidAmerican	5,345,819	2,063,768	39%	615	1,497,812	28%	497
Total	**9,197,928**	**3,548,837**	**39%**	*	**2,772,993**	**30%**	*

* Due to differences in timing of utility system peaks, demand impacts cannot be aggregated across utilities.

As shown in Figure 2, single-family homes represent 71% of total economic residential potential, followed by low-income, multifamily, and manufactured homes. Each home type's proportion of baseline sales serve as the primary drivers, but other factors, such as heating fuel sources, play important roles in determining potential. For example, manufactured homes typically have higher electric heating saturations than other home types, increasing their relative shares of the potential. Conversely, lower-use per customer for multifamily units decreases this potential, as some measures may not be cost-effective at lower consumption levels.

Figure 2. Residential Sector Electric Economic Potential by Segment (Cumulative in 2023)

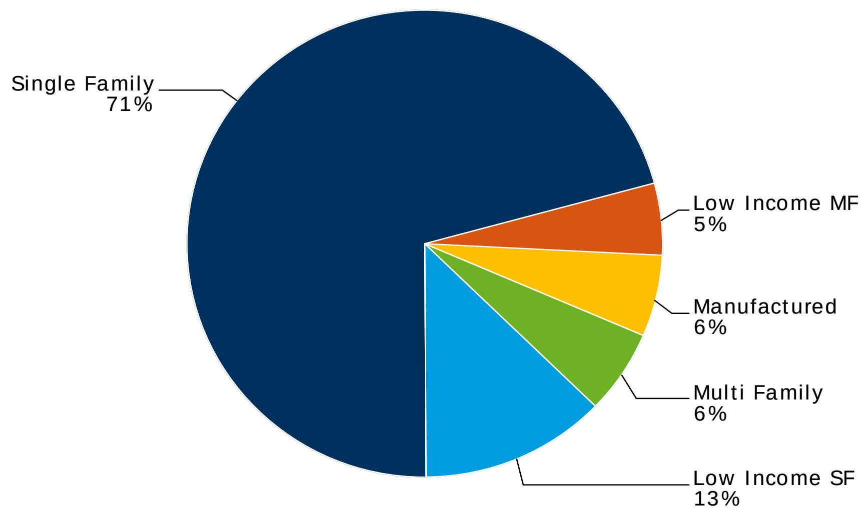
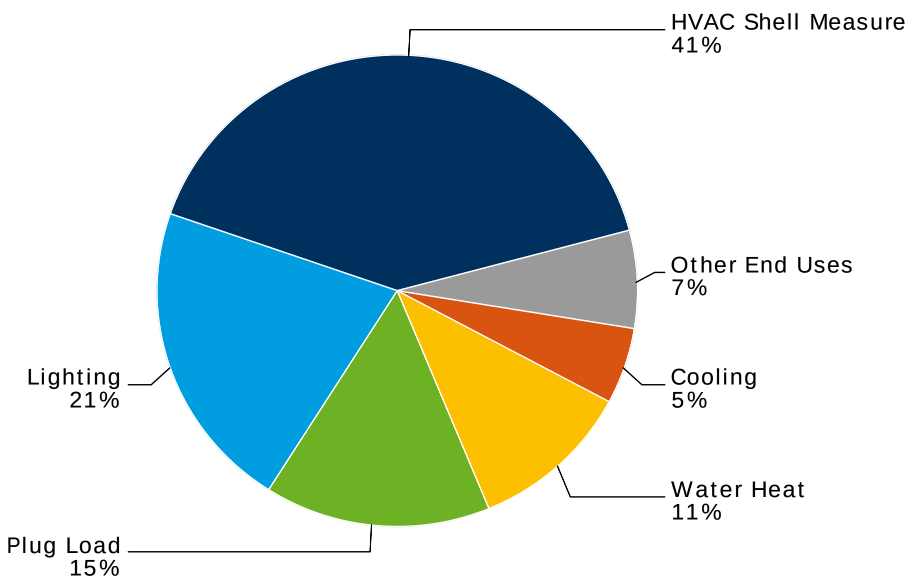


Figure 3 presents the distribution of electric economic potential by measure type.

Figure 3. Residential Sector Electric Economic Potential by Measure Type



Note: 'Other End Uses' includes:
Refrigerator: 3%, Freezer: 2%, Dryer: <1%, Pool Pump: <1%, Heat Pump: <1%

The largest portion of economic potential in the residential sector (41%) results from heating and cooling savings achieved through shell measures. Cooling measures account for nearly 50% of HVAC shell measure savings while ventilation and heating measures account for approximately 25% and 20%, respectively. A small amount of shell measure savings comes from homes with heat pumps. ECM motors, duct sealing, infiltration reduction, radiant barriers, and whole-house fans, account for over 60% of the identified shell measure savings. Lighting measures, primarily LED and CFL bulbs, account for the next largest slice (21%), followed by various plug load end uses and water heating. Table 20 provides technical and economic potentials by end-use category.

Table 20. Residential Sector Electric Energy-Efficiency Potential by End-Use Category (Cumulative in 2023)

End Use	Base Case Sales (GWh)	Technical Potential		Economic Potential	
		GWh	% of Base Sales	GWh	% of Base Sales
Computer	210	64	30%	64	30%
Cooking	296	33	11%	0	0%
Cooling	1,456	817	56%	699	48%
Dehumidifier	283	26	9%	26	9%
Dryer	596	59	10%	22	4%
Heat Pump	168	94	56%	85	50%
Heating	787	380	48%	221	28%
Lighting	817	588	72%	588	72%
Other Plug Load	1,164	191	16%	104	9%
Pool Pump	20	10	51%	10	51%
Refrigerators and Freezers	981	221	22%	148	15%
Set Top Box	206	113	55%	113	55%
Television	699	278	40%	116	17%
Ventilation and Circulation	682	273	40%	273	40%
Water Heat	834	403	48%	305	37%
Total	**9,199**	**3,550**	**39%**	**2,774**	**30%**

Residential Sector: Natural Gas

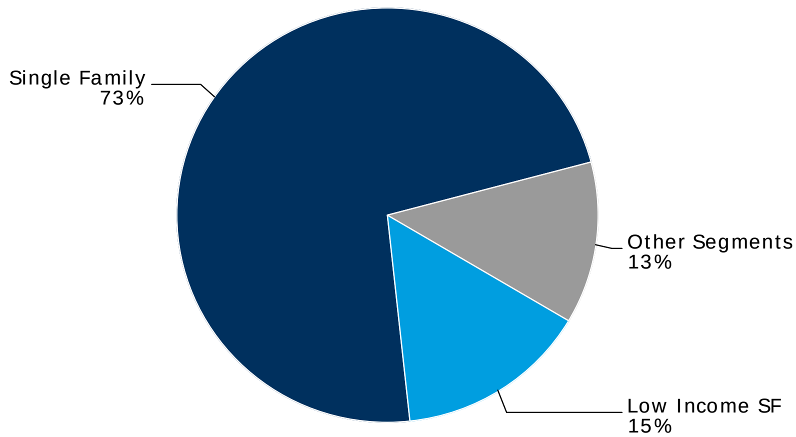
As shown in Table 21, based on resources included in this assessment, natural gas economic potential in the residential sector is estimated at about 176 million therms over the 10-year planning horizon, corresponding to a 26% reduction (27% for Alliant, 27% for Black Hills, and 26% for MidAmerican) in 2023 residential consumption.

Table 21. Residential Sector Natural Gas Energy-Efficiency Potential by Utility (Cumulative in 2023)

Utility	Base Case Sales (Thousands of therms)	Technical Potential			Economic Potential		
		Thousand Therms	% of Base Sales	Peak Day Thousand Therms	Thousand Therms	% of Base Sales	Peak Day Thousand Therms
Alliant	142,565	62,444	44%	531	37,922	27%	345
Black Hills	105,983	44,238	42%	376	28,891	27%	258
MidAmerican	423,046	167,490	40%	1,422	109,010	26%	974
Total	**671,594**	**274,172**	**41%**	**2,329**	**175,823**	**26%**	**1,578**

As shown in Figure 4, single-family homes represent 73% of total economic residential potential, followed by low-income, multifamily, and manufactured homes, with results extremely similar to electric potential, with manufactured homes representing a smaller percentage due to lower saturations of gas heating equipment.

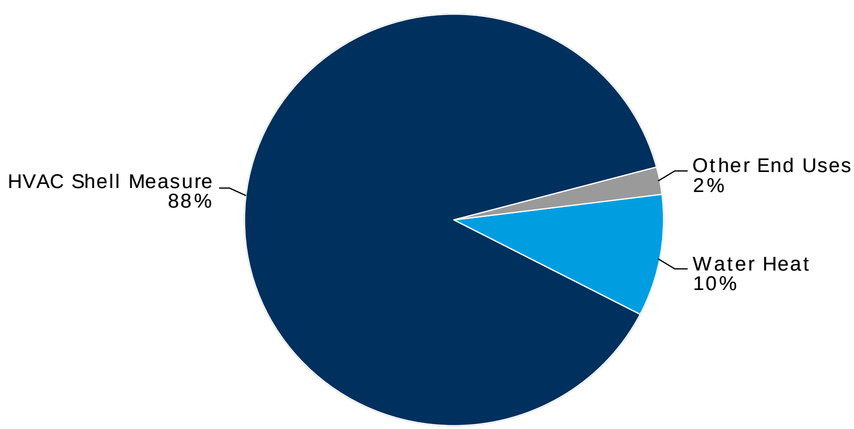
Figure 4. Residential Sector Gas Economic Potential by Segment



Note: 'Other Segments' includes:
Manufactured: 5%, Multi Family: 4%, Low Income MF: 4%

Figure 5 presents distributions of natural gas economic potential by measure type. The largest portion of economic potential in the residential sector (88%) comes from shell measures, followed by water heating (10%). Duct sealing, infiltration reduction, basement and attic insulation, and home energy management systems account for nearly 75% of shell measure savings.

Figure 5. Residential Sector Natural Gas Economic Potential by Measure Type (Cumulative in 2023)



Note: 'Other End Uses' includes:
Heat Central Furna: 2%, Pool Heat: <1%

Table 22 provides technical and economic potential by end-use category.

Table 22. Residential Sector Natural Gas Energy-Efficiency Potential by End-Use Category (Cumulative in 2023)

End Use	Base Case Sales (Thousand Therms)	Technical Potential		Economic Potential	
		Thousand Therms	% of Base Sales	Thousand Therms	% of Base Sales
Cooking	15,526	1,579	10%	0	0%
Dryer	6,591	654	10%	0	0%
Heat Central—Boiler	24,758	9,889	40%	6,028	24%
Heat Central—Furnace	452,542	218,107	48%	152,577	34%
Other	64,002	0	0%	0	0%
Pool Heat	1,513	377	25%	340	23%
Water Heat	106,662	43,565	41%	16,877	16%
Total	**671,594**	**274,171**	**41%**	**175,822**	**26%**

Commercial Sector: Electricity

As shown in Table 23, based on resources included in this assessment, electric economic potential in the commercial sector is estimated at just over 2,180 GWh over the 10-year planning horizon, corresponding to a 28% reduction (29% for Alliant and 27% for MidAmerican) of forecasted 2023 commercial consumption.

Table 23. Commercial Sector Electric Energy-Efficiency Potential by Utility (Cumulative in 2023)

Utility	Base Case Sales (MWh)	Technical Potential			Economic Potential		
		MWh	% of Base Sales	MW	MWh	% of Base Sales	MW
Alliant	3,969,210	1,377,058	35%	358	1,148,549	29%	292
MidAmerican	3,888,201	1,325,592	34%	343	1,033,059	27%	257
Total	**7,857,411**	**2,702,650**	**34%**	*	**2,181,608**	**28%**	*

* Due to differences in timing of utility system peaks, demand impacts cannot be aggregated across utilities.

As shown in Figure 6, miscellaneous buildings and warehouses represent the largest shares (23% and 21%, respectively) of economic potential in the commercial sector. The miscellaneous segment combines customers not fitting into one of the other categories and those that would, but do not having sufficient information to be classified. The commercial sector also provides considerable savings opportunities in offices (14%), retail (11%), and grocery (7%) segments. Moderate savings amounts are expected to be available in education, health, restaurants, and lodging facilities.

Figure 6. Commercial Sector Electric Economic Potential by Segment (Cumulative in 2023)

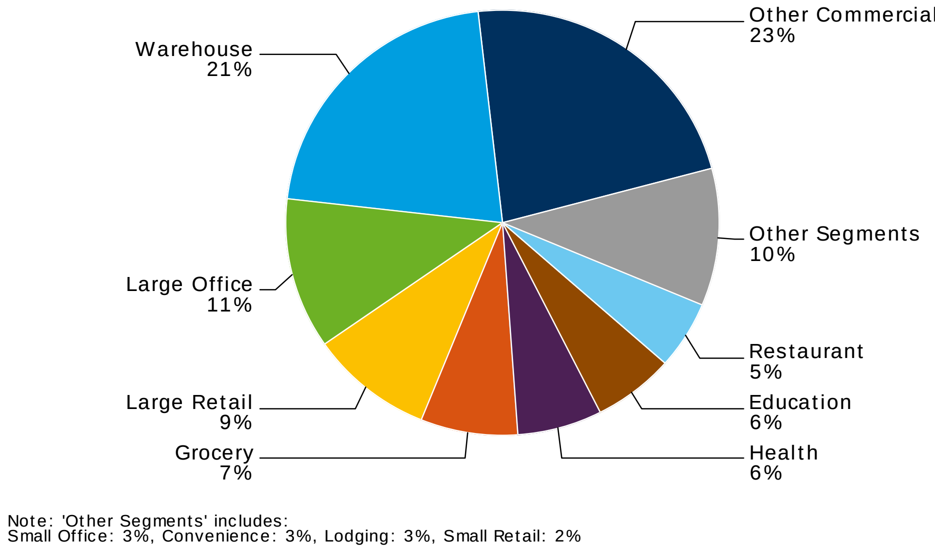


Figure 7 presents distributions of electric economic potential by measure types. The largest portion of economic potential in the commercial sector (62%) comes from lighting, followed by HVAC shell measures (22%). Cooling and ventilation each account for about one-third of shell measure savings, with heat pumps and electric heating accounting for 24% and 6%, respectively. Retro-commissioning, variable frequency drives, ECM motors, variable refrigerant flow systems for heat pumps, and programmable thermostats account for nearly 73% of the shell measure savings.

Figure 7. Commercial Sector Electric Economic Potential by Measure Type (Cumulative in 2023)

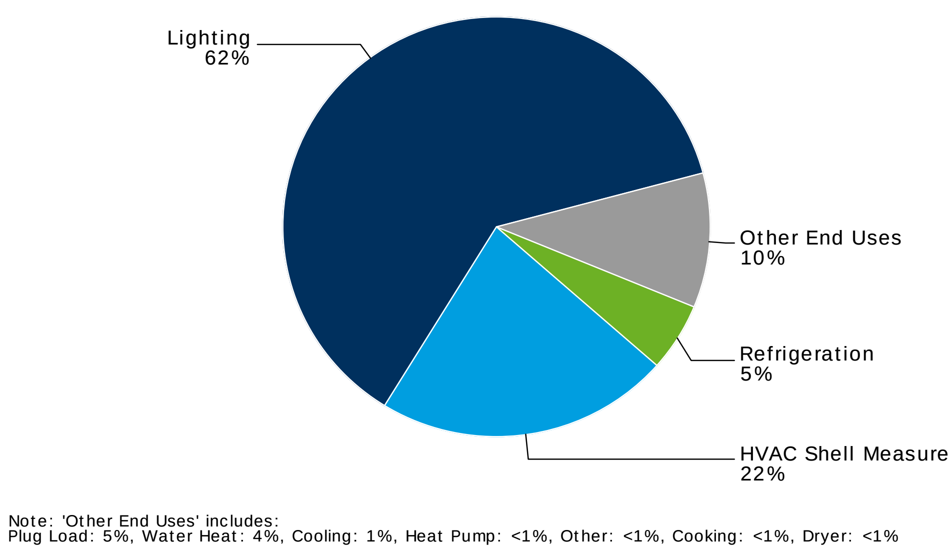


Table 24 provides technical and economic potential by end-use category.

Table 24. Commercial Sector Electric Energy-Efficiency Potential by End-Use Category (Cumulative in 2023)

End Use	Base Case Sales (GWh)	Technical Potential		Economic Potential	
		GWh	% of Base Sales	GWh	% of Base Sales
Cooking	73	4	5%	1	2%
Cooling	844	304	36%	205	24%
Dryer	226	0	0%	0	0%
Heat Pump	366	153	42%	124	34%
Heating	352	82	23%	30	9%
Lighting	3,540	1,605	45%	1,353	38%
Other	25	2	8%	1	5%
Plug Load	974	121	12%	104	11%
Refrigeration	584	150	26%	115	20%
Ventilation and Circulation	680	191	28%	162	24%
Water Heat	192	90	47%	87	45%
Total	**7,856**	**2,702**	**34%**	**2,182**	**28%**

Commercial Sector: Natural Gas

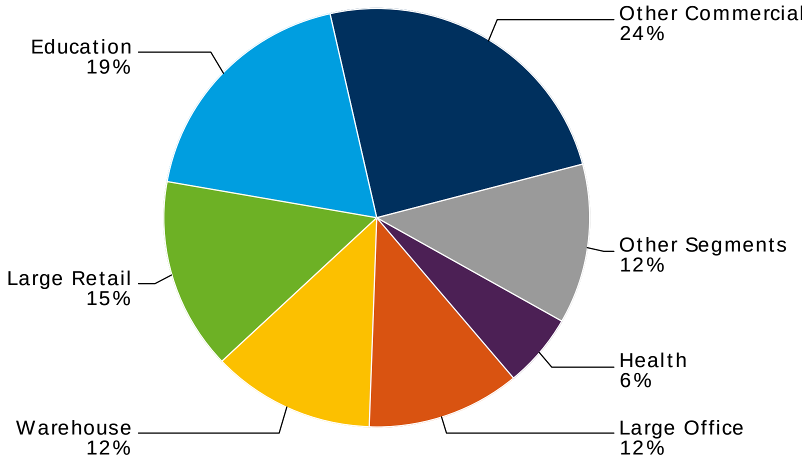
The commercial sector represents about one-third of both technical and economic gas energy-efficiency potential. The 73.6 million therms of economic potential over 10 years, corresponds to a 22% reduction (23% for Alliant and Black Hills and 21% for MidAmerican) of forecasted 2023 commercial consumption, as shown in Table 25.

Table 25. Commercial Sector Natural Gas Energy-Efficiency Potential by Utility (Cumulative in 2023)

Utility	Base Case Sales (Thousand Therms)	Technical Potential			Economic Potential		
		Thousand Therms	% of Base Sales	Peak Day Thousand Therms	Thousand Therms	% of Base Sales	Peak Day Thousand Therms
Alliant	90,558	25,191	28%	193	20,683	23%	162
Black Hills	57,302	15,941	28%	109	13,076	23%	89
MidAmerican	187,721	50,997	27%	358	39,890	21%	283
Total	**335,581**	**92,129**	**27%**	**660**	**73,649**	**22%**	**534**

As shown in Figure 8, miscellaneous buildings and education facilities represent the largest shares of economic potential in the commercial sector (24% and 19%, respectively). As with the commercial electric sector, the miscellaneous segment is composed of a combination of customers not fitting into one of the other categories and those that would fit, but have insufficient enough information to be classified. Considerable savings opportunities are expected in the commercial sector’s retail (15%), office (15%), and warehouse (12%) segments. Moderate savings amounts can be expected in health, restaurants, and lodging, and grocery facilities.

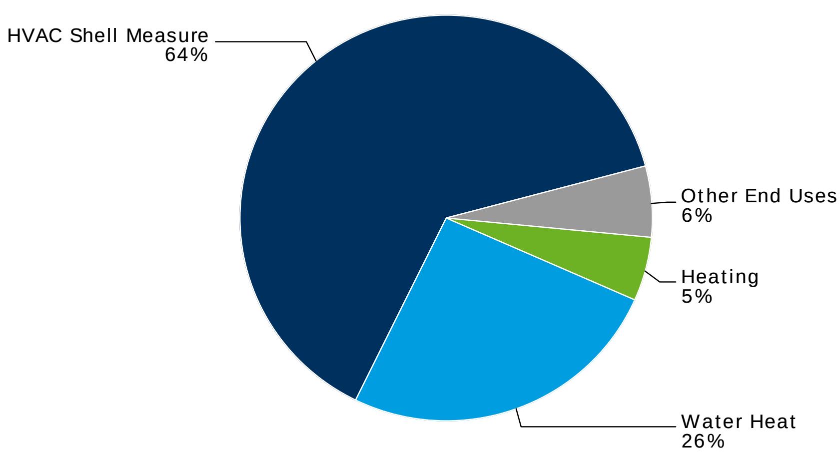
Figure 8. Commercial Sector Natural Gas Economic Potential by Segment



Note: 'Other Segments' includes:
Small Office: 3%, Restaurant: 3%, Small Retail: 2%, Grocery: 2%, Lodging: 2%, Convenience: <1%

Figure 9 presents distributions of natural gas economic potential by measure type. The largest portion of economic potential in the commercial sector (64%) comes from HVAC shell measures, followed by water heating (26%). More than 63% of the shell measure savings comes from furnace applications, with the remainder attributable to boiler measures. Retro-commissioning, demand controlled ventilation systems, variable air-volume systems, boiler reset controls, and infiltration control account for nearly 95% of shell measure savings.

Figure 9. Commercial Sector Natural Gas Economic Potential by Measure Type (Cumulative in 2023)



Note: 'Other End Uses' includes:
Boiler: 5%, Cooking: <1%, POOL HEAT: <1%

Table 26 provides technical and economic potential by end-use category.

Table 26. Commercial Sector Gas Energy-Efficiency Potential by End Use Category (Cumulative in 2023)

End Use	Baseline Sales (Thousand Therms)	Technical Potential		Economic Potential	
		Thousand Therms	% of Base Sales	Thousand Therms	% of Base Sales
Boiler	71,649	23,222	32%	20,644	29%
Cooking	14,149	556	4%	556	4%
Dryer	948	0	0%	0	0%
Heating	179,088	47,624	27%	33,527	19%
Pool Heat	240	34	14%	34	14%
Water Heat	69,507	20,692	30%	18,888	27%
Total	**335,581**	**92,128**	**27%**	**73,649**	**22%**

Industrial Sector: Electricity

Technical and economic energy-efficiency potentials were estimated for major end uses within 18 major industries, including agriculture and street lighting.[15] Across all industries, economic potential totals approximately 1,916 GWh over 10 years, corresponding to a 10% reduction (11% for Alliant and 10% for MidAmerican) of forecasted 2023 industrial consumption, as shown in Table 27.

Table 27. Industrial Sector Electric Energy-Efficiency Potential by Utility (Cumulative in 2023)

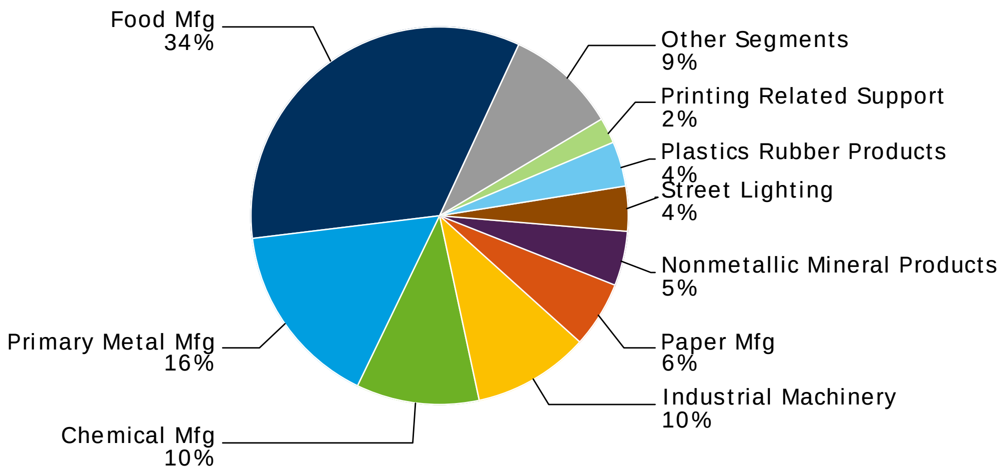
Utility	Base Case Sales (MWh)	Technical Potential			Economic Potential		
		MWh	% of Base Sales	MW	MWh	% of Base Sales	MW
Alliant	7,644,007	976,916	13%	125	871,076	11%	112
MidAmerican	10,649,258	1,212,250	11%	152	1,038,971	10%	131
Total	**18,293,265**	**2,189,166**	**12%**	*	**1,910,047**	**10%**	*

* Due to differences in timing of utility system peaks, demand impacts cannot be aggregated across utilities.

As shown in Figure 10, food processing and primary metal manufacturing facilities represent approximately one-half of the economic potential in the industrial sector (34% and 16%, respectively). Considerable savings opportunities are also expected in the industrial sector's chemical manufacturing segment (10%).

15 Industries analyzed varied by utility, based on customer and sales distributions

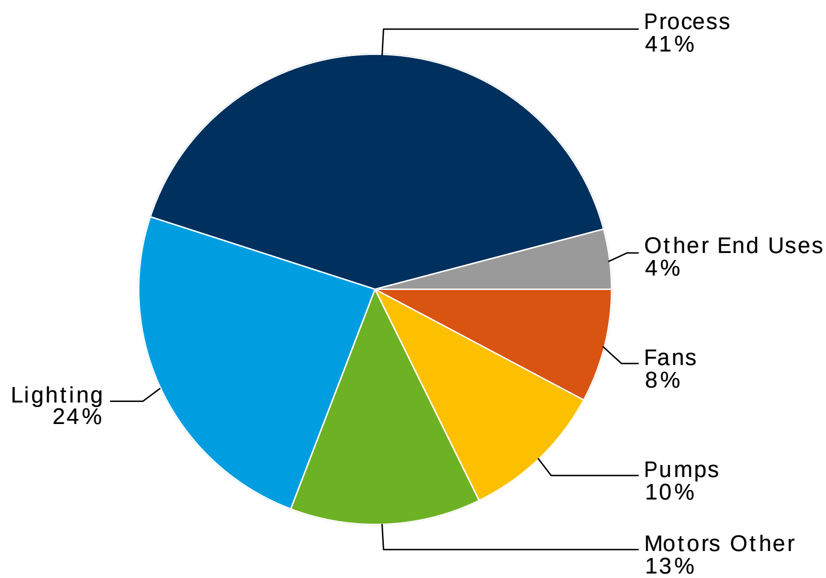
Figure 10. Industrial Sector Electric Economic Potential by Segment (Cumulative in 2023)



Note: 'Other Segments' includes:
Transportation Equipment Mfg: 2%, Fabricated Metal Products: 1%, Instruments: 1%, Wood Product Mfg: 1%
Miscellaneous Mfg: 1%, Electrical Equipment Mfg: <1%, Agriculture: <1%, Mining: <1%
Furniture Mfg: <1%

The majority of electric economic potential in the industrial sector (41%) can be attributed to gains in process efficiency (such as heating, cooling, and compressed air), followed by lighting improvements (24%) and motor system improvements (mainly fans and pumps). As shown in Table 28 and Figure 11, a small amount of additional potential exists for other facility improvements.

Figure 11. Industrial Sector Electric Economic Potential by Measure Type



Note: 'Other End Uses' includes:
HVAC: 4%, Other: <1%

Table 28. Industrial Sector Electric Energy-Efficiency Potential by End-Use Category (Cumulative in 2023)

End Use	Baseline Sales (GWh)	Technical Potential		Economic Potential	
		(GWh	% of Base Sales	GWh	% of Base Sales
Fans	1,056	162	15%	148	14%
HVAC	1,655	170	10%	77	5%
Indirect Boiler	219	0	0%	0	0%
Lighting	1,379	577	42%	463	34%
Motors Other	3,485	288	8%	251	7%
Other	585	2	0%	2	0%
Process—Air Compressor	1,099	248	23%	248	23%
Process—Electro Chemical	1,860	0	0%	0	0%
Process—Heat	2,676	70	3%	68	3%
Process—Other	234	3	1%	3	1%
Process—Refrigeration and Cooling	2,426	463	19%	461	19%
Pumps	1,622	206	13%	190	12%
Total	**18,296**	**2,189**	**12%**	**1,911**	**10%**

Industrial Sector: Natural Gas

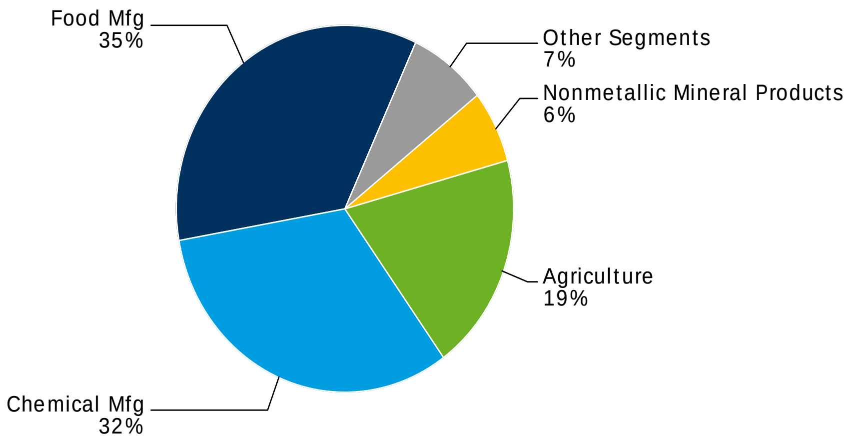
Most industrial processes and end uses rely on electricity; therefore, the industrial sector represents an extremely small portion of natural gas baseline sales and potential. As shown in Table 29, across all industries, economic potential totals approximately 5.3 million therms over 10 years, corresponding to an 8% reduction (9% for Alliant, 8% for Aquila, and 8% for MidAmerican) in forecasted 2023 industrial consumption.

Table 29. Industrial Sector Natural Gas Energy-Efficiency Potential by Utility (Cumulative in 2023)

Utility	Base Case Sales (Thousand Therms)	Technical Potential			Economic Potential		
		Thousand Therms	% of Base Sales	Peak Day Thousand Therms	Thousand Therms	% of Base Sales	Peak Day Thousand Therms
Alliant	33,917	3,132	9%	8	2,969	9%	8
Black Hills	6,697	575	9%	1	540	8%	1
MidAmerican	22,002	1,884	9%	5	1,770	8%	5
Total	**62,616**	**5,591**	**9%**	**14**	**5,279**	**8%**	**14**

Due to the composition of industries using natural gas in Iowa, over 67% of the economic potential lies in the food processing (35%) and chemical manufacturing (32%) segments. As shown in Figure 12, substantial savings opportunities also exist in agriculture (19%) and nonmetallic mineral products (6%).

Figure 12. Industrial Sector Gas Economic Potential by Segment



Note: 'Other Segments' includes:
Industrial Machinery: 2%, Primary Metal Mfg: 2%, Paper Mfg: 1%, Printing Related Support: <1%
Fabricated Metal Products: <1%, Transportation Equipment Mfg: <1%, Plastics Rubber Products: <1%, Wood Product Mfg: <1%
Miscellaneous Mfg: <1%, Electrical Equipment Mfg: <1%, Furniture Mfg: <1%, Instruments: <1%

Almost all baseline consumption occurs in boilers and process heating (87%); thus, these end uses account for 97% of the economic potential. As shown in and Figure 13, the remaining potentials result in HVAC improvements and other (non-heating) process improvements.

Figure 13. Industrial Sector Gas Economic Potential by Measure Type (Cumulative in 2023)

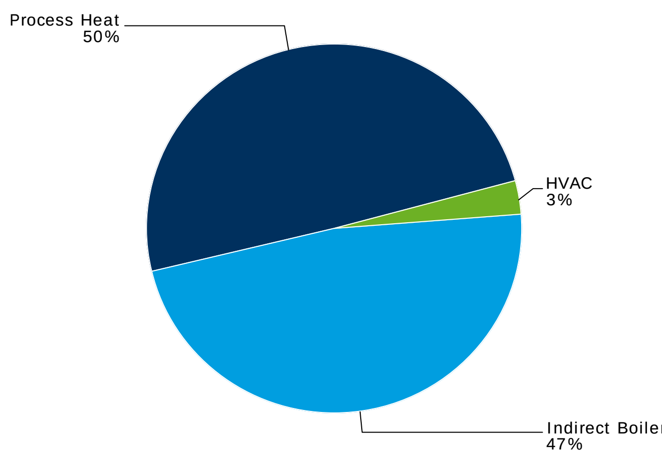


Table 30. Industrial Sector Natural Gas Energy-Efficiency Potential by End-Use Category (Cumulative in 2023)

End Use	Baseline Sales (Thousand Therms)	Technical Potential		Economic Potential	
		Thousand Therms	% of Base Case	Thousand Therms	% of Base Case
HVAC	3,694	210	6%	157	4%
Indirect Boiler	32,829	2,506	8%	2,506	8%
Other	1,919	0	0%	0	0%
Process—Heat	21,063	2,874	14%	2,616	12%
Process—Other	3,110	0	0%	0	0%
Total	**62,615**	**5,590**	**9%**	**5,279**	**8%**

3. ENERGY EFFICIENCY: MARKET POTENTIAL

Market potential, as defined in this study, represents savings that might be achievable under an aggressive acquisition scenario, assuming: incentive payments up to 100% of incremental measure costs; financing availability; exemplary program design and implementation practices; and emergence of new technologies, currently not widely available in the marketplace. This section presents research results in each of these areas, and examines its implications regarding realistic market potential levels in Iowa.

The results of the market potential analysis are intended to provide context to the estimates of economic potential and do not necessarily represent utility targets or "program potential." These savings may be realized through market transformation or improved codes and standards and may not be available or appropriate for utility programs. For example, the electric potential includes a substantial amount of savings from LEDs and CFLs replacing minimum standard bulbs. However, if the new lighting standards cause CFLs to become the de facto standard, the amount of savings available for utility DSM program acquisition could be greatly reduced.

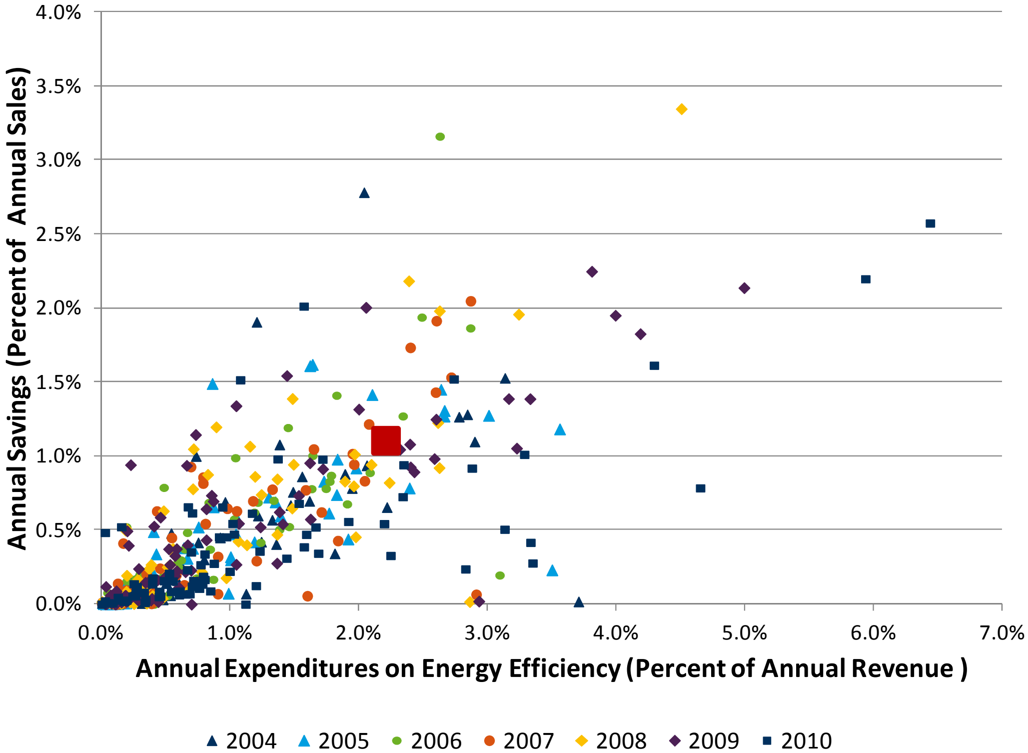
Effects of Increased Incentives

Due to key differences in measure characteristics and customer demographics, and the differing composition of programs and portfolios, one must separately assess incentives' effects on measure adoption for each fuel. While using similar methods, the two analyses adopted rely on fuel-specific potential and benchmarking data. The analyses' results follow.

Electricity

As described in Section 1, analysis quantifying the amount of electric market potential available, given incentives covering the entire incremental measure cost, has been based on portfolio-level data derived from EIA Form 861. Figure 14 shows relationships from 2004 to 2010 between savings (as a fraction of retail sales) and incentive payments (as a fraction of annual retail revenues) for the 75 utilities in the dataset. The figure suggests a generally linear relationship, with relationships that can be examined using regression analysis. The center of the larger red square indicates the average spending and savings for Iowa's electric IOUs in 2010.

Figure 14. Scatter Plot of DSM Savings and DSM Expenditures



The following regression equation estimated the statistical relationship between incentives and savings:

$$\log(\%\ \text{Savings}) = \beta_{0+}\ \beta_1 \log\left(\frac{\text{Incentive}}{\text{Revenue}}\right) + \beta_2 \log\left(\frac{\text{Other Costs}}{\text{Revenue}}\right) + \beta_3 \log(\text{Rate}) + \beta_4 \text{Log}(\text{Time})$$

This formulation states energy-efficiency savings is a function of: incentive payments (Incentive); non-incentive program expenditures (Other Costs), including program administration, marketing, and operating expenses; average per-unit cost of delivered energy (Rate); and time (Time). The rate term included in the equation accounts for the propensity to conserve energy and can be expected to run higher in jurisdictions with high rates. The time variable captures trends resulting from exogenous factors affecting program activity from 2004 to 2010. The equation parameters were estimated using a logarithmic specification with the panel data shown in Figure 14.

The analysis shows a relatively strong overall relationship between savings and the explanatory variables, indicated by a coefficient of determination (R^2) of 0.6, meaning 60% of the savings variation can be explained by the equation's explanatory variable (see Table 31). All estimated parameters have the correct sign, and are statistically significant at the 90% or higher level of statistical confidence, indicating a probability less than 10% that results might be due to chance. Coefficients for the incentive term and other expenditures are statistically significant at the 99% confidence level.

Table 31. Electric Model Terms and Coefficients

Model Term	Coefficient	Standard Error	P-Value
Intercept	0.94	0.54	0.08
Log (Incentive / Revenue)	0.44	0.05	< 0.01
Log (Other Costs / Revenue)	0.57	0.07	< 0.01
Log (Rate)	0.32	0.21	0.12
Log (Time)	-0.26	0.12	0.03

As the equation's terms are expressed in logarithmic form, estimated coefficients for each term in the equation represent the elasticity of savings with respect to that term. For example, as seen in Table 31, the estimated coefficient of incentives as a percent of revenue is 0.44, suggesting a 1% increase in incentives will likely lead to a 0.44% increase in savings. Using this parameter, one can estimate the maximum market potential achievable if incentives increase to 100% of incremental measure cost.

As the estimated coefficient on incentive amount measures the marginal impacts of higher incentives, a starting point for incentive amounts must be assumed. Available information on Iowa's electric utilities in 2010 indicates, on average, incentives covered approximately 40% of incremental measure costs across the energy-efficiency programs in their portfolios. A scenario assuming incentives at 100% of incremental costs thus requires a 150% increase ([100% - 40%] / 40%) increase in current incentive outlays.

Non-incentive expenditures, such as marketing, outreach, planning, and administration, have traditionally been assumed to be relatively fixed. This study's findings indicate this might not be the case. Indeed, the 0.57 estimated elasticity for non-incentive expenditures (shown in Table 31) suggests a positive and statistically significant correlation between non-expenditures and market penetration, and that these expenditures may even be more effective in expanding the market potential than incentives.

This finding is not surprising, given that first-cost is not necessarily the primary barrier in all sectors, and highlights that success in effectively promoting energy-efficiency programs depends on the total marketing effort, consisting not only of incentives, but of effective communication, education, and dissemination of information. Program administrators must examine and choose an appropriate mix of these investments, based on the unique characteristics of their service territories, customer needs, and characteristics of programs and products they offer.

In further analyzing EIA data, Cadmus found a statistically significant positive correlation between incentive payments and non-incentive expenditures of approximately 20%. That is, as incentives increase, so do non-incentive expenditures, and one cannot consider a scenario with drastically increased incentive payments without considering an accompanying rise in non-incentive costs.

Using 2010 reported portfolio savings and expenditures, revenues, and retail sales for the two electric utilities, Cadmus estimates that, if incentives for electric programs increase to 100% of incremental measure costs, up to 90% of estimated statewide economic electric potential will likely be achievable (see Table 32). As shown, however, budgets would need to increase by more than twofold at these incentive levels. As discussed, this increase in incentive spending would likely lead to additional spending on program administration, further increasing program budgets to over $113 million annually.

Table 32. Expected Electric Market Potential If Incentives Increase to 100% of Incremental Costs

Data Value	Statewide Value (2010)
Total Energy Efficiency Program Expenditures	$53,975,612
Total Energy Efficiency Program Expenditures % of Revenue	2.2%
Incentive % of Incremental Measure Cost	40%
Actual Savings % of Retail Sales	1.12%
Estimated Elasticity of Savings Relative to Incentives	0.44%
Actual Energy Efficiency Savings (MWh)	378,578
Change in % Savings at Incentives of 100% of Incremental Cost	66%
Projected Annual Energy Efficiency Savings (MWh)	628,440
Projected Annual Program Expenditures	$113,292,323
Estimated Annual Economic Potential (MWh)	687,221
Market Potential % of Economic Potential	**91%**

The analysis further shows the associated electric energy savings would likely produce statewide life-cycle benefits of approximately $450 million. The estimated costs and benefits do not account for potential future decreases in measure costs as energy-efficient technologies improve over time.

A market potential up to 90% of economic potential is extremely high, compared to results of other potential studies and market potential levels deemed achievable in other jurisdictions. Given economic potentials, relative to technical potentials, are also higher than in most jurisdictions, the identified market potential may not be realistically achievable.

A review of over 100 electric energy-efficiency potential studies completed since 2000, across 37 states, shows the estimates of economic potential exceeded 80% of technical potential (as seen in this study) in only 10 cases. These 10 studies estimate a maximum achievable potential of less than 60% of economic potential, a level significantly below that estimated in this study. Planning study results in several regions with long histories of aggressive energy-efficiency resource acquisition programs also supports the supposition that, relative to the identified potential in this study, market potential up to 90% might be exaggerated.

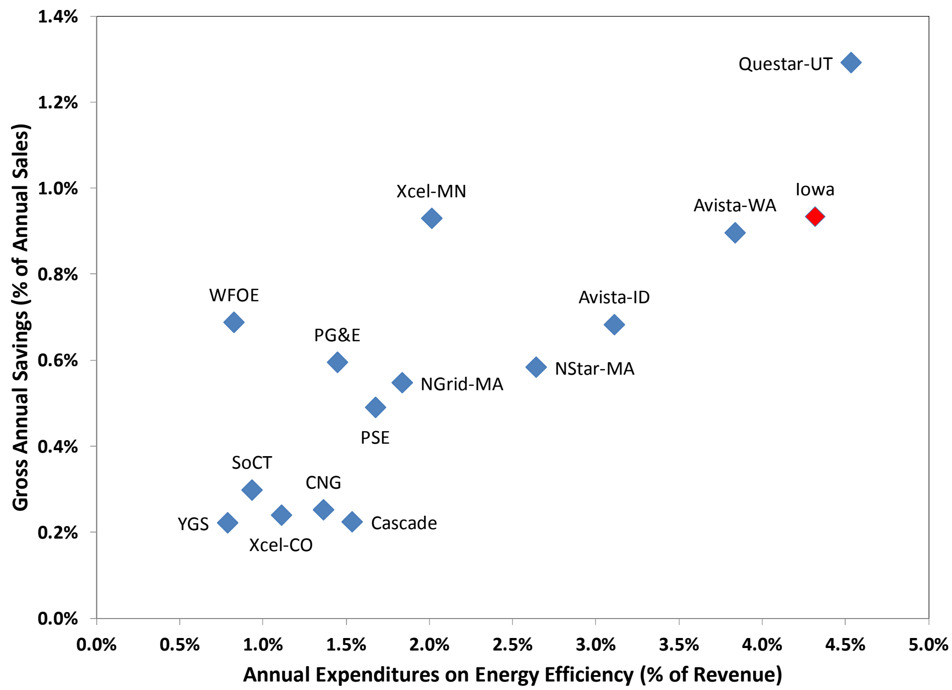
In the Pacific Northwest, for example, 85% of economic potential has been considered a maximum feasible level, which is consistent with findings of potential studies in California. In that state, a 2003 study of statewide electric energy-efficiency potentials estimated that, under the most aggressive scenario, assuming incentives of 100% of measures costs and total market awareness, 73% of the economic potential identified in the study would be achievable.[16]

[16] California Statewide Commercial-Sector Energy Efficiency Potential Study, Xenergy Inc, 2002.

Natural Gas

Due to the lack of centralized natural gas energy-efficiency portfolio data, Cadmus compiled information on 14 natural gas energy-efficiency portfolios, based on the criteria presented in Section 1. Cadmus used these data, presented in Figure 15, to perform a similar regression analysis (as described in the electric section, above).

Figure 15. Scatter Plot of Energy-Efficiency Savings and Expenditures



Cadmus specified a regression equation similar to that for electricity to estimate relationships between natural gas savings and incentives. As data were limited to 2010 results, the equation has no "Time" term:

$$\log(\%\ \text{Savings}) = \beta_{0+}\ \beta_1 \log\left(\frac{\text{Incentive}}{\text{Revenue}}\right) + \beta_2 \log\left(\frac{\text{Other Costs}}{\text{Revenue}}\right) + \beta_3 \log(\text{Rate})$$

As shown in Table 34, estimated coefficients for the incentive and other expenditure terms are positive, while the coefficient for the rate term has a negative sign, which appears counter-intuitive. This coefficient, however, also has a large margin of error and is statistically insignificant.

Table 33. Natural Gas Model Terms and Coefficients

Model Term	Coefficient	Standard Error	P-Value
Intercept	-0.89	1.15	0.453
Log (Incentive / Revenue)	0.49	0.16	0.009
Log (Other Costs / Revenue)	0.15	0.17	0.394
Log (Rate)	-0.62	0.54	0.272

Of the three estimated coefficients, only the incentive term (the critical term in the equation) is statistically significant at the 90% confidence level. The weaker overall performance of the estimated relationship for natural gas (as compared to electric) in the regression model is largely a result of the significantly smaller sample size.

As shown in Table 34, the estimated coefficient of incentives as a percent of revenue is 0.49, suggesting a 1% increase in incentive spending can be associated with a 0.49% increase in savings, a result generally consistent with the results found in the electric analysis. The coefficient for other spending is much smaller (and statistically less significant) than the electric result, suggesting, while savings also increase with other costs, first costs may be the primary barrier.

Table 34. Natural Gas Model Terms and Coefficients

Model Term	Coefficient	Standard Error	P-Value
Intercept	-0.89	1.15	0.453
Log (Incentive / Revenue)	0.49	0.16	0.009
Log (Other Costs / Revenue)	0.15	0.17	0.394
Log (Rate)	-0.62	0.54	0.272

Available information on Iowa's electric utilities in 2010 indicates incentives covered approximately 42% of incremental measure costs across all programs in the three utility's portfolios. A scenario assuming incentives at 100% of incremental costs thus requires an increase of 138% ([100% - 42%] / 42%) in current incentive outlays.

Using 2010 energy-efficiency program savings and expenditures, revenues and retail sales for the three natural gas utilities, Cadmus estimates that, if incentives for natural gas programs increase to 100% of incremental measure costs, the achievable fraction of economic potential might increase to approximately 65% of the estimated economic potential (see Table 35).

Table 35. Expected Achievable Natural Gas Market Potential If Incentives Increase to 100% of Incremental Costs

Data Value	Statewide Value (2010)
Total Energy Efficiency Program Expenditures	$37,851,535
Total Energy Efficiency Program Expenditures % of Revenue	4.1%
Incentive % of Incremental Measure Cost	42%
Actual Savings % of Retail Sales	0.92%
Estimated Elasticity of Savings Relative to Incentives	0.49%
Actual Energy Efficiency Savings (thousand therms)	9,682
Change in % Savings at Incentives of 100% of Incremental Cost	62%
Projected Annual Energy Efficiency Savings (thousand therms)	15,661
Projected Annual Program Expenditures	$74,951,818
Estimated Annual Economic Potential (thousand therms)	25,475
Market Potential % of Economic Potential	**65%**

As annual statewide savings relative to retail sales are currently lower for natural gas than electricity, the analysis projects a lower share of the economic potential as achievable, given it would be more difficult for natural gas programs to ramp up to maximal savings levels. As shown, however, budgets would need to increase twofold at these incentive levels. As discussed, this increase in incentive spending would likely lead to additional spending on program administration, further increasing program budgets to $75 million dollars annually. The analysis further shows the associated natural gas energy savings would likely produce statewide life-cycle benefits of over $100 million.

Effects of Financing Availability

Market potential depends on a number of factors, including retail energy rates, energy-efficiency measure costs, and the program's ability to overcome a host of market barriers recognized in the energy-efficiency literature to impede adoption of energy-efficiency measures and practices by consumers, including high first costs. These barriers tend to vary in severity, depending on customer sectors, local energy market conditions, and other, hard-to-quantify factors. Ultimately, market potential is a function of consumers' willingness and ability to participate in programs.

Financing options (in the form of loan programs) are mechanisms used to help mitigate effects from lack of capital—or high-cost financing—on consumers' ability to participate in energy-efficiency programs. Studies of financing and loan programs, including two recent reports by ACEEE, have found energy-efficiency loan programs have minimal effects on consumers' participation in energy-efficiency programs.

The findings of one ACEEE study[17] suggest participation rates tend to be generally low across programs. Compared to numbers of eligible customers in classes served by these programs, more than half the programs had participation rates below 0.5%. The highest participation rate was reported at 3%, experienced by only two surveyed programs. The report concludes these programs generally have not successfully achieved appreciable market penetration, and, importantly, sound program design does not appear to guarantee success.

A survey of on-bill financing programs found similar results. In a 2011 report, ACEEE examined 19 of 31 on-bill financing programs, structured as on-bill loans or on-bill tariffs in 20 states.[18] The study found less than 1%[19] of the eligible customers participated in these programs, despite several of these programs having been available for nearly 20 years.[20]

In light of extremely high economic potential levels assumed available under a 100% incentive scenario, and the performance of financing programs to date, it is unlikely availability of financing would increase market potential beyond that achievable assuming a 100% incentive.

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[17] Hays, Sara, et. al., *What Have We Learned From Energy Efficiency Financing Programs*, ACEEE, Report Number U115, September 2011.

[18] Bell, Catherine J., et. al., *On-Bill Financing for Energy Efficiency Improvements: A Review of Current Program Challenges, Opportunities, and Best Practices*, Report Number E118, December 2011.

[19] This number represents the average found by ACEEE for the programs reviewed. There have been cases where individual utilities have achieved higher penetration rates for on-bill financing programs, such as Cedar Falls Utility in Iowa.

[20] See also Byrd, D.J. and R.S. Cohen, A Roadmap to Energy Efficiency Loan Financing, Memorandum to U.S. Department of Energy, April 2011.

Effects of Emerging Technologies

In addition to commercially available technologies included in the assessment of technical and economic potentials, Cadmus considered the potential for emerging technologies in the context of market potential. Emerging energy-efficient technologies are those expected to become commercially available and cost-effective within the next five to 10 years.

The primary sources used to identify potential measures and corresponding savings data were reports published by ACEEE. Since the mid-1990s, ACEEE has published reports on *Emerging Energy-Saving Technologies and Practices in the Building Sector*.[21] In 2009 and 2011, reports focused on HVAC and hot water systems, respectively. ACEEE currently is investigating emerging lighting technologies, but, as results of this research are not available at this time, Cadmus referenced work conducted through DOE's CALiPER program.[22]

Generally, these technologies are higher-efficiency replacements for measures already included in the assessment. For example, Advanced Northern Heat Pumps (SEER 16/HSPF 9.6) are a more efficient variant of SEER 16/HSPF 9.0 heat pumps, already included. Active Chilled Beam Cooling with DOAS (dedicated outdoor air system) proves the exception: this measure represents an alternate building design, replacing standard duct systems with integrated features, combining lighting, water-cooled convective heat exchange surfaces, and ventilation. In short, it utilizes pumps to deliver cool water instead of fans to blow cold air.

The analysis assumes replacement measures for existing, cost-effective measures will, in turn, become cost-effective over the planning horizon. In these cases, Cadmus estimated additional potential savings for these measures relative to the comparable measure's economic potential. That is, using the example measure above, additional potential for the SEER 16/HSPF 9.6 heat pump is incremental to the SEER 16/HSPF 9.0 unit. However, if the measure supplanted by this emerging technology does not pass the economic screen, no additional economic potential is assumed for the emerging technology. That is, existing technology would first need to become economically feasible before being supplanted by an emerging technology. For example, as existing natural gas tankless water heaters do not pass the economic screen, it is assumed condensing tankless water heaters will not pass either.

Measures identified through this research, along with applicable sectors, fuels, and end uses, are listed in Table 36. Though ACEEE reports addressed more measures, only those in Table 36 achieved efficiency levels greater than economic measures already in the measure list.

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21 http://www.aceee.org/topics/emerging-technologies-and-practices
22 http://www1.eere.energy.gov/buildings/ssl/caliper.html

Table 36. Emerging Technologies

Sector	Fuel	End Use	Technology	Additional Market Potential (MWh or thousand therms)
Residential	Electric	Water Heating	Add-On Heat Pump Water Heater	27,426
Residential	Electric	HVAC	Optimized Residential Duct Work	763
Residential	Electric	Water Heating	Singe Family On-Demand Recirculation Pumps	1,615
Residential	Electric	HVAC	Multifamily Building Best Practices	43,599
Residential	Gas	Water Heating	Condensing Tankless Water Heater	0
Commercial	Electric	Lighting	LED Replacement of Linear Fluorescent	62,915
Commercial	Electric	HVAC	Active Chilled Beam Cooling with DOAS	2,338
Commercial	Electric	HVAC	Ventilation and Energy Recovery	34,214

The additional market potential from the emerging technologies is estimated at 73,403 MWh in the residential sector and 99,468 MWh in the commercial sector, assuming 90% of economic potential is achievable (given 100% incentives). If realized, these additional savings would increase the electric market potential, shown in Table 32, by about 3%. Cadmus did not identify additional natural gas potential from emerging technologies. Appendix A.5 describes each measure included in the analysis.

4. DEMAND RESPONSE POTENTIAL

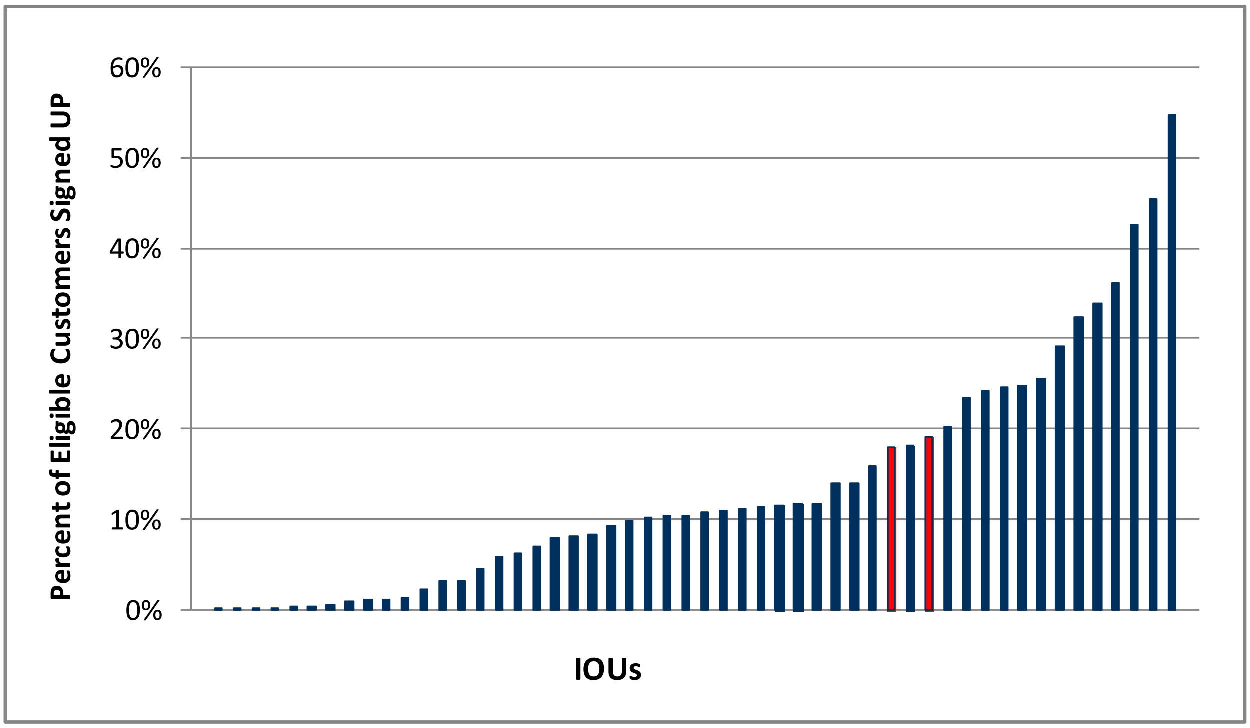
Potential for Expanding Legacy Programs

Residential DLC

As discussed in Section 1, the key metric for the residential DLC analysis was the fraction of eligible customers currently participating, with eligible customers defined as those with residential electric service and central air conditioners. Based on 2010 program activity, residential customer counts, and saturation data from the 2007 Residential Appliance Saturation Survey, Cadmus estimated similar currently participation rates for Iowa DLC programs: 19% and 18% for Alliant and MidAmerican, respectively.

Based on secondary data collected, Cadmus calculated participation rates for an additional 51 residential DLC programs for investor-owned utilities (IOUs) from across the nation. Figure 16 shows the calculated participation for each of these utilities in 2010, with Iowa utilities shown in red.

Figure 16. Participation Rates for 2010 IOU Residential DLC Programs



As program participation serves as the key driver of residential DLC impacts, Cadmus established three scenarios to quantify available potential for Iowa utilities, based on differing program participation levels. Participation levels in the moderate and aggressive expansion scenarios have been based on average participation in the upper-tier and industry-leading IOU programs, respectively.

Assumed participation rates are:

- Baseline: maintaining current program participation levels.
- Moderate expansion: achieving 20% program participation.
- Aggressive expansion: achieving 25% program participation.

To estimate peak demand impacts under each scenario, Cadmus multiplied participation rates by eligible customer forecasts for each utility, calculating the number of participating customers, then multiplying this number by per-participant values currently used by Iowa utilities, to calculate program-level demand impacts. Table 37 compares estimated 10-year potential under each scenario to the 2008 Assessment and each utility's 2010 accomplishments. As shown in Table 37identified potential is lower than in the 2008 Assessment, based on updated data on actual program achievements.

Table 37. Forecasted Residential DLC Impacts in 2023 (MW)

		10-Year Potential			
		2008 Study	2012 Study		
Utility	2010 Program Achievements	Base Case	Base Case	Moderate Expansion	Aggressive Expansion
Alliant	33	53	35	37	46
MidAmerican	31	72	32	35	43

Secondary research into snapback effects indicated residential DLC programs typically see energy savings reductions of 40% to 70% due to snapback.[23] Actual energy saved by these programs is a function not only of demand under contract, but also of the duration and frequency of events. However, based on the secondary literature, Cadmus expect per-hour MWh potential to be roughly half of the MW values presented in Table 37.

Nonresidential Interruptible

Participation in interruptible programs will vary greatly across utilities due to the following:

- The value of capacity savings;
- Eligibility requirements;
- Utility incentives;
- Prevalence of standby generation; and
- Who implements the program (utility vs. third-party aggregator).

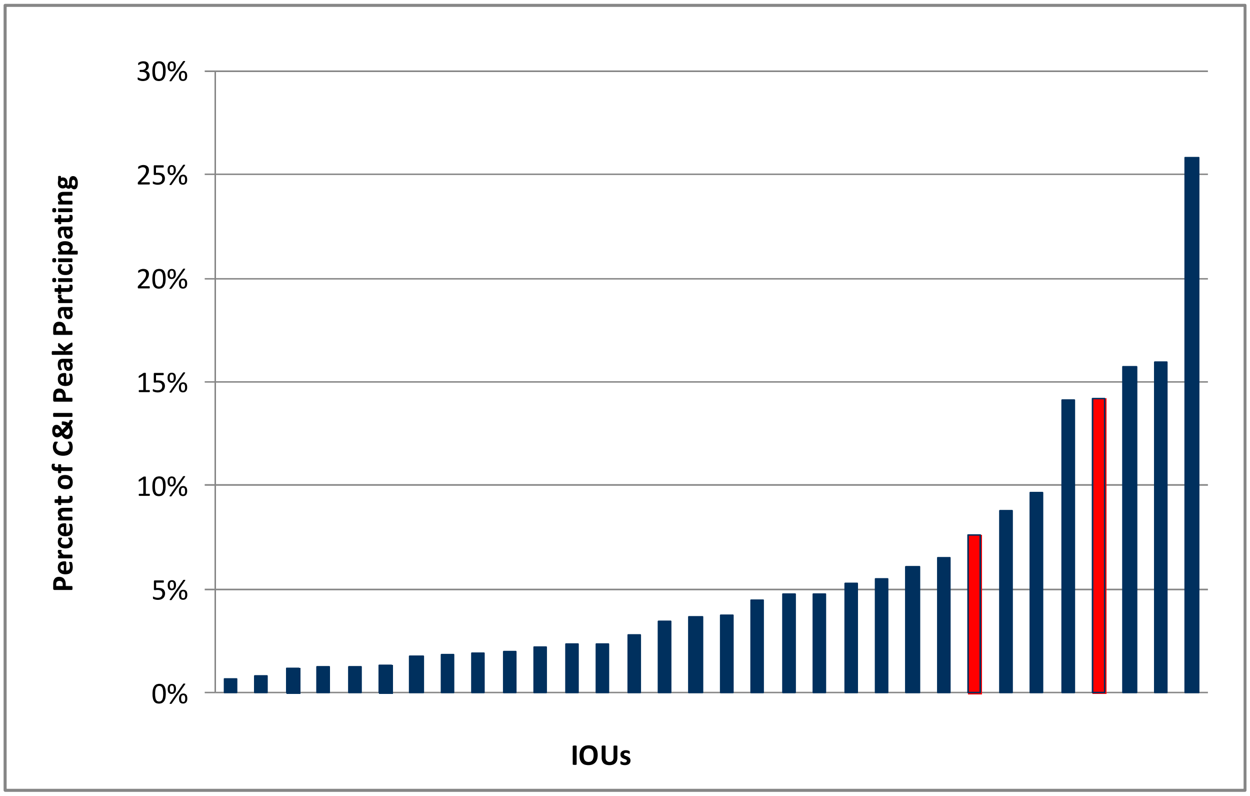
These caveats aside, Cadmus collected data on IOU programs similar to those offered in Iowa to assess opportunities for program growth.

Unlike the residential sector, due to large differences in demand between nonresidential customers, the percent of eligible *load* enrolled (rather than customers) serves as the key metric in assessing program participation. However, as data on eligible loads by utility are not readily

[23] Appendix B lists programs reviewed.

available for most utilities, Cadmus used total nonresidential demand during the system peak hour as a proxy. Using this metric and based on 2010 programs, Alliant and MidAmerican have currently enrolled 14% and 8% of eligible load, respectively. Figure 17 shows similar information collected for an additional 30 IOUs with similar programs, with Iowa utilities appearing as red bars.

Figure 17. Participation Rates for 2010 IOU Nonresidential Interruptible Programs



As program participation serves as the key driver of nonresidential interruptible impacts, Cadmus established three scenarios to quantify available potential for Iowa utilities, based on differing program participation levels. Participation levels in the moderate and aggressive expansion scenarios have been based on average participation in the upper-tier and industry-leading IOU programs, respectively, with the assumed participation rates:

- Baseline: maintaining current program participation levels.
- Moderate expansion: achieving 15% program participation.
- Aggressive expansion: achieving 17.5% program participation.

For each scenario, the percent increase in participation over 2010 activity has been used to calculate each utility's potential. As noted, utilities must consider their current and projected resource needs to determine whether these program participation levels are desirable and prudent.

Table 38 compares estimated 10-year potential under each scenario to the 2008 Assessment and each utility's 2010 accomplishments.

Table 38. Forecasted Nonresidential Interruptible Impacts in 2023 (MW)

		10-Year Potential			
		2008 Study	2012 Study		
Utility	2010 Program Achievements	Base Case	Base Case	Moderate Expansion	Aggressive Expansion
Alliant	264	291	296	304	354
MidAmerican	193	170	238	422	492

As in the residential sector, snapback effects, and thus energy savings attributable to demand response strategies, can vary greatly across utilities. Though literature on the likely snapback effects for nonresidential programs is limited, available data indicate that the effect may be around 50%.

Opportunities With AMI

Analysis of AMI-enabled demand programs was a qualitative exercise, given data quantifying impacts of AMI-enabled programs has been drawn almost exclusively from utility pilot programs, and may not be appropriate for extrapolation to larger markets. Consequently, potential energy and demand savings related to AMI cannot be reliably quantified at this time. Nevertheless, this study outlines a number of potential options that may provide viable savings sources if Iowa electric utilities implement AMI.

Overview of AMI-Enabled Demand Response

At the highest level, AMI's addition enables two-way communication for the mass-market of utility customers. Such two-way communication enables two primary opportunities. First, collection of near real-time interval meter data becomes possible as smart meters record interval meter reads, and send data back to the utility. Second, AMI enables communication from the utility to the customer, with the utility sending signals to the customer's meter, which can be used to specify changes in dynamic pricing or to control various appliances.

AMI technology does not present a new idea: many utilities have installed similar systems strategically for their larger C&I customers. Its strategic aspect arises regarding cost-effectiveness, as non-AMI systems have been inappropriate for installation in some situations, due to costs outweighing benefits. Such systems have often relied on dedicated Internet connections and advanced metering.

AMI enables a much lower per-meter cost for such advanced capabilities. By deploying system-wide communication networks, AMI systems reduce communication costs, and open doors to more cost-effective smart meter installations. Thus, as the C&I market has utilized various forms of advanced metering, the residential and small commercial market will likely realize much greater impacts from AMI.

Consequently, our research focused on residential, AMI-enabled opportunities. AMI can automate load reductions within a home or business through use of demand response enabling technology, which can be remotely signaled when utilities call demand response events, thus reducing an appliance's load through control strategies established by the utility or the customer. AMI-enabled demand response technologies include the following:

- **Smart thermostats:** Devices similar to programmable thermostats, but receiving and reacting to utility pricing and signals. Customers using smart thermostats typically program devices to react in specific ways when demand response events occur. For example, a customer may choose to raise the temperature set point by four degrees during an event to reduce load. Smart thermostats automate this process.
- **Smart appliances:** Smart appliances typically are very efficient versions of traditional appliances, equipped with AMI communication capabilities. They can receive event notifications or pricing signals, modifying operations to reduce demand during demand response events. For example, a smart refrigerator, when signaled with a relatively high electric price, may cycle its refrigerant compressor to reduce peak consumption. Other smart appliances include: water heaters, lighting, clothes washers and dryers, and dishwashers.
- **Load control devices:** AMI load control devices resemble traditional load control devices, except they communicate over AMI systems, and have an added benefit of communicating their status; so non-operable devices can be more readily repaired.
- **Home energy management systems (HEMS):** In advanced homes utilizing HEMS to control operations such as HVAC, lighting, appliances and security, adding AMI allows HEMS' to control systems to reduce demand when signaled through an AMI network.

In addition to demand response enabling technologies, other AMI-enabled technologies improve communication of energy usage from the utility to consumer. Traditionally, customers have received monthly utility bills that report consumption and charge customers for their aggregate monthly consumption, a system that somewhat disconnects customers from immediate connections between their actions and energy consumption. However, AMI enables near real-time feedback, informing customers of their energy consumption much more quickly. Examples of enhanced communication devices include the following:

- **Personal Web portals:** These portals offer customized Websites customers can use to monitor interval consumption. Such systems allow customers to analyze their consumption over time periods they choose to view. Increasingly, these systems employ advanced analytics to provide customers with even more useful information. For example, some systems allow customers to benchmark their performance against those of neighbors with similar homes. Some systems allow customers to specify what they wish their utility bills to be, and the portal provides recommended actions they should take to meet these goals.
- **In-home displays (IHD):** These are standalone devices, typically communicating with smart meters to show customers their energy consumption and current utility pricing. These devices allow customers to better understand their energy consumption.
- **Energy Orb:** These standalone devices, which change color as energy rates change or as demand response events are called, signal customers to take appropriate actions to reduce their electric demand.

Program Examples

AMI Enabled DLC

As noted, AMI adoption creates opportunities to control appliances within customers' homes and businesses. In some ways, they differ little from current DLC programs: individual load reductions from activities such as cycling central air conditioners may not differ from load reductions resulting from currently deployed DLC programs. However, AMI improves upon DLC by implementing two-way communication. Most residential DLC programs experience lower demand reduction capabilities due to malfunctioning DLC devices. As traditional systems cannot communicate their status to the utility, these devices often remain inoperable until discovered through inspections. Utilities typically experience 10% to 20% losses due to non-operable DLC devices. With AMI-enabled DLC, non-operable devices can be more readily detected, and inoperability rates can typically be decreased to between 2% and 5%.

AMI Enabled Dynamic Pricing

Dynamic pricing has encountered a limiting factor in that traditional utility meters cannot record or transmit the interval data required to reconcile customer consumption. However, as AMI enables such communication, it allows implementation of dynamic pricing programs. To date, the majority of dynamic pricing data have resulted from pilot evaluations, which have been plagued with potential bias, stemming from early adopters' reporting results, as these individuals may use AMI capabilities more than average customers. Nevertheless, preliminary pilot results have been somewhat promising.

The Brattle Group recently synthesized results of 109 AMI-enabled dynamic pricing pilots, finding the majority of pilots resulted in load reductions of up to 16%, with a 12% median demand reduction.[24] The majority of these pilots relied on customers taking action when prompted through signaling techniques such as telephone calls, e-mails, and text messages.

Brattle also examined 39 AMI-enabled dynamic pricing programs, utilizing various combinations of enabling technologies. These programs showed consistently higher savings than programs without enabling technologies, with a median demand reduction of 23%.

Summary of AMI-Enabled Demand Response Opportunities

From initial pilot results, AMI appears to expand demand reduction capabilities of residential demand response programs, though the extent of this expansion remains to be seen, as program persistence issues have not been thoroughly studied. Additionally, studies of the reliability and security of these programs and enabling technologies remain in progress. Further, how AMI-enabled programs and traditional programs overlap, and how demand savings may shift, still must be understood before specific estimates of demand reduction can be determined.

From improving operability rates of existing DLC programs to offering new demand response programs to customers, who otherwise would not sign up for traditional DLC programs, AMI will likely expand utilities' demand reduction capabilities.

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[24] Ahmed Faruqui and Palmer, J. "Dynamic Pricing of Electricity and its Discontents." The Brattle Group. August 2011.

5. ASSESSMENT OF THE NET-TO-GROSS RATIO

Definitions

Net-to-gross (NTG) assessments primarily seek to determine energy savings attributable to energy-efficiency programs by explicitly accounting for ***freeridership*** (energy savings likely to have occurred in the program's absence) and ***spillover*** (energy savings induced but not subsidized by the program). Savings resulting from this calculation are the "net" program savings, and the ratio of net program savings to gross savings is the NTG ratio.

About Freeridership

Freeridership subtracts from gross energy savings likely to have occurred through adoption of energy-efficiency measures by participants, independent of the program. That is, participants are considered freeriders if they would have adopted the same energy-saving measures at the same time, in the same quantity, and at the same efficiency level, had the program not existed.

About Spillover

Spillover adjustment adds energy savings from adoption of high-efficiency measures outside the program, but likely induced by the program. These additional energy savings are assumed to derive from greater knowledge and awareness of energy-efficient options resulting directly from the program's availability and influence.

Spillover can occur within participant and nonparticipant populations. For example, participants in a program may be motivated to adopt high-efficiency measures beyond those subsidized by a program. Simultaneously, the knowledge, awareness, and availability of measures caused by a program may induce nonparticipants to adopt the same energy-efficient measures.

For most programs, the number of eligible nonparticipants far outnumbers participants; thus, potential exists for large spillover impacts within this population.

About Program-Induced Market Effects

A third possible adjustment is program-induced market effects[25]—that is, any change the program causes to operations of supply chains in energy-efficiency markets. For example, the programs may result in:

- Manufacturers changing the efficiency of their products;
- Wholesalers and retailers changing their stocking decisions, reacting to shifts in demand for more efficient goods caused by IOU programs; and/or
- Architects and builders adopting energy-efficient practices.

[25] Note that some literature includes nonparticipant spillover as part of market effects.

These market effects can be significant, especially in upstream programs implemented through point-of-sale discounts. Such transformational market effects are, arguably, the ideal achievements of energy-efficiency programs, and can have long-lasting impacts. However, it is broadly accepted that these impacts can be difficult to measure for at least two reasons:

- Identifying these consumers in the larger populations can be difficult, as they may not be aware they participated in a program.
- A large number of factors may influence consumers' purchasing decisions.

Thus, measuring and attributing these effects to particular energy-efficiency programs has been a significant measurement and evaluation challenge.

Treatment of Freeridership and Spillover

Depending on the relative magnitudes of freeridership and spillover, NTG may be less than, greater than, or equal to 1.0. However, in jurisdictions where freeridership is the only measured effect, NTG never takes a value greater than 1.0.

Applying NTG also affects the cost-effectiveness of IOU programs. The Iowa Chapter 35 rules specify the method and assumptions for cost-effectiveness tests, including the Societal Cost Test (SCT), the standard for determination of cost-effectiveness in Iowa. The rules have been based on the Standard Practice Manual (SPM) for Economic Analysis of Demand-Side Management Programs, established by the California Public Utilities Commission (CPUC).[26]

In calculating benefits for the Total Resource Cost (TRC) test, the CPUC observed: "…ratepayers, through the energy-efficiency revenue requirements collected to fund these programs, incur a cost for freerider participants that must not be ignored in the formulation of the TRC test."[27] (The same observation applies to the SCT, which is a variant of the TRC.)

Due to ambiguity regarding how to fold in freerider considerations on the equation's cost side, the CPUC (in its 2007 Clarification Memo) modified the original method for calculating TRC costs by adding a transfer incentive (INC) recapture term to the initial TRC cost equation, as follows:

$$\text{TRC Costs} = \text{PRC} + \text{NTG}*\text{PC} + \text{UIC} + (1.0-\text{NTG})*\text{INC}$$

Where,

PRC = program administrator costs

PC = participant device costs (*before* INC is received)

UIC = (for fuel substitution programs) utility increase supply costs

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[26] The SPM describes procedures for determining cost-effectiveness of energy-efficiency programs from five perspectives: resource allocation efficiency (Total Resource Cost); the utility (Utility Cost Test); participants (Participant Cost Test); society (Societal Cost Test); and ratepayers (Rate Impact Measure).

[27] 2007 SPM Clarification Memo, D.07-09-043, pages 154-158, California Public Utilities Commission, 2007.

NTG = net-to-gross ratio

INC = incentive costs, restricted to include only dollar benefits.

According to the CPUC, adding the INC term to the TRC formulation ensures removal of freerider costs does not remove program costs that become utility-revenue requirements, consistent with the test's intent and purpose. Given administrative costs normally represent only a small percentage of total resource costs, freeridership impacts on TRC (and SCT) results tend to be small.

Treatment of NTG Across Jurisdictions

The definition, measurement, and treatment of freeridership—and of NTG in general—vary across jurisdictions in the United States. Some jurisdictions include both freeridership and spillover in defining net savings, while others allow only freeridership to be counted. In several cases, freeridership and spillover are measured separately, and incorporated in NTG, while other jurisdictions estimate NTG without specifying freeridership and spillover individually. Finally, in some cases, measurement of NTG—or its components—may not be required. Instead, gross savings, adjusted for actual installation rates, are used as the measure of program impacts. This is also the case with regional transmission organization (RTOs), such as the New England independent system operator (ISO-NE), where verified gross savings serve as the basis for verification of energy-efficiency bids into the forward energy market.

Cadmus compiled data on 32 jurisdictions active in energy efficiency to determine how NTG is defined, and whether it is used as an adjustment to gross savings. The survey established the following highlights:

- All but six of these jurisdictions (81%) have energy-efficiency resource standards (EERS) in place, setting minimum performance requirements, either as legislative or regulatory mandates or voluntary goals.
- No requirements exist for NTG calculations in 12 jurisdictions (38%).
- In 17 jurisdictions (53%), freeridership is included in determination of program savings. In seven of these jurisdictions (41%), freeridership is applied at the measure level.[28]
- In 10 jurisdictions (31%), NTG calculations include freeridership and either participant or nonparticipant spillover effects.
- In the majority of cases where NTG is calculated, it is applied prospectively for planning purposes. In these jurisdictions, utilities rely on adjusted gross savings for reporting compliance with targets, but are required to use deemed freeridership values in their program plans.
- Participant spillover is measured in 12 jurisdictions (37%) in the sample, while nonparticipant spillover is taken into account in 10 (31%).
- The incidence of cases only assessing freeridership suggests asymmetrical treatment of spillover and freeridership effects.

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28 New Jersey applies freeridership only to appliance recycling programs.

For a list of jurisdictions reviewed, and the NTG activity in each, see Appendix C.

Examples of NTG Values

Table 39 lists deemed NTG values adopted by the CPUC for the 2009–2011 program cycle. Although these NTG values do not include spillover effects, the CPUC allowed evaluations of the 2006–2008 energy-efficiency programs to contain an examination and estimation of participant spillover. As seen, NTG estimates vary widely across market sectors and measures. On average, NTG ratios are lower in the residential sector than in the commercial and industrial sectors, mainly due to the high freeridership in upstream programs.

Table 39. California Program Deemed NTG Ratios

Program	Average NTG	Maximum NTG (Measure)	Minimum NTG (Measure)
Residential			
Lighting	0.78	0.85 (Multiple)	0.60 (CFL ≤30 watt)
Appliance Replacement	0.70	0.85 (Clothes washer 15% above standard)	0.41 (Dishwasher EF>0.58)
Appliance Recycling	0.66	0.702 (Freezer)	0.614 (Refrigerator)
Water Heating	0.76	0.85 (multiple)	0.58 (Water Heater EF>0.62)
HVAC	0.67	0.85 (Programmable thermostat with direct install)	0.49 (Programmable thermostat with prescriptive rebate)
Multifamily	0.84	1.0 (Boiler controls)	0.76 (Lighting)
New Construction	0.53	0.62 (Lighting)	0.48 (Whole building single family RNC)
Residential Audits	0.80	N/A	N/A
Default Values	0.78	0.85 (New measures with <5% market share)	0.70 (New measures with ≥5% market share)
Nonresidential			
Lighting	0.78	0.85 (Multiple)	0.60 (CFL ≤30 watt)
HVAC	0.74	0.85 (Multiple)	0.50 (Multiple)
Refrigeration	0.68	0.82 (Refrigeration in NRNC)	0.46 (Strip door curtains)
Motors	0.84	N/A	N/A
Water Heating	0.64	0.82 (Water heating in new construction)	0.46 (Water heating in existing buildings)
Building Shell	0.93	N/A	N/A
Whole Building	0.70	N/A	N/A
Custom	0.75	0.85 (Multiple)	0.64 (Multiple)
Agricultural	**0.50**	**0.75 (Vacuum pump VSD)**	**0.26 (Plate cooler)**
Audits	0.41	0.48 (Lighting/cooling 20 to 100 kW)	0.29 (Lighting/cooling less than 20 kW)
Retrocommissioning	**0.95**	**1.0 (Gas measures)**	**0.90 (Electric measures)**
Local Govt Partnerships	0.68	N/A	N/A
Default Values	**0.78**	**0.85 (New measures with <5% market share)**	**0.70 (New measures with ≥5% market share)**

Source: 2008 Database for Energy-Efficient Resources (http://www.deeresources.com/deer0911planning/downloads/DEER2008_NTG_ValuesAndDocumentation_080530.zip) Version 2008.2.05 December 16, 2008

To date, only one evaluation (NYSERDA)[29] has estimated spillover effects for a new construction program. The evaluation showed a 46% freeridership rate (consistent with Table 39), and a combined participant-and-nonparticipant spillover rate of 54%, more than offsetting the freeridership estimate.

Measuring Freeridership and Spillover

A variety of methods and analytic techniques have been used to measure or to account for freeridership and/or NTG in general. Despite apparent differences, these methods and techniques tend to fall into one of two categories: statistical and self-report.

Statistical Methods

Statistical methods are based on the general difference-in-differences approach, where actual energy consumption is measured for program participants and a comparable group of nonparticipants in two time periods: before and after program implementation. Using statistical methods:

- Participants are exposed to program treatment in the second period, but not in the first.
- The comparison (nonparticipant) group is not exposed to treatment during either period.

Implemented properly, with a well-chosen control group, this approach removes potential biases related to the unique characteristics of participants, and biases from comparisons over time, which could result from non-program related trends (so-called “naturally occurring conservation”). Net program impacts are then calculated by subtracting the average change in nonparticipants’ consumption from the average change in the participant group.

This approach is sometimes implemented within an econometric framework for the following reasons: (1) controlling for the residual difference between the two groups; (2) evaluating the sensitivity of savings to various factors; and (3) estimating savings for bundles of measures. It cannot, however, be used for measuring NTG for individual measures. Moreover, this approach does not provide estimates for the individual NTG components—freeridership, spillover, and market effects.

The approach is also not well suited to estimating NTG in large commercial and industrial energy-efficiency programs. Due to the heterogeneity of these customers, it often can be impractical to identify an appropriately comparable group of nonparticipants. Also, as energy savings in these programs are often a small fraction of total consumption, it can be difficult to isolate consumption changes resulting from implementation of energy-efficiency measures. Moreover, this method is not recommended for upstream programs or new construction programs (where the lack of a pre-program period limits the effectiveness of the approach).

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[29] *New Construction Program (NCP) Market Characterization and Assessment*, prepared for New York State Energy Research and Development Authority, prepared by Summit Blue Consulting, LLC, August, 2008.

Self-Report Methods

Studies relying on self-reporting are more common than those relying on statistical methods. At a basic level, these methods directly involve asking participants questions about what they would have done in the program's absence. Responses are then scaled, weighted, and combined to produce a composite freeridership score (or index) for each respondent. Scores are then weighted (by savings) and averaged to produce a program-level freeridership fraction.

The self-report approach does not produce an NTG ratio. The other NTG components—spillover and market effects—must be estimated separately, and then be factored into the calculations. Surveys for determining spillover effects within groups of participants or nonparticipants are especially sensitive to variations in spillover scores. Small fractions multiplied by very large numbers of customers can dramatically boost savings.

Using surveys to assess freeridership raises concerns about response bias, particularly biases involving ***social desirability*** (the tendency of respondents to gauge their responses to conform to socially acceptable values). This well-recognized issue in social sciences has been discussed in a vast body of academic and professional literature.

Due to social desirability, respondents tend to offer what they think is the right answer, resulting in freeridership overstatement. Also, as some evaluation experts have noted, people have internal reasons—as explained by social psychology's attribution theory—motivating them to make certain decisions.

Another aspect is called the ***construct validity***. This issue stems from the fact that while survey respondents—by virtue of their participation in the program—are predisposed to conservation, the extent that their responses have been conditioned by the psychological effects of the conservation program remains unclear. Thus, what surveys measure may be the program's effect rather than what would have happened in its absence.[30] In areas with long histories of conservation programs and activities, it can be difficult to determine who is a freerider and who has been influenced by the program.[31]

In recent years, research methods have become more sophisticated, resulting in development of a series of questions and incremental answers designed to understand partial freeriders.

- In general, freerider questions ask interviewees about actions they would have taken had the program not been in place.
- For spillover, recent survey-based studies have focused mainly on participant and nonparticipant spillover. Participant surveys elicit responses about whether customers

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30 See Peters, Jane S. and Marjorie McRae., *Freeridership Measurement Is Out of Sync with Program Logic…or, We've Got the Structure Built, but What's Its Foundation*? Proceedings, ACEEE Summer Study Monterey, CA, August 2008.

31 Friedman, Rafael, Maximizing Societal Uptake of Energy Efficiency in the New Millennium: Time for Net-to-Gross to Get Out of the Way? Proceedings, International Energy Program Evaluation Conference, Chicago, August 2007.

have purchased additional energy-efficient measures of the same type without financial assistance.

- Nonparticipant spillover surveys ask customers if they purchased efficiency measures due to their awareness of the program.
- These developments have resulted in more systematic and transparent approaches, but results remain sensitive to evaluators' subjective assumptions.

Recall presents another problem, especially regarding spillover. Studies have found interviewees have difficulty self-reporting details such as usage, size, and efficiency levels.

Partly due to inherent biases, NTG results can vary sharply, based on the method selected. For example, two studies completed in the mid-1990s found self-reported freeridership estimates can be more than 50% higher than discrete choice approaches.[32] On the other hand, a recent study of several small commercial-sector programs in California found results, derived from more advanced statistical models (based on a nested logit model specification), were nearly identical to those obtained from self reports[33] (see Table 40).

Table 40. Freeridership Rates Differences Based on Research Approach

	Discrete Choice	Self-Reported
2010 California Small Commercial Programs	77%	78%
1995 Commercial Lighting Study	22%	32% to 38%
1994 PG&E Commercial Rebate	27%	42%

For these reasons, some experts have argued estimating freeridership and spillover can be too expensive, given considerable uncertainty about the results.[34]

32 Train, K. and E. Paquette, "A Discrete Choice Method to Estimate Freeridership, Net-to-Gross Ratios, and the Effect of Program Advertising," Energy Services Journal, Vol. 1, No. 1, 1995.

33 Grover, Stephen, et. al., *Free to Choose? A Comparison of a Nested Logit Model with a Billing Regression Model and Self-Report Analysis in a Commercial Impact Evaluation*, Proceedings, International Energy Program Evaluation Conference, Boston, August 2011.

34 Saxonis, William P., *Freeridership and Spillover: A Regulatory Dilemma*, Proceedings, Energy Program Evaluation Conference, Chicago, August 2007.

Cross-Program Research

The National Energy Efficiency Best Practices Study, an ongoing project sponsored by the CPUC, provides some insight into how the NTG issue has been handled in programs across the country.[35] The project seeks to identify best practices, and to communicate findings to program administrators for enhancing design of their programs.

In-depth interviews were conducted with managers of more than 100 programs in 2004 and 2005. Based on these interviews, program profiles were developed, and best practices were identified. Information was also provided regarding whether a program included a NTG adjustment, and whether this adjustment was based solely on freeridership, or if it also included spillover. Table 41 summarizes NTG values reported.

Table 41. NTG Values Identified Through the Best Practices Project

Program Area	NTG Value(s)	Freeridership Value(s)	Spillover Value(s)
Residential			
Lighting	0.57, 0.8, 1.27	5.7%, 6%	9.8%, 15%
Air Conditioning	0.8	N/A	N/A
Single Family Comprehensive	0.89, 0.93, 0.94, 0.97	3%, 4.4%	0%
Multifamily Comprehensive	0.78, 0.89	0%, 3%	N/A
New Construction	0.8, 1.0, 1.16	0%, 20%	N/A
Nonresidential			
Lighting	0.96, 1.0	N/A	N/A
HVAC	0.85, 0.96, 1.0	0%, 15%	N/A
Large Comprehensive	0.7, 0.8, 1.0, 1.06	N/A	N/A
New Construction	0.65, 0.67, 0.75, 0.81, 0.93	7%, 33%, 40%	N/A

See the Best Practices Website for detailed reports: http://www.eebestpractices.com/index.asp

More than 50% of studies reviewed either assumed or calculated an NTG value of 0.9 or greater. (In most cases, NTG values only included freeridership, or were based on a deemed NTG assumption.) Reported freeridership values varied significantly, even within program groups. Spillover effects were reported very infrequently.

Another cross-program study reviewed evaluation efforts of 50 resource acquisition programs and 31 information-only programs from the 2002–2003 California energy-efficiency programs.[36] That study found only 23 evaluations took freeridership into consideration.

Far fewer studies included efforts to account for spillover effects: three measured participant spillover, and three measured nonparticipant spillover.

[35] This study is managed by Pacific Gas and Electric Company under the auspices of the California Public Utility Commission in association with the California Energy Commission, San Diego Gas and Electric, Southern California Edison, and Southern California Gas Company. The website address is: http://www.eebestpractices.com/index.asp

[36] *California 2002-2003 Portfolio Energy Efficiency Program Effects and Evaluation Summary Report*, prepared for Southern California Edison and the Project Advisory Group by TecMarket Works, January 16, 2006.

Although the study stated freeridership and spillover were important considerations that should be included in evaluation research, it provided no guidelines as to which effects may have greater impacts, or whether it was appropriate to assume freeridership and spillover effects essentially cancelled each other out. However, some specific program evaluation efforts were identified, which will be reviewed in the next section of this report.

Specific Programs

This section examines measurement results for specific program types, based on data available from evaluation reports assessing both freeridership and spillover. Selection of program types was based on their expected savings potential in Iowa.

Lighting Programs

Table 42 lists results from four evaluation efforts that assessed lighting freeridership and spillover effects.[37] The majority of these programs have an estimated NTG value is 1.0 or higher, as spillover estimates are higher than freeridership estimates.

Table 42. Residential and Commercial Lighting Programs with Spillover Estimates

Sponsoring Organization	NTG Values	Freeridership Values	Spillover Values
Residential			
Efficiency Vermont*	1.19	6%	25%
Energy Trust of Oregon**	0.75	51%	26%
Efficiency Maine***	1.10	20%	30%
Nonresidential			
NYSERDA****	1.10	39%	80%

* *Final Report: Phase 2 Evaluation of the Efficiency Vermont Residential Programs*, prepared for the Vermont Department of Public Service, prepared by KEMA, Inc, December 2005

** *Process and Impact Evaluation of the 2007-2008 Energy Trust of Oregon Home Energy Solutions Program Volume 2,* prepared for the Energy Trust of Oregon, prepared by Opinion Dynamics Corporation, January, 2010.

*** *Process and Impact Evaluation of the Efficiency Main Lighting Program*, prepared for Efficiency Main, prepared by Nexus Market Research, Inc., and RLW Analytics, Inc., 2007.

**** *New York's System Benefits Charge Program Evaluation and Status Report—Year Ending December 31, 2010,* prepared for the New York Public Service Commission, prepared by NYSERDA, March, 2011.

37 Note: the NYSERDA NTG value does not equal (1 - freeridership + spillover), which is the formula used by most programs, but uses (1-freeridership) * (1 + spillover). Note also that the efficiency Vermont values represent a more recent study than that identified in Table 39.

Nonresidential Large Comprehensive Programs

Programs in this category promote procurement and installation of high-efficiency energy technologies by providing incentive payments and design/audit assistance, in some cases, to partially offset incremental equipment costs. Customers can receive incentives for customized projects based on calculating the amount of kWh saved, or based on a measurement-and-verification procedure. Providing incentives to shorten payback periods and assistance to quantify equipment performance increases the adoption of new technologies (see Table 43).

Table 43. Nonresidential Large Comprehensive Programs with Spillover Effects

Sponsoring Organization	NTG Values	Freeridership Values	Spillover Values
Wisconsin Power & Light*	0.91	44%	34%
NYSERDA**	1.23	35%	58%
CA Standard Performance Contract	0.7	30%	N/A

* *Shared Savings Decision-Making Process Evaluation Research Results,* prepared for Wisconsin Power & Light by Summit Blue Consulting, April 11 2006

** *Commercial and Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation*, prepared for New York State Energy Research and Development Authority, prepared by Summit Blue Consulting, LLC, May, 2007.

The SPC program in California has a relatively low NTG value of 0.7. However, this NTG estimate contains adjustments only for freeriders, and does not include spillover effects.

Cadmus also reviewed evaluations estimating spillover effects from two similar programs. Much like the California SPC program, freeridership is large, with values of 35% for NYSERDA and 44% for Wisconsin. However, these high freeridership values are largely offset by large spillover estimates, with an adjusted NTG of 0.91 for Wisconsin and 1.23 for NYSERDA.

Refrigerator and Freezer Recycling Programs

NTG estimates for appliance recycling programs tend to be well below 1.0. As shown in Table 44, these estimates in California are 0.61 for refrigerators and 0.7 for freezers. This type of program likely does not lend itself to much (if any) spillover effect, as it is unlikely many participants or nonparticipants would dispose of additional qualified refrigerators and freezers beyond those they dispose of within the program. Therefore, these low NTG values may be appropriate.

Numerous studies investigating NTG ratios for refrigerator and freezer recycling programs have been completed recently. The results from these evaluations indicate consistently sub-1.0 NTG ratios, ranging from 0.31 to 0.79 for refrigerators, and from 0.38 to 0.82 for freezers (see Table 44).

Table 44. Reported NTG Ratios for Appliance Recycling Programs

Study	Study Year	Refrigerator NTG Ratio	Freezer NTG Ratio
Rocky Mountain Power Wyoming, The Cadmus Group	2011	0.57	0.58
Ameren Illinois, The Cadmus Group	2010	0.79	0.82
Pacific Gas & Electric, The Cadmus Group	2010	0.51	N/A
Ontario Power Authority, The Cadmus Group	2008	0.48	0.52
Statewide Residential Appliance Recycling Program, ADM Associates, Inc.	2008	0.61	0.71
Wisconsin Residential Appliance Turn-In Program, PA Consulting Group,	2008	0.57	N/A
Washington Refrigerator and Freezer Recycling Program, PacifiCorp, KEMA	2007	0.31	0.56
California Statewide Residential Appliance Recycling Program, KEMA-Xenergy	2004	0.35	0.54
Sacramento Municipal Utility District, Heschong Mahone Group	2003	0.55	0.68
Southern California Edison, Xenergy	1998	0.53	0.57
Southern California Edison, Xenergy	1996	0.42	0.38

Energy-Efficient Residential Clothes Washers

Many utilities offer programs promoting ENERGY STAR residential appliances, such as clothes washers. In recent years, however, evidence has appeared that the market for energy-efficient clothes washers is being transformed, with resulting low NTG estimates. Attribution for this market transformation may lie with the ENERGY STAR program, and not with local utility financial incentive programs. If so, this would indicate very little spillover (especially nonparticipant spillover) from this program.

Efficiency Vermont[38] has evaluated energy-efficient clothes washers as part of its portfolio of energy-efficient appliances, offered under the efficient products portion of its residential program. In 2001, Efficiency Vermont estimated the NTG ratio for this program element as only 0.38. In 2004, Efficiency Vermont re-estimated NTG, and results showed an even lower value of 0.17.

These studies did not specifically address spillover. However, the evaluation report noted the high saturation of ENERGY STAR clothes washers in the marketplace not as a local phenomenon, but as a national phenomenon, inferring attribution for spillover would require a national rather than local effort.

Despite this very low NTG value, Efficiency Vermont plans to continue administering rebates for ENERGY STAR clothes washers to maintain the good relationships with retailer channels built up over many years.

[38] *Final Report: Phase 2 Evaluation of the Efficiency Vermont Residential Programs*, prepared for the Vermont Department of Public Service, prepared by KEMA, Inc, December 2005

Conclusions

Cadmus' examination of the methods, assumptions, and policies used to address NTG resulted in these key findings.

- ***Methods for measuring NTG elements, particularly spillover, are imprecise.*** The methods for calculating freerider and spillover effects exhibit considerable limitations, and little consensus exists among evaluation experts on best methods. Methods used to calculate NTG have inherent biases, particularly those based on self-reporting (the most common approach). These biases can significantly affect NTG analysis results.
- ***NTG estimates would have a small impact on the societal benefit test.*** If the benefit-cost tests were run with net impacts, programs with an NTG ratio of less than one would have administrative costs spread over fewer participants. Given administrative costs normally represent only a small percentage of program expenditures, this impact would be minor.
- ***Many states have assumed a NTG ratio of 1.0***. A review of NTG methods and application of NTG in 32 jurisdictions conducted by Cadmus found that 13 (40%) did not adjust savings for freeridership. In a recent decision by the CPUC, IOUs will report gross savings as the measure for compliance.
- ***A study of best-practices programs found more than two-thirds of all identified programs had an NTG value of approximately 1.0.*** Approximately half of the studies (49%) either assumed or calculated a NTG value of 1.0, and 68% of the studies had NTG values between 0.9 and 1.0. In most cases, NTG values, when used by a program, were only based on freeridership values. Consequently, an even higher percentage of programs would have a NTG ratio of approximately 1.0 if spillover were examined.
- ***Assuming a NTG ratio of 1.0 may be conservative in certain cases***. Research indicates some programs, particularly those for lighting, routinely achieve NTG ratios well over 1.0 when spillover is examined. Even in programs where high freeridership is reported, spillover effects are largely ignored. If properly accounted for, spillover effects may offset freeridership to a large extent.

Given these findings, it appears reasonable that gross savings be used as the basis for reporting and target compliance. However, utilities should make efforts to design effective programs that minimize freeridership through the following techniques:

1. ***Regularly track the saturation of measures within their own service areas and in other jurisdictions.*** For example, ENERGY STAR clothes washers continue to gain market share throughout the country, and freeridership will likely increase, resulting in an NTG of less than 1.0.
2. ***Carefully monitor market responses to particular programs, and set incentive levels that minimize freeridership.*** As programs mature and market shares for efficiency measures increase, program administrators may be inclined to reduce incentive levels. Paradoxically, however, freeridership tends to be higher in programs with low incentives, as lower incentives are less likely to motivate customers to adopt efficiency measures. Thus, incentive levels should be carefully reviewed and set at values that motivate a substantial number of participants to install efficiency measures.

SEC INTERROGATORY #48

INTERROGATORY

[B/6/3, p. 25] Please reconcile the "theoretical basis" for the equivalency of free ridership and spillover with the empirical results for free-ridership and spillover in jurisdictions in which they have been studied.

RESPONSE

We assume this question references section 4.2, in which we state that:

> Some evaluators have argued, and some regulators have accepted, that spillover and market effects balance out free riders (e.g., PWP and Evergreen Economics 2017; Khawaja, Haeri, and Hedman 2014; Haeri and Khawaja 2012). While there is as yet little empirical evidence for this argument, there is good theoretical reason to expect it is true.

The argument is that successful programs will increase trade allies' promotion and sales of efficient equipment. Not all of the increased sales will receive program rebates and incentives. Some customers will accept the contractors' recommendations but will not bother to apply for rebates and incentives. But since the contractors' increased promotion and sales are at least partly the result of the program's influence, the program should theoretically receive credit for some portion of that increase. The reason that this "theoretical equivalency" (not our words) is at variance with empirical research is that: 1) free-ridership assessments likely overstate free-ridership (for reasons argued extensively throughout sections 3 and 4 of our report); and 2) spillover assessments likely underestimate spillover (as we argued in section 4.2 of our report).

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #49

INTERROGATORY

[B/6/3, p. 30] Please explain how market baseline conditions include free-ridership and spillover.

RESPONSE

The market baseline represents the current state of the market, as a result of both program and non-program effects. Thus, this would include direct program effects as well as free-ridership and spillover.

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #50

INTERROGATORY

[B/6/3, p. 31] Please describe in detail where, whether in the 2015 results or in any other year, attribution to non-utility programs has been double counted in attribution and in free ridership.

RESPONSE

Our argument does not depend on identifying specific instances of double-counting of savings attributed to non-utility programs. Our argument is a logical one, which depends on the definition of gross and net savings. It relied on the assumption that energy efficiency program evaluators understand net savings to refer to savings attributable to the program in question.

This is the assumption that underlies all survey approaches to assessing free-ridership with which we are familiar as such approaches seek to determine what the program participant would have done without the program's influence. In such approaches, "what the program participant would have done without the program's influence" (i.e., the free-ridership portion of the savings) would encompass the savings attributable to all influences other than the utility program, including any non-utility programs. Therefore, in such approaches, any savings attributed to those non-utility programs should come out of the free-ridership portion of the savings, not out of the net (i.e., program-attributable) portion of the savings.

If, however, the free-ridership assessment asked what the program participant would have done without the influence of the program or any of the identified non-utility programs, then the savings attributable to non-utility programs should come out of the net savings thus determined.

Witnesses: R. Bliss
J. Peters

SEC INTERROGATORY #51

INTERROGATORY

[B/6/3, p. 33] Please confirm that self-report methods are the most commonly accepted approach to NTG in most North American jurisdictions, and is the only empirical method used for custom C&I programs. Please detail those jurisdictions that have rejected self-report methods, and the reasons why. Please provide links to decisions where available.

RESPONSE

Research Into Action ("RIA) would like to clarify that the RIA report does not state that self-report methods are the only empirical NTG assessment method used for custom C&I programs. At least one report (Violette, Seiden, Erikson, Podolefsky, McMillan, Robinson, Dimetrosky, and Lieb 2015) identifies "market-based methods" as the most *appropriate* primary research methodology for custom measure programs.

Based on RIA's review of multiple sources (e.g., Violette & Rathbun 2014; Ridge, Willems, Fagan, and Randazzo 2009; PWP & Evergreen Economics, 2017), self-report is the most common method of NTG assessment in general. While those reports did not specifically address NTG methods for custom programs as distinct from other types of programs, one report (TetraTech 2011) does discuss NTG methods particularly for custom programs. That report disagrees with Violette et al. (2015), noting that, "The only methods that work well for custom or case-specific measures are end-user post-hoc counterfactual surveys, and vendor surveys asking about specific customers." This is because custom projects typically are fewer and less homogeneous than projects in other types of programs, and most other approaches (e.g., econometric, billing analysis) require larger samples and/or greater homogeneity among projects. The authors suggest that the customer self-approach can be bolstered by input from contractors (e.g., design team members), suppliers, project file review, and program staff review. They note the latter should not be used as a sole source of information, as program staff have a vested interest in identifying low free-ridership; however, program staff may provide information about their inputs and potential influences, which the evaluator may investigate through other sources.

RIA note that all, or nearly all of the NTG research that RIA has conducted (see the response to SEC Interrogatory #40, found at I.EGDI.SEC.40 and a majority of any other impact evaluation research that RIA have been involved with, has involved self-report methods. However, as RIA noted in our report, the selection of the self-report method is motivated by its cost and ease of administration more than other considerations.

In Section 5.3 of our report, RIA discussed a trend to use deemed or negotiated NTG values and cited several sources for support. Table 2 in that section (p. 22 or the report, or p. 30 of the pdf) lists several U.S. states that use deemed or stipulated values. RIA have identified and reviewed documentation relating to the establishment of stipulated NTG values for two of those states, Hawaii and Iowa.

The documentation for Hawaii shows that Hawaii Energy established deemed NTG values in 2011, updated those values in 2012, and has applied those updated values each year to at least 2016 (Flanagan 2011, Evergreen Economics 2013, Hawaii Energy 2016, Opinion Dynamics 2017). In stating the justification for establishing deemed NTG values, the overview of the Hawaii Energy EM&V plan for program year 2010 (Flanagan 2011) states that “approaches used to measure NTG ratios have been shown to produce unstable results” and that “the definition of NTG is controversial in the presence of market effects from prior programs and existing Program and non-program activity (which contributes to the instability and potential unreliability of measurements)” (p. 8).

That evaluation plan further elaborates that one of the motives for using the stipulated NTG is “avoiding expenditure of EM&V resources on activities that yield results that may at best be unreliable and/or could contribute to analytic uncertainty of program savings results” (p. 9). The documentation that RIA reviewed does not provide information on how the NTG value for custom programs was determined.

For the State of Iowa, RIA identified and reviewed a final report from the Office of Consumer Advocates (“OCA”), a division of the Iowa Department of Justice, to the Iowa Utilities Board (Office of Consumer Advocates 2015). This report discusses the decision of an Oversight Committee, consisting of investor-owned utilities, the OCA, and environmental interveners. That Committee accepted the consultant’s recommendation to use a deemed NTG value of 1.0 where supported by previous research, conduct *secondary* research to establish a deemed NTG value where research indicates the NTG ratio is not likely to be 1.0, and conduct *primary* research to establish the NTG ratio for programs that contribute large savings to the utilities’ energy efficiency portfolio and “warrant the expense of primary NTG research” (p. 3). The latter would typically include custom measure programs.

The point is not that jurisdictions that have elected to use deemed NTG values have explicitly rejected self-report methods. It is more like they have rejected the idea of establishing a new NTG value each year, based on research that is understood to have limited reliability.

Witnesses: R. Bliss
J. Peters

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Witnesses: R. Bliss
J. Peters

The following sources were cited, however are no longer available online. The following reports have been added as attachments:

Ridge, R., P. Willems, J. Fagan, and K. Randazzo. 2009. "The Origins of the Misunderstood and Occasionally Maligned Self-Report Approach to Estimating Net-to-Gross Ratio." In Proceedings of the International Energy Program Evaluation Conference. Madison, WI: IEPEC. (Attachment 1).

Office of Consumer Advocates. 2015. Final Report: In Re: Interstate Power and Light Company (Docket No. EEP-2012-001), Mid-American Energy Company (Docket No. EEP-2012-002), and Black Hills/Iowa Gas Utility, LLC, d/b/a Black Hills Energy (Docket No. EEP-2012-003). Submitted to the Iowa Utilities Board, Department of Commerce, State of Iowa. November 25, 2015. (Attachment 2.)

Violette, D., K. Seiden, J. Erickson, M. Podolefsky, J. McMillan, S. Robinson, S. Dimetrosky, and N. Lieb. 2015. Final Report: Iowa Energy-Efficiency Net-to-Gross Report. Prepared for Iowa Utility Association and the Oversight Committee. September 2, 2015. (Included with Attachment 2 - Office of Consumer Advocates 2015).

Witnesses: R. Bliss
J. Peters

The Origins of the Misunderstood and Occasionally Maligned Self-Report Approach to Estimating the Net-To-Gross Ratio

Richard Ridge, Ridge & Associates, Alameda, CA
Phillipus Willems, PWP Inc, North Potomac, MD
Jennifer Fagan, Itron, Inc., Madison, WI
Katherine Randazzo, KVD Research Consulting, El Cajon, CA

ABSTRACT

The net-to-gross ratio is one of the key parameters necessary to estimate a program's net energy and demand impacts and a variety of methods have been developed to estimate this critical parameter. Which technique one chooses depends of a number of factors such as time, money, data availability, and effect size. One non-experimental approach (i.e., one that does not involve any comparison group), the self-report approach (SRA), has been in use for at least 30 years and was developed in response to a number methodological challenges and policy-related issues. Because the SRA does not involve any formal comparison groups, it has been criticized as inherently biased and unreliable.

Professionals on both sides of this debate almost always fail to understand and appreciate the SRA's place within the larger evaluation framework, its evolving use over the last 30 years in the evaluation of education, mental health, juvenile justice, and energy efficiency programs and the resulting improvements in both its internal validity and reliability. To address this failure, this paper will discuss the rich history and evolution of this non-experimental approach in the broader evaluation community, and its more specific application in the evaluation of energy efficiency programs in California. This paper will also respond to some of the more common criticisms of the California SRA (the CA-SRA).

Background

A core feature of the use of any method to "determine" the impact of a program is the assumption that evaluation efforts have established a causal connection between the program and customer behavior. The establishment of causality is at the core of arguments for and against research methods aimed at establishing program impacts. When we couch our arguments in terms of causality, we benefit from being aware of the rich history of philosophical and methodological thinking and writing about causality that has taken place over the last 30 or 40 years. This awareness allows us to appreciate the issues and their complexity. It is important to establish that we in the energy efficiency field are not the first to address these issues and we can benefit from those who went before us. We therefore spend a few paragraphs of this paper rooting our arguments in this literature.

Historically, the social sciences have been heavily influenced by the *positivist* (or empiricist) philosophical approach to causality (Mohr 1995). Positivism asserts that causal relationships are not directly observable and therefore, causality is a matter only of observed regularities in associations of events (Hume 1737; Salmon 1998). According to this view, systematic, quantitative comparisons of events that produce correlations between variables are as close as researchers can get to causal explanation. This approach has sometimes been referred to as *variance theory* by Mohr (1995) and manipulation theory by Yang (2009) and emphasizes variables and the correlations among them. Variance theory is closely associated with statistical testing of hypotheses and, in particular, the regression model.

The randomized controlled trial (RCT), sometimes called the gold standard of the empiricist approach, consists of random assignment of subjects to two or more groups, only one of which receives the treatment. One version of the RCT, the posttest-only control group design, is illustrated below in Figure 1 (Campbell and Stanley 1966). In Figure 1, R represents random assignment, *X* represents the treatment, O_1 represents the posttest for some variable *Y* for the treatment group and O_2 represents the posttest for the same variable for the control group.

$$\begin{array}{ccc} \mathbf{R} & \mathbf{X} & \mathbf{O_1} \\ \mathbf{R} & & \mathbf{O_2} \end{array}$$

Figure 1. Posttest-Only Control Group Design

The comparison group represents what would have happened in the absence of the treatment. Any differences between the treatment and control group based on the posttests can be attributed to the treatment since all the other possible explanations have been effectively controlled for via randomization. That is, all the threats to internal validity have been addressed.[1] In other words, did in fact the experimental treatments make a difference in this specific experimental instance, i.e., if not *X* then not *Y*.

Because random assignment is not always possible, researchers have found it necessary to develop a number of other less powerful designs that are referred to as quasi-experimental. In such designs, researchers work with in-tact groups in natural social settings. However, such designs fail to control for all of the threats to internal validity (Campbell & Stanley 1966; Shadish, Cook, & Campbell 2002), particularly self-selection, making *definite* proof of causality impossible.

The Realist Perspective

The *realist* view of causal explanation represents a recent philosophical shift in the social sciences (Sayer 1984; Salmon 1998; Maxwell 2004). Realism defines causality as consisting not of regularities but of real (and in principle observable) causal mechanisms and processes, which may or may not produce regularities. It deals with events and the processes that connect them and analyzes relationships between events using data that retain relevant chronological and contextual connections. This perspective ascribes value to contextual factors and mental processes downplayed by the positivist approach to research. The realists view asserts that sometimes the reasons that people give for their behavior are indeed the causes of their behavior.

Mohr (1995) examines the central argument of the realists that stated reasons can be the causes of intentional behavior, often the focus in program evaluation. When people behave they do it for reasons that they can "observe" and when interrogated by a researcher they can report the most important reasons[2]. Of course, as he points out, at any given time we have good reasons for doing a lot of different things, but we do not always act on all of these reasons. We do only one thing, perhaps for only one of the many reasons. The other reasons might not have caused anything. Here, he introduces the concept of the "operative reason" which he defines as: ". . . the reason that actually operates to

[1] The traditional threats to internal validity identified by Campbell and Stanley (1966) are: 1) history, 2) maturation, 3) testing, 4) instrumentation, 5) regression, 6) selection, 7) mortality, and 8) interaction of selection and maturation, etc. However, as some have pointed out, even these designs are not perfect due to differential attrition (experimental mortality) from the experimental groups and the constraints (Shadish, Cook, and Campbell 2002) on external validity (Bickman & Reich 2009).

[2] Mohr (1995) provides a more detailed analysis of *physical* causality and *factual* causality, with the former associated with the realist position. Unfortunately, space does not permit a full exegesis of this distinction.

produce the behavior performed – and to stipulate that the operative reason is different from all the others in that it was the strongest" (265). That is, people undertake a particular action in order to achieve a certain goal because a particular reason was the strongest among all the competing reasons for undertaking that action.

This distinction between the empiricist and realist schools applies not only to the social sciences but also to the natural sciences, separating more experimental fields like physics and chemistry from those that deal with relatively unique situations, including evolutionary biology and geology. Gould (1989) observed:

> Historical science is not worse, more restricted, or less capable of achieving firm conclusions because experiment, prediction, and subsumption under invariant laws of nature do not represent its usual working methods. The sciences of history use a different mode of explanation, rooted in the comparative and observational richness of our data. (279)

We might add to this list of sciences that do not rely on experimental methods evolutionary biology, geology, and paleontology. This realist view of causation is compatible with and supports all the essential characteristics of qualitative research:

- If causal processes can be directly observed, then this supports the emphasis placed by many qualitative researchers on directly observing and interpreting social and psychological processes. It is possible to observe causal process in single cases without requiring comparison of situations in which the presumed cause is present or absent.
- Seeing context as intrinsically involved in causal processes supports the insistence of qualitative researchers on the explanatory importance of context.
- That mental events and processes are real phenomena that can be causes of behavior supports the fundamental role that qualitative researchers assign to meaning and intention in explaining social phenomena and the essentially interpretative nature of our understanding of these.
- In claiming that causal explanation does not inherently depend on pre-established comparison, it legitimizes qualitative researchers' use of flexible and inductive designs and methods.

This distinction between positivist/empiricist and realist approach is very similar to a distinction developed by Mohr (1982; 1995, 1996) between *variance theory* and *process theory*. Variance theory deals with variables and correlation, quantitative measurement, and experimental or correlational designs. Process theory deals with events and the processes that connect them; it is based on an analysis of the causal processes by which some events influence others. Maxwell (2004) also notes that:

> Process theory is not merely 'descriptive,' as opposed to 'explanatory' variance theory; it is a different approach to explanation. Experimental and survey methods typically involve a 'black box' approach to the problem of causality; lacking direct information about social and cognitive processes, they must attempt to correlate differences in output. Qualitative methods, on the other hand, can often directly investigate these causal processes. (p. 249)

However, as Maxwell (2004) points out, both the variance theory and the process theory face potential validity threats and each has its particular strengths.

The realist central argument is that qualitative research methods are as valid in determining causal explanation as purely quantitative ones, if they are well-designed to avoid threats to the validity of explanation. There are various research strategies that can be applied to qualitative research to best address these potential threats. The strategies are particularly productive when used in concert with a detailed theory of explanation in a given case, which can inform research design and interpretation of evidence as well as aid in developing alternative theories to be ruled out. Strategies typically associated with variance theory, strategies of intervention and comparison, observation and analysis, strategies to develop and assess all alternative explanations, and triangulation can all provide important checks on bias and uncertainty in qualitative research. Four such strategies are described below.

- Intervention and comparison, commonly associated with quantitative research methods, are certainly compatible with qualitative research. Mixed-method research makes particular use of intervention to provide a detailed account of the process by which a particular statistical regularity occurs and to confirm statistical conclusions. Comparison without a formal control group but across sites or cases is also very helpful in identifying causal influences by providing evidence of altered or absent presumed influences. Comparisons can also be made between those in the treatment group and typical behavior (i.e., standard practice) within the same industry.
- Strategies can also be applied to the observation and analysis of causation that can help to address threats to validity. These strategies are unique to qualitative research, because they rely on observing processes rather than just end results. Such observations can also provide increased opportunities for developing and eliminating alternate hypotheses. Such "rich data" (also known as "thick description") give a more complete picture of context and process and therefore help to "counter the twin dangers of respondent duplicity and observer bias" by increasing the amount and varying the type of information necessary to confirm or deny a theory.
- Strategies for developing and assessing rival hypotheses can also guard against such threats. The *modus operandi* approach (Scriven, 1995) to alternative explanations is the most simple, relying on the researcher to identify other hypotheses and search for evidence of them in the data. This method is clearly vulnerable to researcher bias, as it may be difficult for researchers to identify other competitive theories and to detail them sufficiently to be able to test them. A similar strategy is that of identifying discrepant evidence and negative cases, which challenge the prevalent theory, explaining it away or adapting the hypothesis to incorporate the conflicting evidence.
- Triangulation, using a variety of research methods and data sources, is a strategy adopted before the data are collected and reduces the risk of systematic biases. However, there is also a risk that triangulation can make methodological or research bias harder to detect, by employing methods or data sources that are vulnerable to the same biases. Using the feedback of research participants to check conclusions and methods, can aid in identifying biases and alternative explanations, but subjects' inputs are subject to biases and influences of their own, not least of which is the need to reach consensus with the researcher.[3] Ultimately, Maxwell (2004) argues, ". . . validity threats are ruled out by evidence, not methods; methods need to be selected for their potential for producing evidence that will adequately assess these threats" (259)

In summary, qualitative and quantitative research methods each have their own threats to internal validity, as well as recourse to research design and implementation strategies to address these threats. Common to both methods is the danger of oversimplification of causal processes. Out of context, simple statements of linear relationships may be more distorting than illuminating. Qualitative analysis has an important advantage over quantitative in this respect: by providing insight into the composition of those relationships, it can aid in the strategic design of future research and help to advance practical action in the field studied.

[3] See discussion below of socially desirable responses and various strategies that have been developed to minimize this bias.

The Program Evaluation Framework

The development of the realist position paralleled the recognition on the part of many evaluators that the evaluation designs typically associated with the positivist approach were not always possible (Weiss 1972; Weiss & Rein 1972). As a result, many evaluators began to explore alternatives that would allow them to generate causal conclusions (Guba & Lincoln 1981; Cronbach 1982). This approach, consistent with the realist view, argues that qualitative research methods are as valid in determining causal explanation as purely quantitative ones, if they are well-designed to avoid threats to the validity of explanation.

The hallmark of scientific inquiry is the ability to eliminate alternative explanations and contradictory evidence. Research, whether quantitative or qualitative, must be meticulously designed to identify, detail, and test rival hypotheses. The *modus operandi*, introduced earlier, which, Mohr (1996) argued, shows a "distinct basis of efficacy" with respect to causation. Imagine that an outcome has occurred and the task of the evaluator is to demonstrate that the program, A, has caused the observed outcome, B. There are several other possible causes of B, such as C, D, and E. Each of these has a " signature" that has been defined by Mohr (1994) as: either or both (a) a mechanism or a known causal chain of events by which A, C, D, and E would lead to B and (b) the occurrence of other events in addition to A that are logically associated with or attributable to an active B, or C, or D, or E. The task of the analyst is to show that the signature of A has indeed been actualized, whereas the signature of each of the other possible or plausible causes has not. This basis of determining causality is relied upon heavily in many areas, such as detective work, cause-of death determination, medical diagnosis, and troubleshooting in connection with machinery, as in auto repairs (see *Car Talk*, National Public Radio). Chen (1990) and Rogers (2000) argues that sound program theories and logic models can provide valuable assistance in identifying the plausible set of rival hypotheses.

Most recently, Scriven (2009) has perhaps been one of the most outspoken champions of a process theory approach to causation. Scriven argues that the foundation of what constitutes cause in both science and law is based on the notion that causation is directly and reliably observable in everyday life. He further observes that:

> . . . good scientists have been entranced by the paragon of experimental designs, the randomly controlled trial or RCT, and illicitly generalized this into the required standard for all good causal investigation. It is suggested here that this view is completely refuted by a careful look at the way astronomy, epidemiology, engineering, geology, field biology, and many other sciences establish a causal conclusions to the highest standards of scientific (and legal) credibility. (151)

He even quotes Cook and Campbell to good effect: ". . . we do not find it useful to assert that causes are 'unreal' and are only inferences drawn by humans from observations that do not themselves directly demonstrate causation" (140).

Other evaluators have developed other approaches to demonstrating causality using non-experimental methods. For example, Yin (1994) provides guidelines for assessing causal relationships using case studies. Tashakkori and Teddlie (1998) also argue that their ". . . conceptualization of internal validity is not limited to experimental studies and causal relationships (p. 67)." Finally, consider Weiss (1997, 2000) who suggests that a theory-driven evaluation can substitute for classical experimental study using random assignment. She suggests that if predicted steps between an activity and an outcome can be confirmed in implementation, this matching of the theory to observed outcomes will lend a strong argument for causality: "If the evaluation can show a series of micro-steps that lead from inputs to outcomes, then causal attribution for all practical purposes seems to be within reach" (Weiss 1997, 43).

Some, such as Tashakkori and Teddlie (1998), recommend a mixed methodology in which quantitative and qualitative approaches are combined to improve internal validity. Or, consider Patton who concludes that: "The field has come to recognize that, where possible, using multiple methods – both quantitative and qualitative – can be valuable since each has its strengths and one approach can often overcome weaknesses of the other (p. 267)." Applying these ideas to the California energy efficiency evaluation context, the 2005 Protocols provide that the use of both experimental/quasi-experimental and non-experimental methods are available to evaluators at the enhanced level of rigor in the 2005 Protocols.

The Energy Efficiency Program Evaluation Framework

As mentioned earlier, evaluators of energy efficiency programs also recognized, like evaluators in other fields, that there are situations in which the standard quantitative approaches involving comparison groups are not always possible. For example, in the industrial sector, three barriers are immediately apparent. First, there is an expected very small signal to noise ratio (low statistical power) in a participant/nonparticipant billing analysis i.e., the expected difference in monthly energy use between participants and nonparticipants was too small to detect reliably compared to other sources of variation in kWh that vary greatly across individual industrial sites. In addition, large industrial customers targeted by the program have been contaminated by participation in energy efficiency programs in prior years making it very difficult to find true nonparticipants. Finally, even if the first two problems were absent, the large industrial customers targeted by the program are each unique making it unlikely that one could find a group of nonparticipants that could be matched with participants on critical variables.

Also, consider new construction programs which also eventually confronted the problem that many of the large residential and nonresidential developers, architects and engineering firms had also been contaminated by participation in energy efficiency programs in prior years making it very difficult to find true nonparticipants. Over the years, a wide variety of methods such as discrete choice, difference-of-differences, and econometric modeling, had been used to estimate the net energy and demand impacts of these programs. However, these approaches have become, over time, increasingly unreliable and have produced implausible results. Thus, Chappel et al. (2005) concluded that, based on an assessment of these methodologies and a review of the needs of the 2004-05 Building Efficiency Assessment (BEA) study, the self-report approach is the most appropriate one for evaluating this complex and diverse program and market.

Again, finding a true nonparticipant who has not been contaminated by exposure to some energy efficiency treatment has become very difficult making it very difficult to model the effects of a single intervention using a variety of statistical techniques that relied on the comparison of participant and nonparticipant data.

Of course, there are also other budgetary or timing constraints that might prohibit the use of the quantitative approaches. The expected magnitude of the savings for a given program might not warrant the investment in a perhaps more expensive evaluation design that could involve a billing analysis or a discrete choice analysis of both participants and nonparticipants (assuming such group is even available). Or, key stakeholders might not want to wait for a billing analysis, which typically requires up to 12 months of post-implementation consumption data, to be completed. And with a small signal to noise ratio, the sample sizes necessary for the required statistical power can be prohibitively expensive.

In 1993, the recognition that methods involving comparison groups were not always feasible was first formalized in the energy efficiency field in California in the *Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management (DSM) Programs* (1993 Protocols). Based on this recognition, the SRA (hereafter referred to as the California SRA (CA-SRA)) was allowed as one way to estimate the NTGR[4] (a measure of the strength of the causal relationship between the program and the decision to install energy efficient equipment). From 1994 through 1998, the IOUs were responsible for conducting process and impact evaluations, guided by the 1993 Protocols[5], of their energy efficiency programs. During this time period, all IOUs used the CA-SRA along with other techniques as approved by the CPUC.[6] It is important to note that, although not required by the 1993 Protocols, the IOUs often employed triangulation (the use of two or more techniques to increase accuracy) in estimating net impacts. They did this because they, as well as the CPUC, understood that there is error associated with any single method, that the results would be used in integrated resource planning (IRP), and that the results would be used in a very direct way to determine their earnings on their energy efficiency investments.

Beginning in 2006, the Energy Division of the California Public Utilities Commission assumed responsibility for conducting all impact evaluations. In 2005, the *California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals* (2005 Protocols) were developed to guide the evaluation of the programs in the 2006-08 funding cycle. Again, the CA-SRA was permitted with the agreement of the IOUs. However, the 2005 Protocols *explicitly* require (for the same three reasons listed above) triangulation for programs assigned the *enhanced* level of evaluation rigor[7].

This emphasis on triangulation throughout the last 15 years reflects a desire that the situations in which one was forced to rely solely on any one method would be rare. Of course, whether one is able to use one or more than one method, there will still be uncertainty surrounding the savings estimates owing to such things as sample error, measurement error, and the failure of multiple methods to arrive at the same answer. If the earnings mechanism established by regulators can either penalize or reward a utility if the savings vary by as little as 1 percent either way, then the pressure on evaluators to produce perfectly accurate and precise estimates of savings would be enormous. What policy makers and regulators sometimes forget is that no measurement system, no matter how rigorous, within the broader evaluation community, can meet that standard of accuracy. When evaluators fail to deliver the level of accuracy and precision required by regulators, one should not flog the evaluators and condemn their evaluation methods. Rather, one should change the regulatory framework from the high-stakes system of rewards and penalties so that they are more consistent with best evaluation practices.

The CA-SRA

Space limitations allow only a brief description of the CA-SRA and its relationship to the literature described earlier. The CA-SRA, rooted in the realist tradition, is a non-experimental approach that produces an estimate of the NTGR, an index of program influence. The NTGR is required by the 2005 Protocols and is used to adjust estimated gross energy and demand impacts in order to produce net energy and demand impacts, i.e., those impacts attributable to the program.

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[4] The NTGR typically varies from 0 to 1 and represents the proportion of the gross savings that are attributable to the program.

[5] Appendix J (*Quality Assurance Guidelines For Statistical, Engineering, and Self-Report Methods for Estimating DSM Program Impacts*) to the 1993 Protocols provided a listing and discussion of the essential issues that should be considered by evaluators using self-report methods, together with some recommendations on reporting the strategies used to address each issue.

[6] Two additional methods, both of which involved the use of a comparison (not control) group, were discrete-choice analysis and billing analysis.

[7] Tashakkori and Teddlie (1998) classify such triangulation as *parallel mixed analysis,* which, they argue, is probably the most widely used mixed data analysis strategy in the social and behavioral sciences.

The CA-SRA involves asking one or more key participant decision-makers a series of closed and open-ended questions about their motivations for installing the efficiency equipment, about whether they would have installed the same EE equipment in the absence of the program, to establish the temporal precedence of the program, as well as questions that attempt to rule out rival explanations for the installation (Weiss 1972; Scriven 1976; Shadish 1991; Wholey et al. 1994; Yin 1994; Mohr 1995; Rogers et al. 2000; Donaldson, Christie, & Mark 2008). In the simplest case (e.g., residential customers), the CA-SRA is based primarily on quantitative data while in more complex cases in the nonresidential programs the CA-SRA is strengthened by the inclusion of additional quantitative and qualitative data which can include, among others, in-depth, open-ended interviews, direct observation, and review of customer and program records [8]. Many evaluators believe that additional *qualitative* data regarding the economics of the customer's decision and the decision process itself can be very useful in supporting or modifying *quantitatively*-based results (Britan, 1978; Weiss and Rein, 1972; Patton, 1987; Tashakkori and Teddlie, 1998; Cook, 2000). In early 2007, the Energy Division published the *Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approaches* which contained 17 recommendations for further improving the validity and reliability of the CA-SRA (available at www.calmac.org) [9]. The output of the CA-SRA is an index (NTGR), a single number representing program influence. An estimated NTGR is required by the CPUC to adjust estimated gross impacts[10].

In 2007, the CPUC formed two groups (the Residential and Non-Residential NTGR Working Groups) comprised of nationally recognized experts in the use of the SRA to consolidate the lessons learned over the last 15 years in order to make further improvements in the CA-SRA. The primary objectives of this work were to address what appeared to be a systematic overestimation of freeridership (Ridge, 2001) and to produce standardized questionnaires, methods, and algorithms that could be used by all contract groups evaluating the energy efficiency programs in California for 2006-08. A more detailed description of the residential and non-residential CA-SRAs can be found at www.calmac.org.

We conclude this section by stressing that it does not make sense to paint all efforts to estimate NTGRs using the self-report approach, one version of which is the CA-SRA, with the same brush as some critics have done. Distinctions must be made between those efforts that conform to best practices in the use of this technique such as the CA-SRA and those that don't.

A Response to Critics

Over the years, a number of criticisms and arguments (many of which are of the straw man variety) have been leveled at the CA-SRA. We will very briefly address those that seem most important.

[8] Of course, even in the simplest cases, an evaluator is free to supplement the analysis with additional quantitative and qualitative data such as interviews with architects and engineers involved in residential new construction or HVAC installers and a review of available market share data.

[9] In 2003, PA Government Services prepared another comprehensive, although different set of comprehensive guidelines for the use of the self-report approach. The report, "Standardized Methods for Free-Ridership and Spillover Evaluation – Task 5 Final Report (Revised)" was prepared for National Grid, NSTAR Electric, Northeast Utilities, Unitil, and Cape Light Compact.

[10] Since 2004, the CPUC only adjusts for freeridership, rather than all contributions to net impacts such as participant and nonparticipant spillover.

Legitimacy

Some have leveled the general criticism that the CA-SRA is not a legitimate social science tool for establishing causality. This paper, it is hoped, has made some progress in refuting this criticism.

Turbulent Environment

In any evaluation, as the number of alternative hypotheses grows, the task of teasing out the effects of a single intervention becomes more challenging, i.e., a large portion of the population has been contaminated by other energy efficiency interventions or events in the marketplace such as Energy Star, Flex Your Power, efforts by such retailers as Wal Mart, other PGC-funded programs and growing awareness of the dangers posed by global warming. This is the case whether one is using quasi-experimental or one of the various realist approaches to causality. To argue that the increasing number of energy efficiency interventions makes it *impossible* to assess the efficacy of any given program, one must show that this environment is more challenging than that faced by evaluators in other arenas such as education, mental health, and advertising. We see no compelling evidence that this is the case. In fact, in these other turbulent environments, evaluators continue to evaluate a wide variety of interventions using a growing number of innovative techniques and designs in order to inform important decisions.

Nonlinear Approach

Peters and McRae (2009) argue that the CA-SRA is based on a false assumption, that the route by which the program reaches the energy user is linear (" . . . the participant seeks the solution to a problem or to purchase a piece of equipment, learns of the efficiency opportunity promoted by the program, and decides to take the efficient action."). In fact, the CA-SRA explicitly recognizes that the route is nonlinear by attempting to identify the engineers, architects, vendors etc. who were most important in the customer's decision to participate and uncover the various ways in which the utility programs might have influenced these market actors. In the turbulent energy efficiency environment, the CA-SRA is focused on identifying the multiple lines of influence over time and recognizes that out of context, simple statements of linear relationships are more distorting than illuminating (Rogers 2000).

Recall

One of the problems inherent in the CA-SRA is that we are asking customers to recall what has happened in the past. It is well known in the interview literature that the more factual and concrete the information the survey requests, the more accurate responses are likely to be. Where we are asking for motivations and processes in situations that occurred one or two years ago, there is room for bias. In order to minimize the problem of recall, CA-SRA interviews should be conducted with the decision maker(s) as soon after the installation of equipment as possible (Stone et al. 2000).

Subjective

Various stakeholders have criticized the CA-SRA as being too subjective. The CA-SRA collects a variety of qualitative and quantitative evidence (e.g., corporate documents, past purchase patterns, closed-ended questions regarding motives and their strength from multiple sources). If an evaluator is able to provide some *evidence* for the mechanisms involved in the hypothesized causal links then this is not merely subjective.

Treating Ordinal Data as Interval

We begin by distinguishing ordinal data from interval data. Ordinal data have order, but the interval between measurements is not meaningful (i.e., moving from a 1 to a 2 is not necessarily the same as moving from a 5 to a 6). As a result, it is technically inappropriate to apply basic mathematical operations such as the calculation of means. On the other hand, interval data have meaningful intervals between measurements which support a variety of arithmetic operations. In the CA-SRA, what we are attempting to measure, among other things, is a participant's perception of the influence of the utility program on their decision to implement the energy-efficient measure. Because this is not something that is directly observable and measureable, we must rely on answers to a series of questions regarding the reasons for the installation. To assess the strength of any reason, we have chosen response categories along a 0-10 scale since the strength of the reasons cannot be adequately captured by a "yes" or "no" response. Making this choice means that we are not certain that moving from a 1 to a 2 is the same increase as moving from a 5 to a 6. However, we are willing to treat the responses as "sufficiently" interval for our purposes. While the debate over treating ordinal scales as interval has been going on for some time, there is strong support in the social science literature that treating ordinal variables as interval yields results that are both *meaningful* and *useful* to decision makers (Velleman & Wilkinson 1993; Tashakkori & Teddlie 1998)[11]. The ordinality of the observed data presumably reflects an underlying interval scale that just can't be measured at that level. Therefore, the lack of consistency in the distance between measured levels (1-2 versus 5-6) constitutes measurement error, something researchers of all kinds live with constantly. There is no reason to think that this measurement is not randomly distributed, and, therefore, of the most benign kind. At the very least, there is no reason to assume that the varying size of intervals biases responses upward or downward.

The Meaning and Calculation of the NTGR

Some have demonstrated that the calculation of the core NTGR can vary dramatically depending on the algorithm and the weights that an evaluator assigns to the different components. That changing the algorithms or weights results in big changes is obvious. It is equally obvious that algorithms and weights must be developed experienced professionals who understand that algorithms and weights have to be transparent, plausible and defensible and that they must be subjected to thoughtful sensitivity analysis. Many of the tools in science can provide bad results when done poorly. That does not prove the tool is bad only that the scientist is doing bad work - whether it is in free-ridership estimation, regression analysis, DOE2 modeling, or other fields with regression, gas chromatography, blood lab testing, reading biopsies, etc.![12]

Socially Desirable Responses

Another commonly recognized motivation for biased answers is that some people will like to portray themselves in a positive light; *e.g.*, they might like to think that they would have installed energy-efficient equipment without any incentive (the socially desirable response). This type of motivation could result in an artificially low net-to-gross ratio. The existence of the socially desirable response has been a perennial problem for survey researchers. Critics (Peters & McRae, 2008) appear to think that simply leveling this criticism is sufficiently damning. Unfortunately, they appear unwilling to

[11] Note that measurement of variables such as intelligence, depression and quality of life are all ordinal but are usually interpreted as if they were interval.

[12] These observations, with which we wholeheartedly agree, were provided recently by Lori Megdal.

acknowledge the various methods and techniques (Bradburn, Sudman, & Wansink 2004; Lyberg et al. 1997; Groves et al. 2004) that have been developed to address this potential source of bias and the extent to which these have been incorporated into the CA-SRA. For example, Bradburn, Sudman, and Wansink (2004) provide a checklist of 13 techniques for minimizing this bias including using data from knowledgeable informants (e.g., vendors, installers, etc.), attempting to validate the answers, and using both closed and open questions. These three are among a number of techniques that have been incorporated into the CA-SRA. Of course, it is possible that a respondent might exaggerate the importance of the program because they want the program and its rebates to continue. Technically, this is not a case of the socially desirable response bias but does represent a type of biased response that should be mentioned. The same techniques used to reduce the socially desirable response bias can be used to mitigate this other type of bias.

Stated Intentions

Peters and McRae (2008) argue that asking the respondent what they would have done in the absence of the program (the so-called *counterfactual*) is fatally flawed, since people are notoriously bad about following through on their stated intentions. This indeed would be a fatal flaw if only a single counterfactual type of question were asked of a single decisionmaker. In fact, the approach in the residential and nonresidential sectors is far more robust. Some questions are designed to measure the counterfactual by asking the participant a number of questions about what they would have done in the absence of the program. However, other questions attempt to get at the *operative* reasons for installing the efficient equipment. As part of this set of questions, the respondent is prompted to consider program and other possible non-program influences that might have played a role in the decision. Still other questions attempt to establish the temporal precedence of the program (information and/or rebate), i.e., when the participant first heard about the program relative to their decision to install the efficient equipment. In the nonresidential sector, additional information is gathered from program files, vendor surveys, account representatives, interviews with industry experts, and other program documentation to construct an internally consistent story surrounding the decision to install the energy efficiency equipment.

Conclusions

We have demonstrated that the realist approach is a legitimate method with a firm grounding in the epistemological literature. A variety of qualitative evaluation methods have been developed over the last 30 years that are consistent with the realist approach. Such qualitative methods for assessing causality can be rigorous and even more so if they are combined with quantitative methods, and vice versa. Within the evaluation community, many leading experts have endorsed such an approach, although many do see it as complementing not supplanting experimental or quasi-experimental approaches, i.e., a version of the mixed method approach. The CA-SRA is consistent with these qualitative approaches developed in the broader evaluation community. In California, for projects with substantial savings that have been assigned the enhanced level of rigor, the 2005 Protocols require, and we agree, that two or more approaches of the available three (discrete choice with a comparison group, billing analysis with a comparison group, and the CA-SRA) must be used. Such a mixed method approach provides a much improved (not perfect) level of accuracy. For programs that have been assigned the standard or basic level of rigor and for which methods involving comparison groups are impossible, the CA-SRA can provide estimates of the NTGR that are sufficiently rigorous for determining the degree of program influence for assessing program efficacy.

We also argued forcefully that any regulatory set of rewards and penalties should never require a level of accuracy that exceeds the ability of any evaluators to provide. To do so places and unreasonable burden on evaluators and ensures a never ending, contentious and unproductive relationship among program implementers and the regulatory community.

Finally, the straw man criticisms that have been lodged against the CA-SRA must be recognized for what they are; accusing the CA-SRA of methodological sins it never committed then deploring its lack of virtue.

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STATE OF IOWA
DEPARTMENT OF COMMERCE
BEFORE THE IOWA UTILITIES BOARD

IN RE: INTERSTATE POWER AND LIGHT COMPANY	DOCKET NO. EEP-2012-0001
MIDAMERICAN ENERGY COMPANY	DOCKET NO. EEP-2012-0002
BLACK HILLS/IOWA GAS UTILITY, LLC, d/b/a BLACK HILLS ENERGY	DOCKET NO. EEP-2013-0001

FINAL REPORT

The Office of Consumer Advocate ("OCA"), a division of the Iowa Department of Justice submits this Final Report with the consent of Interstate Power and Light Company ("IPL"), Black Hills Energy ("BHE"), MidAmerican Energy Company ("MEC"), and the Iowa Environmental Council and the Environmental Law and Policy Center (collectively "Environmental Intervenors") pursuant to Iowa Utilities Board ("Board") orders approving settlements in the above-captioned dockets.

The Iowa Administrative Code requires utilities to "estimate gross and net capacity and energy savings, accounting for free riders, take-back effects, and measure degradation." (199 IAC 35.8(2)*"c"*). Historically, utilities have met this requirement in energy efficiency plans by relying on a deemed ratio of 1.0. The Board, in its most recent orders approving the latest electric and natural gas energy efficiency plans, agreed that a report about net-to-gross ("NTG") policy would be beneficial to the Board, the utilities, and stakeholders by providing a more complete and accurate analysis of whether it is beneficial, given Iowa's regulatory regime and the design of energy efficiency plans and possible implementation framework.

In MidAmerican Docket No. EEP-2012-0002, the Board stated in its final order:

> The Board finds the approach outlined in Appendix 1 of the Settlement Agreement (M&V Plan, p.6) is reasonable and will ultimately provide more complete and accurate information regarding net-to-gross in Iowa. . . . The settlement provisions on net-to-gross that include a collaborative process are reasonable and will be approved. Under settlements reached in the various energy efficiency plan dockets, all investor-owned utilities will participate in the net-to-gross collaborative, which should result in a better product than if each utility proceeded independently.

In Interstate Power & Light Docket No. EEP-2012-0001 and Black Hills Energy Docket No. EEP-2013-0001, the IUB found the settlement provisions providing for a collaborative report of net-to-gross to be similarly reasonable.

Accordingly all three investor-owned utilities, the OCA, and the Environmental Intervenors participated in a collaborative process resulting in the attached Final Report from Navigant Consulting which provides information to help make informed decisions on the future application of NTG in energy efficiency programs in Iowa.

The collaboration involved a process that began by forming an Oversight Committee that included the investor-owned utilities, the OCA, and the Environmental Intervenors and outlining the Oversight Committee's desired study outcomes. These were included in a Request for Proposals ("RFP") and issued by the Iowa Utility Association ("IUA") on behalf of the Oversight Committee. The Oversight Committee received and reviewed a total of seven proposals, and interviewed three finalists in October, 2014. The Oversight Committee awarded Navigant the contract, and Navigant began work on the report in December 2014. The IUA participated in the Oversight Committee discussions and managed the contract with Navigant on behalf of the Oversight Committee. In the first half of 2015, the Oversight Committee held several in-person and teleconference meetings with Navigant to manage the direction of the project.

Navigant provided the Oversight Committee with an initial draft report in July 2015 and members of the collaboration have discussed their opinions about Navigant's recommendations and initial plans for pursuing those recommendations. In particular, the Oversight Committee agrees with Navigant's recommendation that energy efficiency programs be divided into the following three categories: (1) programs that continue with a deemed NTG value of 1.0 due to low benefits and net savings, and where previous research suggests that the NTG value would be close to 1.0; (2) programs for which secondary research will be conducted to establish deemed values other than 1.0 because previous research indicates that 1.0 is not likely to be an accurate NTG value, but the expense of primary research is not justified; and (3) programs that contribute large savings to the utilities' energy efficiency portfolio and warrant the expense of primary NTG research. The Final Report identifies which programs fall into each of these categories for each of the utilities based on the cost-effectiveness of conducting primary research. The Final Report suggests that NTG can be addressed by adjusting net savings from gross savings with a ratio other than 1.0, as appropriate, as well as through adjustments in the savings calculation baseline for many programs or measures.

Throughout the process, participants focused on balancing the benefits of accurate NTG values with the cost-effectiveness of obtaining those values. The Oversight Committee continues to discuss strategies for researching and applying NTG values and hopes to arrive at a mutually agreeable method for a new and more accurate approach to NTG in Iowa.

WHEREFORE, OCA submits this Final Report with consent Interstate Power and Light Company, Black Hills Energy, MidAmerican Energy Company and the Environmental Intervenors for the Board's information and consideration.

Respectfully submitted,

Mark R. Schuling
Consumer Advocate

/s/ Anna K. Ryon
Anna K. Ryon
Attorney

1375 East Court Avenue
Des Moines, Iowa 50319-0063
Telephone: (515) 725-7200
E-mail: IowaOCA@oca.iowa.gov

OFFICE OF CONSUMER ADVOCATE

ATTACHMENT

Final Report

Iowa Energy-Efficiency Net-to-Gross Report

Prepared for:
Iowa Utility Association and the Oversight Committee

From:

Navigant Consulting, Inc.
Dr. Daniel Violette, Dr. Ken Seiden, Jeff Erickson, Dr. Molly Podolefsky, Jeff McMillan and Scott Robinson

Apex Analytics, LLC
Scott Dimetrosky and Noah Lieb

September 2, 2015

Navigant Consulting, Inc.
1375 Walnut Street
Suite 200
Boulder, CO 80302

303.728.2500
navigant.com

NAVIGANT

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Executive Summary

A deemed net-to-gross (NTG) value of 1.0 for all energy efficiency programs has been in place in Iowa for more than a decade, supported by periodic secondary research efforts. The Iowa Utilities Board (Board) in its most recent orders approving the Alliant Energy, Black Hills Energy and MidAmerican Energy 2014-2018 Energy Efficiency Plans, also approved a collaborative process to "provide more complete and accurate information regarding net-to-gross in Iowa."[1] The collaborative process included an Oversight Committee that included representatives from the three investor-owned utilities (MidAmerican, Alliant Energy, and Black Hills Energy), the Iowa Office of Consumer Advocate, the Iowa Energy Center, the Environmental Law and Policy Center, and the Iowa Environmental Council.

The Iowa Utility Association contracted with Navigant Consulting, Inc. and Apex Analytics (the Navigant team) to conduct a new NTG study in 2015. The Navigant team's role was to provide the Oversight Committee with the information and context needed to make an informed choice on the future of NTG research and values in the state, and provide guidance and recommendations for developing an Iowa approach to applying NTG.

This study describes the landscape of NTG estimation methodologies currently in use across the country, provides context and guidance on which methods are most appropriate to Iowa programs, reviews the current state of NTG policies around the country, particularly in relation to Iowa's regulatory landscape, examines NTG research cost-benefit issues with a focus on potential net research benefits for specific Iowa utility programs, and provides options and recommendations for Iowa stakeholders in developing an Iowa-specific NTG approach .

The Navigant team conducted literature reviews, including NTG research reports, white papers, academic works, regulatory and legal filings. Additionally, the team conducted in-depth interviews with all three Iowa investor owned utilities, Alliant Energy, Black Hills Energy and MidAmerican Energy, in order to obtain the most current data and information on their energy efficiency and demand-side management (DSM) portfolios and programs. Navigant also developed an analytical tool for estimating the net benefits of conducting NTG research for specific Iowa programs under varying real-world scenarios.

Alternative NTG Research Perspectives

Navigant identified three central perspectives on NTG research while gathering and analyzing information for this Iowa NTG research report. These perspectives, which are briefly summarized below, influence the views—and the desired NTG research agenda—of all industry professionals and policymakers working on this topic. Understanding these perspectives and how they are associated with the views of the various Oversight Committee members, provides important contact for our findings and recommendations.

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[1] State of Iowa Department of Commerce Utilities Board, MidAmerican Energy Company Docket Number EEP-2012-0002, Final Order, issued December 16, 2013; State of Iowa Department of Commerce Utilities Board, Interstate Power and Light Company Docket Number EEP-2012-0001, Final Order, issued December 2, 2013; State of Iowa Department of Commerce Utilities board, Black Hills/Iowa Gas Utility, LLC, dba Black Hills Energy, Order Approving Settlement, December 17, 2013.

What we term a *deemed perspective* is the first of these three views and most closely represents a viewpoint historically held by Iowa utilities. From a deemed perspective, the uncertainty associated with primary NTG research often outweighs its benefit, and adoption of deemed values based on secondary research is considered sufficient. Iowa utilities have used a portfolio wide deemed ratio of 1.0.

Another viewpoint, which has historically been held by Iowa's environmental and consumer advocacy stakeholders, is represented by what we refer to as the *resource perspective*. According to this perspective, primary research on net savings and NTG research – focusing on free ridership and spillover – is necessary to ensure the reliability of energy efficiency and DSM programs as a resource, to confirm they are generating the expected returns on investment for ratepayers, and to increase actual savings caused by the programs by informing program design and implementation changes.
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The *market perspective* is a final viewpoint. It holds the determination of specific net savings / NTG component values such as free ridership and spillover are of secondary importance to understanding how utility programs operate and affect markets over time. The focus of this perspective is improved program designs and performance rather than NTG component values, though overall program-specific net savings and NTG values may still be obtained via market research. A market approach supports the development of a common practice baseline, an approach to NTG supported in the recently released Clean Power Plan (CPP)[2], which is discussed further below. Many Iowa stakeholders and members of the Oversight Committee find aspects of the market view appealing and most agree on the importance of understanding how utility programs operate and affect markets over time. The market perspective provides the common ground for developing an Iowa-specific NTG research agenda that would not necessarily be burdensome for Iowa utilities, nor a point of contention between utilities and other stakeholders, and would tie NTG research directly to CPP compliance through the potential to develop common practice baselines.

Findings and Recommendations for Consideration by the Oversight Committee

The Navigant team's research reveals that conducting primary NTG research will generally be cost-effective and appropriate for most of the larger energy efficiency programs, but there are many smaller programs where maintaining deemed a NTG value of 1.0, or other values based on secondary research, would be appropriate. Additionally, the findings suggest a flexible, common-sense approach which considers the perspectives described above as complementary rather than mutually exclusive. This "blended" view is most likely to facilitate cooperation and compromise between the various parties in agreeing upon a common NTG approach for Iowa.

Table 1 presents findings on the cost-effectiveness of conducting primary NTG research for various Iowa utility EE/DSM programs. Green rows indicate programs where primary NTG research is cost-effective across a range of scenarios. Orange rows reflect the opposite case, where primary NTG research is not cost-effective across a range of scenarios, and yellow rows reflect program where primary NTG research is generally not cost-effective, but may be cost-effective or nearly cost-effective, under certain specific scenarios. While the analysis behind these calculations is described in detail in Section 6, the overall finding is that the cost-effectiveness of conducting NTG research varies by program depending on the size of the program and its importance in terms of savings, the size of the utility, the variability of NTG values exhibited by different types of programs, and the potential for program design or implementation improvements based on better NTG information:

[2] Clean Power Plan, U.S. Environmental Protection Agency website: http://www2.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants

- For the larger utilities (MidAmerican and Alliant), this analysis shows that under most realistic scenarios, NTG research will be cost-effective for a large number of programs, though some programs rarely if ever warrant primary NTG research.
- By contrast, for small utilities (Black Hills) primary NTG research may not be cost effective for most programs under most realistic scenarios, unless coordination of research with larger utilities makes primary research more cost-effective.

It is important to note that even from a deemed perspective, programs that exhibit only marginally positive net research benefits may be candidates for assigning deemed values based on other jurisdictions' findings, which may can differ from 1.0, along with infrequent NTG research to validate or calibrate these values.

Table 1. Summary of High and Low Net Research Benefit Outcomes by Program

Alliant	Low Value of Primary NTG Research	High Value of Primary NTG Research
Commercial New Construction	$1,267,610	$3,813,441
Custom Rebates	$2,132,920	$7,316,725
Nonresidential Prescriptive Rebates	$290,280	$1,183,585
Residential Prescriptive Rebates	$142,990	$748,572
Appliance Recycling	$53,950	$259,222
Change-a-Light	($84,170)	$124,714
Home Energy Assessments	($67,730)	($51,548)
Black Hills Energy		
Residential Prescriptive	($56,730)	$76,637
Nonresidential Prescriptive	($89,270)	($4,885)
Residential New Construction	($55,330)	($12,505)
Nonresidential Custom	($54,610)	($25,766)
Nonresidential New Construction	($61,480)	($45,533)
MidAmerican		
Residential Equipment	$477,510	$1,736,588
Nonresidential Equipment	$1,039,560	$3,774,746
Commercial New Construction	$596,840	$1,887,601
Upstream Retail Lighting	$70,470	$558,255
Industrial Partners	$210,290	$608,815
Commercial Assessment	($18,640)	$106,763
Residential Assessment	($29,840)	$101,952

Where primary NTG research is warranted for many programs, Iowa stakeholders should consider implementing the market-based methods detailed in this report to gain a more comprehensive understanding of the larger energy efficiency programs, and the markets in which they operate. Market-based NTG research approaches to programs should also be used to generate common practice market baseline values and/or NTG values. This is especially appropriate given that it will help utilities comply with the CPP, which suggests a common practice market baseline approach. Programs should be considered on an individual basis in determining the best NTG research approach and associated timing, and approaches and timing should be adaptable to changing markets and programs.

Navigant's research process for this report and attendant conversations with and between stakeholders have resulted in a better understanding of the NTG research issue overall and a high degree of agreement on a large number of NTG research issues. Identification of the three key perspectives on NTG research has provided a framework within which stakeholders can more easily define and articulate their values and priorities, and translate those into appropriate NTG research methods on a program-by-program basis. While some issues remain unresolved, conversations and dialogue between stakeholders have at least delineated their preferences, viewpoints and rationales, facilitating future compromise.

During the development of this research report, draft federal guidelines were released in a final version of the Clean Power Plan (CPP), and this, as well, has implications for potential Iowa NTG research approaches. While the CPP indicates that either Net or Gross approaches may be adopted where justified, it supports adoption of a common practice market baseline approach to NTG. This is an approach that has been pioneered and used for decades in the Pacific Northwest. A common practice market baseline approach effectively assumes a NTG value of 1.0, but reduces gross savings relative to existing code and minimum standard baselines. The common practice baseline approach is discussed in detail in Section 4 , along with other NTG methods.

Table 2 summarizes Navigant's recommendations to guide Iowa in moving forward with a uniform approach to NTG research.

Table 2. NTG Research Recommendations for Consideration by the Oversight Committee

Continue with a deemed NTG value of 1.0 for programs with low net benefits and savings, and where research has found programs are likely to have a NTG value close to 1.0.
Continue to apply state-of-the-industry net savings research methods to demand management programs such as demand response and direct load management programs, and for residential behavior programs such as Opower HERs.
Conduct secondary research to determine and establish deemed values other than 1.0 for programs where the costs of NTG research are not justified, but research shows a NTG value of 1.0 to be unlikely. These are generally the programs in yellow and orange in Table 1.
Conduct primary NTG research to estimate NTG values and/or common practice market baselines for key programs contributing large savings to the utility's DSM portfolio, using any or multiple methods outlined in this report. Most of these programs are represented in green in Table 1, though there may be additional programs for which the utility conducts primary research.
For programs warranting primary NTG research, market-based methods may be used as the primary research methodology, providing a comprehensive understanding of energy efficiency markets, facilitating development of common practice market baselines, and/or generating estimates of the FR and SO components of NTG values.
NTG research should begin immediately rather than during the next five-year planning cycle, and resulting NTG values should be applied prospectively. Particularly for the green programs in Table 1, research should begin during the current planning cycle to facilitate updates to the Iowa TRM and utility program designs prior to finalizing the next set of five-year plans.
NTG research should be conducted at a minimum once per each five-year planning cycle, but for programs contributing large savings to the portfolio, programs in rapidly changing markets, primary research may need to be conducted every 2 to 3 years and possibly more frequently. Ultimately, the research findings will provide guidance as to when additional / new NTG research should be conducted.
Periodic review of all established deemed NTG value should be conducted to ensure they remain relevant and appropriate.

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1. Introduction

1.1 History and Context

Section 1 Contents:
• History and Context
• Research Goals and Objectives
• Organization of this Report

The Iowa Administrative Code requires utilities to "estimate gross and net capacity and energy savings, accounting for free riders, take-back effects, and measure degradation."[3] Historically, utilities have met this requirement in energy efficiency plans by relying on a deemed net-to-gross (NTG) ratio of 1.0.

This deemed value has existed for more than a decade, beginning with an initial IUA report prepared in 2002 that laid out recommendations for dealing with NTG issues in the Energy Efficiency Plans filed by the state's utilities for 2004-2008.[4] That report provided a comprehensive look at the current state and history of NTG policy, exploring existing methods and identifying common practices in use across the United States, while focusing on the competing forces of free-ridership and spillover. At that time, the report concluded that due to lack of consensus on best practices, problems with accuracy of measurement and practical time and expense constraints, Iowa was best served by adopting a deemed NTG value of 1.0, implying that the effects of free-ridership and spillover effectively cancel one another out.

Iowa's utilities revisited the issue of NTG policy in 2008 in advance of the 2009-2014 Energy Efficiency Plans.[5] While again addressing trends and recent approaches to NTG accounting, free-ridership and spillover, the second report broadened the scope of inquiry to include potential market effects. The 2008 IUA-sponsored report found that the majority of evaluation studies issued after 2002 still calculated NTG values close to 1.0. In line with the 2002 study, the report suggested Iowa's investor-owned utilities maintain the assumption of a NTG ratio of 1.0. However, the report concluded with the caveat that due to the existence of free-ridership, Iowa's utilities should continue to design incentive programs with the intention of discouraging free riders. The most recent iteration of the report, conducted in 2012 in advance of the 2014-2018 Energy Efficiency Plans, was similar in scope and findings to its predecessors.[6] Updated research and evaluation report findings were presented, but the conclusions drawn and recommendations made to Iowa's utilities and stakeholders were largely unchanged.

The Iowa Utilities Board (Board) in its most recent orders approving the 2014-2018 Energy Efficiency Plans developed by Alliant Energy, Black Hills Energy and MidAmerican Energy, described a collaborative NTG process. The Board stated that the Settlement Agreement establish a new collaborative process "will ultimately provide more complete and accurate information regarding net-to-gross in Iowa" and that the "settlements reached in the various energy efficiency plan dockets, all investor-owned utilities will participate in the net-to-gross collaborative, which should result in a better product than if each utility proceeded independently."[7]

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[3] 199 IAC 35.8(2) "c".

[4] Global Energy Partners and Quantec (2002). *Assessment of Energy and Capacity Savings Potential in Iowa, Volume II: Free Riders and Spillover—A Look Back, A Path Forward*.

[5] Quantec, Summit Blue Consulting, Nexant Inc., A-TEC Energy Corporation and Britt/Makela Group (2008). *Assessment of Energy and Capacity Savings Potential in Iowa, Volume II*.

[6] Cadmus (2012) *Assessment of Energy and Capacity Savings Potential in Iowa, Volume I*.

[7] This quote was taken directly from the MidAmerican docket, but Alliant Energy and Black Hills Energy's Order dockets are also cited here for reference. State of Iowa Department of Commerce Utilities Board, MidAmerican

The collaborative process includes an Oversight Committee that – on behalf of the state of Iowa, its utilities, and other interested parties – is charged in the Settlement Agreement with preparing "a report to the Board with recommendations regarding NTG policy and possible implementation framework."[8] In addition to the three investor-owned utilities, the Oversight Committee includes representative from the Iowa Office of Consumer Advocate, the Iowa Energy Center, the Environmental Law and Policy Center, and the Iowa Environmental Council.

1.1.1 National NTG Context

Iowa has many of the same NTG challenges and opportunities faced by states across the U.S. in determining how to approach (NTG) in a rapidly evolving political and regulatory landscape. Nationwide, over the past decade utility-run energy efficiency, demand response and behavioral programs have increased in number and prominence, ushering in renewed interest in estimating net savings through NTG research. The increasing prominence of demand-side programs contributed to publication of the Net Savings Uniform Methods Project (UMP) chapter, a national effort to detail current net savings estimation methods, to examine best practices for estimating savings from energy efficiency programs, and encourage application of methods consistent with these practices.

The EPA's Clean Power Plan (CPP), finalized in August of 2015, is another key political change increasing the importance of energy efficiency portfolios. The proposed CPP requires states to significantly reduce CO2 emissions from fossil fuel plants, while granting states some flexibility in meeting this mandate. Choices in energy efficiency portfolios and defensible savings may hold the key to many states, including Iowa, complying with these new regulations. [9]

1.2 Study Goals and Objectives

The Oversight Committee contracted with Navigant Consulting, Inc. and Apex Analytics (the Navigant team) to conduct a new NTG study in 2015. The Navigant team's role was to provide the Oversight Committee with the context and information necessary to make informed choices on appropriate NTG research agendas for Iowa and its utilities.[10] The goal was to provide the Oversight Committee with information needed for them to set policies consistent with goals and objectives regarding EE in Iowa.

At the onset of this assignment the Oversight Committee established the following study objectives:

Energy Company Docket Number EEP-2012-0002, Final Order, issued December 16, 2013; State of Iowa Department of Commerce Utilities Board, Interstate Power and Light Company Docket Number EEP-2012-0001, Final Order, issued December 2, 2013. State of Iowa Department of Commerce Utilities board, Black Hills/Iowa Gas Utility, LLC, dba Black Hills Energy, Order Approving Settlement, December 17, 2013.

[8] State of Iowa Department of Commerce Utilities Board, MidAmerican Energy Company Docket Number EEP-2012-0002, Final Order, issued December 16, 2013; State of Iowa Department of Commerce Utilities Board, Interstate Power and Light Company Docket Number EEP-2012-0001, Final Order, issued December 2, 2013. State of Iowa Department of Commerce Utilities board, Black Hills/Iowa Gas Utility, LLC, dba Black Hills Energy, Order Approving Settlement, December 17, 2013.

[9] Clean Power Plan, U.S. Environmental Protection Agency website: http://www2.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants.

[10] As cited in footnote 7, the MidAmerican Final Order docket states that Navigant's research fills the role of helping the Oversight Committee to prepare "a report to the Board with recommendations regarding NTG policy and possible implementation framework."

- Provide a review of current net-to-gross practices around the country, the relationship between different approaches to net-to-gross and policy objectives.
- Provide a description of trends in the use of net-to-gross ratios, particularly with respect to best practices for net-to-gross ratios in states with strong and effective energy efficiency programs and standards.
- Provide a review of the practical application of various methods used to estimate net- to-gross results.
- Provide an estimate of the cost of conducting net-to-gross analyses per customer and per percent of budgets.
- Describe the frequency required to maintain accurate net-to-gross ratios with respect to different energy efficiency measures.
- Describe the level of accuracy achieved through net-to-gross studies.
- Provide analysis as to whether and how use of net-to-gross might improve the design, cost-effectiveness, and confidence in reported savings of energy efficiency programs in general.
- Provide an Iowa-specific analysis as to whether net-to-gross ratios should apply to all measures or programs or whether certain measures or programs should be prioritized.

1.3 Organization of this Report

The remainder of this report is organized as follows:

- Section 2 - Iowa NTG Background
- Section 3 - New Perspectives on NTG, Attribution, and Research
- Section 4 - Review of Practical NTG Approaches, Best Practices, Trends and Methods
- Section 5 - State-Specific NTG Approaches, and Relationship to Policy Objectives and Perspectives
- Section 6 - Benefit / Cost Analysis of NTG Research
- Section 7 - An Iowa Research Agenda for Net Savings

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2. Iowa NTG Background

Section 2 Contents:
• Statement of Issues and Settlement Agreement
• Outcomes of Settlement Relating to NTG
• Ongoing use of NTG by Iowa Utilities
• Iowa Utilities' Current EE Portfolios

The determination of net savings and/or NTG ratios is not a new issue to Iowa utilities and stakeholders. NTG has been considered by Iowa utilities both implicitly (in program and rebate design) and explicitly for many years. Iowa utilities use a portfolio-wide NTG value of 1.0, a practice currently in place in several other states. While Navigant holds that this portfolio-wide deemed approach is no longer appropriate by current industry standards, Iowa's historical use of a portfolio deemed value was based on secondary research, conducted during each planning cycle going back more than a decade, which found the portfolio-wide deemed value appropriate.[11] By contrast, utilities in many states employ primary research-based NTG estimation methods such as participant and trade ally surveys, structured expert judgement and historical tracing approaches, randomized controlled trials (RCTs) and billing analyses.[12] Each method has its place, and there is no one-size-fits-all approach to address NTG research questions.

This section provides context for recent and historical NTG dialogue in Iowa, describes how Iowa utilities arrived at the current state of NTG estimation, and identifies utility and stakeholder concerns and interests in moving forward with NTG research. The Navigant team contacted various members of the Oversight Committee, Alliant Energy, Black Hills Energy and MidAmerican Energy to collect relevant documents, briefings, testimony, reports and filings related to the utilities programs and NTG research in Iowa. [13] These and other documents are synthesized to provide needed background for the report and create a balanced view of the current state of NTG research in Iowa, while shedding light on the events leading to Iowa stakeholders' current investigation of NTG research options.

2.1 Statement of Issues and Settlement Agreement

In July of 2013, Iowa utilities, environmental and consumer advocacy groups, along with several other stakeholders, filed a Joint Statement of Issues before the Iowa Utilities Board, asking that the Board make a determination on a range of issues surrounding Iowa utilities' energy efficiency portfolios, practices

[11] Global Energy Partners and Quantec (2002). *Assessment of Energy and Capacity Savings Potential in Iowa, Volume II: Free Riders and Spillover—A Look Back, A Path Forward*; Quantec, Summit Blue Consulting, Nexant Inc., A-TEC Energy Corporation and Britt/Makela Group (2008). *Assessment of Energy and Capacity Savings Potential in Iowa, Volume II*; Cadmus (2012) *Assessment of Energy and Capacity Savings Potential in Iowa, Volume I.*

[12] All these methods, and others, are described in Section 3.

[13] *MidAmerican Iowa Exploratory NTG Research: Background, Methodology, Results and Key Findings*, prepared by Tetra Tech, November 30, 2014; *The Assessment of Energy and Capacity Savings Potential in Iowa,* prepared by The Cadmus Group, February 28, 2012; *Energy Efficiency and Demand Response Potential for Iowa municipal Utilities, For the Years 2012 and 2018,* prepared by Energy Center of Wisconsin, June, 2009; State of Iowa Department of Commerce Utilities Board, MidAmerican Energy Company Docket Number EEP-2012-0002, Joint Statement of Issues, Filed July 29, 2013; State of Iowa Department of Commerce Utilities Board, MidAmerican Energy Company Docket Number EEP-2012-0002, Non-Unanimous Partial Settlement Agreement, filed August 26, 2013; State of Iowa Department of Commerce Utilities Board, MidAmerican Energy Company Docket Number EEP-2012-0002, Final Order, issued December 16, 2013; State of Iowa Department of Commerce Utilities Board, MidAmerican Energy Company

and planning. Some of the issues raised in the Statement which were pertinent to NTG research included:

- Whether a NTG value other than 1.0 should be considered for certain programs, and what the implications would be.
- Whether the utilities' Energy Efficiency Portfolios were cost-effective.
- Whether the utilities are achieving sufficient economic potential.
- Whether utility savings targets are appropriate.
- Whether utilities' energy efficiency programs provide optimal benefits to customers, and if additional performance-based criteria should be used to gauge optimal benefits and help to optimize cost-effective energy efficiency opportunities.

Consideration of these issues with respect to all three utilities ultimately resulted in a Joint Motion for Approval of Non-Unanimous Partial Settlement for Alliant Energy and MidAmerican Energy, and a Non-Unanimous Settlement for Black Hills Energy. The settlements were filed by the utilities, the OCA, the ELPC, the IEC and other stakeholders. As a result of the settlement process, a collaborative group was established to investigate NTG in Iowa, and Navigant was hired to provide research on NTG to help inform this collaborative effort.

2.2 Existing NTG Consideration and Research in Iowa

Iowa utilities have been implicitly considering NTG values in designing their programs since they began offering demand-side programs in the early 1990s. In adjusting these programs to move customers up the efficiency ladder and adjust rebate levels (examples include both residential or commercial prescriptive programs), Iowa utilities may *already be taking into consideration* issues such as free ridership (FR) and market effects (ME).

A more explicit example of how Iowa utilities are already considering net savings is in the case of demand response (DR), direct load control (DLC) and Home Energy Report (HER) programs. Typical savings estimation methodologies for DLC and DR programs use participants provide net rather than gross savings due to the use of control groups or control periods. Similarly, HER programs typically utilize a randomized controlled trial (RCT) design, again resulting in net savings estimates. Additionally, MidAmerican Energy has already undertaken NTG research for some of its programs in the previous planning cycle, between 2009 and 2013[14]. MidAmerican describes the purpose of this research as being to better inform Iowa stakeholders as to what NTG research entails and looks like in practice. From this perspective, MidAmerican's initial NTG research provides insights into the types of issues and concerns that will have to be dealt with in future Iowa NTG research efforts.

2.3 Iowa Utilities' Current EE Portfolios

Interviews with Alliant Energy, MidAmerican Energy and Black Hills Energy provided Navigant with an up-to-date perspective on their current energy efficiency portfolios, which programs are top priorities in terms of EE savings, recent changes to programs, and market and industry changes affecting program performance.

[14] Schuauer, Laura, "*MidAmerican Iowa Exploratory NTG Research: Background, Methodology, Results and Key Findings,*" Tetra Tech, November, 2014.

While each utility offers a wide variety of programs, residential and commercial prescriptive rebate programs remain the backbone of the utilities' EE portfolios.[15] Alliant Energy generates 24% of its annual electric savings and 49% of its annual gas savings through its residential and commercial prescriptive rebate programs. These programs provide 49% of MidAmerican Energy's electric savings 32% of its gas savings. Similarly, 67% of Black Hills total gas savings is generated through these programs. Other large programs include Alliant Energy's custom rebate program, MidAmerican Energy's new construction program, and Black Hills Energy's residential new construction program.

Despite a few large programs providing much of the savings, all three utilities offer a wide variety of energy efficiency programs to meet the various needs of their customers including new construction, lighting, energy assessment, low-income weatherization, agriculture, education, appliance recycling and other targeted energy efficiency programs. Though these programs do not contribute large savings to each utility's portfolio, the utilities and other Iowa stakeholders value these programs because they meet the varied needs of different customer segments.

While Iowa utilities' energy efficiency portfolios share many common characteristics, each utility's portfolio exhibits differences based on the needs of its customers. For example,

- Alliant Energy offers a commercial/industrial custom rebate program that accounts for 45% of its annual electric savings, whereas custom programs for the other two utilities are much smaller.
- Black Hills Energy provides gas only, and serves a smaller market than the other two utilities, and has a larger number of low-income targeted energy efficiency programs, including low-income weatherization, low-income energy education, low-income affordable housing and low-income multifamily efficiency improvement programs.
- MidAmerican has dedicated a large percentage of its total EE portfolio expenditures to meet the EE needs of commercial customers. Its Commercial Energy Solutions, Commercial New Construction and Industrial Partners programs account for roughly a quarter of total annual EE portfolio expenditures.

According to all of the utility interviews, their residential new construction programs have been heavily impacted by recent market and industry changes. Participation in these programs has been steadily and rapidly declining due to building code changes which have made program participation less profitable. These utilities have also work in cooperation to administer commercial new construction programs through the Weidt Group, which are largely standardized across utilities. This enables contractors and commercial customers to qualify for similar incentives through a uniform process across utility territories. Finally, due to the increasing prominence of lighting applications, particularly LEDs and CFLs, in prescriptive rebate programs, both Alliant Energy and MidAmerican have recently created

[15] Alliant Energy, Black Hills Energy and MidAmerican Energy all provided regulatory filing documents with the most up-to-date utility cost test values for Navigant to use as benefit inputs for each program. The source documents referenced for each utility are as follows: For Alliant Energy, we referenced the *Interstate Power and Light Company—2014-2018 Energy Efficiency Plan*, prepared for the IUB, Docket No. EEP-2012-0001, November 30, 2012. For Alliant Energy we also referenced the *IPL Energy Efficiency Plan—Compliance*, prepared for IUB, January 31, 2014, Corrected Revised January 25, 2013. For Black Hills Energy Navigant referenced the *Black Hills Energy—Energy-Efficiency Plan 2014-2018*, prepared for the Iowa Utilities Board (IUB), Docket No. EEP-2013-0001, April 1, 2013. For MidAmerican Energy Navigant referenced *MidAmerican Energy Company—2014-2018 Energy Efficiency Plan, Revised Volume II*, prepared for the IUB, Docket No. EEP-2012-0002, February 24, 2014.

upstream lighting programs as stand-alone programs outside the prescriptive programs they were formerly within.

Tables 3 through 5 present detailed information on the majority of EE/DSM programs offered by the three Iowa utilities, including information on the relative size of budget and savings for each program. These tables provide clarity on the relative size and importance of various programs to each utility's portfolio.

Programs have been color-coded in these tables to indicate whether or not NTG research is likely to be beneficial based on the Navigant team's industry experience.[16] Programs in green may potentially yield positive net benefits to conducting NTG research. Blue indicates programs for which net savings are already being calculated through impact evaluations. Programs in red are programs that seem unlikely to yield positive net benefits to conducting NTG research under almost any scenario. By their design and target customer group, these are more likely to have NTG ratios close to 1.0 (e.g., low income programs), or the programs don't claim energy or capacity savings. While the cost-effectiveness of conducting primary NTG research is analyzed in detail for each program in Section 6, the findings in Tables 3 through 5 present general findings on the types of program, by utility, which are generally expected to warrant NTG primary research, versus those that are not.

[16] A more detailed analysis of the cost-effectiveness of NTG research for each program is detailed in Section 6.

Table 3. Alliant Energy—Demand-Side Management Program Information

Portfolio Summary					
Programs	Total 5 Year Plan Program Budget	Program Budget as Percent of Total Portfolio Expenditure	Program Savings as Percent of Total EE Portfolio Electric Savings	Program Savings as Percent of Total EE Portfolio Gas Savings	Recent Changes to the Program
Appliance Recycling	$8,683,739	2%	7%	0%	No major changes for 8 or 9 years.
Change-a-Light	$12,562,177	3%	7%	0%	Now stand-alone program, previously part of prescriptive programs.
Commercial New Construction	$6,224,671	2%	8%	5%	Adoption of 2012 IECP.
Custom Rebates Program	$46,436,752	13%	45%	12%	No recent changes.
Home Energy Assessment Program	$16,595,359	4%	2%	15%	Offers two levels: basic and additional, at higher price.
Non-Residential Prescriptive Rebate	$44,093,861	12%	16%	32%	Added additional measures such as commercial food service
Residential Prescriptive Rebate	$65,209,023	18%	8%	17%	Discontinued all residential appliance rebates.
New Home Construction	$5,122,346	1%	0%	3%	Added HERS rating
Nonresidential Interruptible Program	$122,369,826	33%	NA	NA	
Residential Direct Load Control Program	$12,764,384	3%	NA	NA	
Agriculture	$4,537,592	1%	2%	2%	
Business Assessments Program	$5,365,189	1%	2%	2%	
Low Income Energy Wise Education/Energy Savers Program	$467,677	0%	0%	0%	
Low Income Multifamily and Institutional	$2,459,008	1%	0%	0%	
Low Income Weatherization	$16,154,632	0%	2%	10%	
Multifamily	$786,978	0%	0%	0%	

(green)	Likely to experience net benefits from NTG research
(blue)	Already calculating net savings
(orange)	Unlikely to experience net benefits from NTG research

Table 4. Black Hills Energy—Demand-Side Management Program Information

Portfolio Summary				
Programs	Gas Only 5 Year Plan Program Budget	Program Budget as Percent of Total Portfolio Expenditure	Program Savings as Percent of Total EE Portfolio Gas Savings	Recent Changes to the Program
Nonresidential Custom Program	$289,500	1%	6%	Incentive target is 2-year payback, with a maximum of 50% of value.
Nonresidential New Construction Program	$1,086,800	4%	2%	Delivered with other utilities.
Nonresidential Prescriptive Program	$4,371,700	15%	21%	More cooking measures added; Some boilers under 300K Btu added.
Residential Evaluation Program	$3,496,500	12%	5%	Multifamily component is new. Has multiple tiers available now.
Residential New Construction Program	$2,660,900	9%	9%	Codes have changed, and no longer using HERS rating.
Residential Prescriptive Program	$12,956,800	45%	50%	Is a feeder program, required to get insulation incentives.
GIAC	$110,000	0%	-	
Low Income Affordable Housing	$534,300	2%	0%	
Low Income Energy Education	$117,800	0%	1%	
Low Income Multifamily Efficiency Improvements	$110,500	0%	0%	
Low Income Weatherization Program/Weatherization Team	$3,221,800	11.1%	2%	
Nonresidential Evaluation Program	$18,200	0%	0%	

Green	Likely to experience net benefits from NTG research
Blue	Already calculating net savings
Peach	Unlikely to experience net benefits from NTG research

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Table 5. MidAmerican Energy—Demand-Side Management Program Information

Portfolio Summary					
Programs	Total 5 Year Plan Program Budget	Program Budget as Percent of Total Portfolio Expenditure	Program Savings as Percent of Total EE Portfolio Electric Savings	Program Savings as Percent of Total EE Portfolio Gas Savings	Recent Changes to the Program
Commercial Energy Solutions	$54,239,586	10%	5%	7%	New program offering. Changed from “Business Check” to increase attractiveness of program to mid-large buildings.
Commercial New Construction Program	$43,393,302	8%	12%	5%	Delivered with other utilities.
Industrial Partners Program	$39,803,537	8%	8%	2%	Recently rebranded, Energy Manager now assigned to individual commercial customers.
Nonresidential Equipment Program	$48,480,366	9%	23%	12%	Bringing in custom as its own track. Expanded to offer more kitchen measures, 15 new measures total.
Residential Assessment Program	$26,682,083	5%	1%	0%	Now all measures initiated through Assessment program are recorded in the Assessment program.
Residential Equipment Program	$114,749,062	22%	9%	35%	Requiring quality installations for HVAC equipment. Many appliances removed. Incentive levels increased.
Upstream Lighting	$13,978,913	3%	12%	NA	Recently offered as stand-alone program
Residential New Construction	$30,260,120	6%	2%	6%	Participation declining due to code impacts and market change
Nonresidential Load Management	$42,855,363	8%	NA	NA	
Residential Behavior Program	$9,465,000	2%	17%	16%	
Residential Load Management	$15,082,639	3%	NA	NA	
Agriculture Program	$1,051,137	0%	0%	0%	
Appliance Recycling Program	$10,545,792	2%	4%	4%	
Multifamily Program	$42,220,230	8%	4%	2%	
Nonresidential Low Income	$385,092	0%	0%	0%	
Residential HVAC Tune-up	$8,567,500	2%	0%	2%	
Residential Low Income Program	$19,673,381	3%	1%	3%	

(green)	Likely to experience net benefits from NTG research
(blue)	Already calculating net savings
(peach)	Unlikely to experience net benefits from NTG research

3. New Perspectives on NTG, Attribution, and Research

Section 3 Contents:
• Energy Resource View
• Market View
• Deemed View
• Blended Perspectives
• NTG Viewpoints in Iowa

The work on NTG methods and policies, given the historical and current context expressed by Iowa stakeholders, led to Navigant identifying three perspectives on net savings, attribution and research:

- Energy resource view
- Market view
- Deemed view

These perspectives provide a convenient framework for characterizing the priorities and viewpoints of various Iowa stakeholders with respect to NTG research, both currently and looking forward. In addition, looking at these three views can result in a "blended" perspective that might be most appropriate for a state's policy or stakeholder group.

3.1 Energy Resource View

The first of these perspectives is what termed an energy resource view. It is perhaps the most dominant viewpoint, and describes the perspective that NTG research should focus on energy efficiency and other demand-side programs as resource investments that are similar to traditional supply-side resources. In this paradigm, program impacts are measurable in terms of both gross and net savings, akin to power plant operations, outages, etc.

The energy resource view tends to emphasize estimating net savings. The goals of this viewpoint are to achieve more certainty on the return the ratepayers are getting on their investments in energy efficiency and to increase savings caused by the programs. Though market effects may be considered from this perspective, the focus is on the magnitude of market effects and their influence on net savings.

This energy resource perspective can lead to NTG research being performed for selected programs that account for a large part of the overall portfolio savings, or for programs that may have undergone changes and updated information is needed. The rationale behind conducting frequent, regular NTG research on major programs is that if these programs or the markets in which they operate are changing over time, researched NTG values estimated in year 1 may no longer be accurate in the out years of a program plan. The objective is to treat demand-side program savings as a reliable resource. The more resource savings[17] (i.e., resources attributable to the program) at risk that might wrongly attributed to a program (down-side risk) or mistakenly not attributed to a program (upside risk), the greater the incentive to conduct research to pin down more accurate NTG values and reduce that risk.

[17] Resource savings are those saving attributable to the program, i.e., they would not have occurred if the program had not been offered. These savings include direct savings from customer participants, as well spillover savings that are attributable to the program, but are not directly captured in the program tracking system. This includes additional savings that program participants might take as a result of participating in the program, potential non-participant savings, and spillover in the market in terms of trade ally recommendations, stocking practices, and general knowledge regarding energy efficiency practices. These savings are often inconsistently defined in the literature, but generally have been termed spillover and/or market effects.

Consider, for example, a large utility's residential prescriptive rebate program, and suppose that program accounts for a third of all energy efficiency portfolio savings for the utility. In that case, if the utility assumes a NTG value of 1.0 when the true value is 0.7, there could be millions of dollars in program resource savings being wrongly attributed to the program. Those dollars also could be invested in programs or measures to generate more savings. Another way of looking at this from a resource perspective is that the utility's return on investment for that energy efficiency program is 30% lower than it believes. If the utility believes such a scenario is possible for some of its programs, and has a resource perspective, it will aim to conduct research often enough and in a rigorous enough manner to reduce that risk to an acceptable level.

3.2 Market View

The second NTG perspective Navigant has identified is a market view. This view places greater importance on examining the overall market while still recognizing the importance of achieving savings from EE programs and activities. From this perspective, NTG research should focus on understanding the markets in which energy efficiency and other demand-side programs operate, particularly the program's influence on the market, Rather than focusing exclusively on estimates of net savings, free ridership and spillover, a market view focuses on how the program affects the market, whether the program is working as intended, and alternate performance metrics in the form of sales and market share time series showing how energy efficiency programs contribute to changes in the market for energy efficiency. A common research approach from this perspective is to conduct market characterization studies focusing on trade ally practices, retail and distributor equipment stocks, the stock of knowledge related to energy efficiency technologies and practices among building managers, ESCOs and architecture and engineering (A&E) firms. Both common practice market baseline values and NTG values may be generated through market-based research. In light of recent CPP guidance supporting use of a common market baseline approach, a market-based research approach may be particularly valuable to Iowa utilities.

The goal from a market perspective is to understand energy efficiency markets as comprehensively as possible in relation to programs, and use this information to provide program design guidance. While common practice market baseline and NTG values may be produced with market-focused research, these should be complemented by other indicators to provide the larger view of the role of the program in the overall market. In the residential lighting market, for example, this entails understanding how sales of CFLs versus LEDs are shifting and how rapidly, which types of outlets different consumers purchase efficient bulbs from, how saturated is the market for these bulbs in different geographic regions, what trends do retailers see in the sales, prices and diversity of different types of efficient bulbs over time, how do retailers market bulbs and how are their marketing practices changing over time, and how do all of these factors relate to energy efficiency program design and delivery.

As another example, consider new home construction markets, where a market view will be concerned with understanding the interaction between program participation and building codes, changes in building codes over time, anticipated changes in the market for energy efficient construction materials and services, how the knowledge base regarding energy efficient technologies and practices among building managers, ESCOs and A&E firms is changing over time, how trade ally practices are changing over time, how the building stock and equipment stocks are changing over time, in relation to energy efficiency programs.

From the market vantage point, NTG research typically does not need to be undertaken on a yearly basis. A typical timeline for market characterization studies is bi-annually, though this varies by jurisdiction. More important efforts might be trade-ally and market-actor panels that are maintained over time to provide information on the role of the program in providing energy savings, but also on the role of the programs in the overall market.[18] The key is to conduct market characterization research often enough to develop a time series of indicators showing how energy efficiency programs contribute to changes in the market. In the case of many Iowa utilities, the market served by residential new construction programs has changed radically over the past decade, largely due to changes in building codes. A series of regular bi-annual market characterization studies spanning 15 years would paint a clear picture of the interaction between the market for energy efficiency in new home construction and utility new home construction energy efficiency programs. This would clarify how large a role utilities' energy efficiency programs have played in the evolution of this market over time, and help to correctly attribute changes in this energy efficiency market to utilities' programs.

3.3 Deemed View

A deemed perspective suggests that there is enough information in the market to estimate net savings ex ante by looking at current sales data, and from studies in other regions such that net savings is estimated at a level of accuracy acceptable to the stakeholders. This viewpoint may be driven by perceptions that NTG studies are expensive to conduct, are subject to biases, and do not add enough additional accuracy to the ex ante deemed estimates of net savings. From a deemed perspective it often makes more sense to lock in place a prospective NTG value for a program or a group of programs than to conduct research into net savings. A jurisdiction or utility with a deemed perspective may rely on the best NTG research available conducted elsewhere relating to programs or groups of programs in the portfolio, in lieu of conducting primary research to estimate NTG values. A deemed value may be established portfolio-wide, or on a program by program basis, though in Navigant's judgement a portfolio-wide deemed approach is no longer justifiable by current industry standards.

The deemed view holds that funding new NTG research is not warranted because these NTG values may be "close enough," despite the fact that the same inherent biases and precision issues may exist for other jurisdictions' NTG values. In other words, the perceived value of the increase in precision gained through conducting primary NTG research may be outweighed by the cost. Another framing of the idea of borrowing existing NTG values from other jurisdictions' research is that if you collect a large sample of researched NTG values for a given program, using the average of these values may help to converge on the true NTG value and eliminate some of the bias and imprecision of individual estimates through a triangulation-type approach.

An important caveat to the deemed approach is that a careful review of NTG values and their appropriateness to a program or group of programs is always in order. It is never justifiable to lock down a prospective NTG value for a program or group of programs without ever revisiting that value to assess appropriateness in the future. Market changes, technology changes and program changes may all cause formerly adequate NTG values to no longer be appropriate. In this case, even from a deemed perspective, periodic review and evaluation of prospectively deemed NTG values is always necessary. The amount of change in a market or program will generally dictate when and how often these periodic reviews should be conducted.

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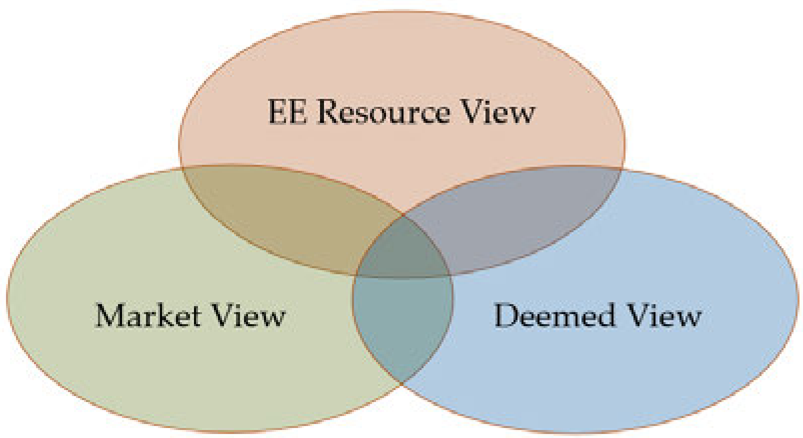
[18] One reason this might be selected as a policy view is to examine the impact of multiple programs targeting a similar market. These might be DOE programs, efforts by cities and regional organizations, and utility programs and activities.

3.4 Blended Perspectives

As shown in Figure 3-1, the energy resource, market and deemed viewpoints are not mutually exclusive. An individual jurisdiction or stakeholder may hold multiple or differing views depending on whether they are considering the entire energy efficiency portfolio versus a particular program, or the type of program and how important it is to the overall portfolio.

For instance, a stakeholder whose overall perspective is a market view may approach a new or large program in a utility's portfolio with a resource view to get a clear idea of what savings that program generates for the utility, and what return the utility is getting on its investment in that program. At the same time that stakeholder may view low-income and multifamily energy audit and insulation programs as unlikely to have a NTG that differs from 1.0, and subscribe to a deemed view for these programs. Other instances where viewpoints may overlap or merge is when looking at NTG research over different time periods. An individual may hold an energy resource view overall, for instance, but for the current year may feel that a deemed approach is more appropriate in order to sync up with planning cycles, process evaluations or other events. In many cases these perspectives are complimentary, and the best outcome for Iowa stakeholders with respect to developing a NTG research agenda will most likely involve a blending of views.

Figure 1. Three Perspectives on NTG Research



3.5 NTG Viewpoints in Iowa

The viewpoints described in this section provide a useful framework for stakeholders to reference when developing a NTG research agenda for Iowa. The utilities have historically demonstrated a deemed perspective on NTG with a portfolio-wide NTG value of 1.0. This NTG value was based on secondary research based on studies outside of Iowa showing that a portfolio-level value of 1.0 was sufficient.[19] By contrast, other Iowa stakeholders including environmental and consumer advocacy groups appear historically to have held a viewpoint better characterized by the energy resource perspective. This

[19] Global Energy Partners and Quantec (2002). *Assessment of Energy and Capacity Savings Potential in Iowa, Volume II: Free Riders and Spillover—A Look Back, A Path Forward*; Quantec, Summit Blue Consulting, Nexant Inc., A-TEC Energy Corporation and Britt/Makela Group (2008). *Assessment of Energy and Capacity Savings Potential in Iowa, Volume II*; Cadmus (2012) *Assessment of Energy and Capacity Savings Potential in Iowa, Volume I*.

perspective is focused on the ability to ensure that the ratepayers are realizing intended returns on investments in energy efficiency programs, that the savings provided by energy efficiency programs are able to be relied upon as a quantifiable and trusted resource, and that savings are maximized by the programs.

Importantly, through ongoing dialogue with utilities and stakeholders in this study, all parties voiced a strong interest in conducting market characterization research, and focusing on trade ally and other market actor experiences, in order to gauge the impact energy efficiency programs have on the market for energy efficiency in Iowa. This suggests that an emphasis on the market view, blended with both deemed and resource perspectives, as a potential avenue for the state of Iowa. We return to this theme in Section 7 of this report.

4. Review of Practical NTG Approaches, Best Practices, and Trends

4.1 Methods for Estimating NTG Values

Section 4 Contents:
• Methods for Estimating NTG Values
• NTG Best Practices and Research Trends
• Confidence, Precision, and NTG Algorithms
• Mapping Methods to Iowa Programs

There are a variety of methods for estimating NTG values, each of which is appropriate under different scenarios. The Uniform Methods Project (2014)[20] and the SEE Action Report and Guides (2012),[21] provide detailed listings of applicable methodologies currently employed and characterizes each in terms of difficulty, applicability and special considerations. The Navigant team augmented this core methods research by examining academic research papers, white papers and current industry standards and practice for estimating NTG ratios and net savings.[22]

Table 4 provides a brief overview of each of the nine major categories of NTG research methods, along with how they align to the NTG perspectives discussed in Section 3.[23] Each method has strengths and weaknesses, and situations where it is appropriate to use as an industry practice, though some of these methods are more commonly used than others. Surveys and structured expert judgment methods, for instance, are more commonly used than historical tracing or top-down macroeconomic approaches. It is common industry practice to use more than one method and triangulate the results, particularly for high priority program where the NTG research results may have larger implications. In this case, multiple methods listed in Table 4 may be used in tandem to research the NTG value for a single program.

High and low costs are approximated in Table 4 for each method, along with a brief summary explanation. All costs are for stand-alone studies, i.e., studies focused primarily on NTG, and not combined with process or impact evaluations. The low-cost end of the range represents industry practice, whereas the high-cost method generally adds in extra sample and data sources. High-cost approaches are usually applied to programs with high expected savings, and where there is uncertainty around NTG such that a more rigorous study is warranted. The higher-cost studies may also provide better information on specific components of NTG. All studies address free ridership, for example, and nearly all address participant spillover. Addressing non-participant spillover, however, may require

[20] Violette, Daniel M. & Rathbun, Pamela. (2014) "Methods for Determining Energy Efficiency Savings for Specific Measures." Chapter 17 in The Uniform Methods Project: Methods for Determining Energy efficiency Savings for Specific Measures. www.nrel.gov/docs/fy13osti/53827.pdf.

[21] *Evaluation, Measurement, and Verification of Residential Behavior-Based Energy efficiency Programs: Issues and Recommendations* (2012a), Todd, A., Stuart, E., Schiller, S. and Goldman, C., of Lawrence Berkeley National Laboratory (LBNL) for State and Local Energy Efficiency Action Network (SEE Action Network), 2012. SEE Action (2012b). *Energy Efficiency Program Impact Evaluation Guide*. Prepared by Steven R. Schiller, Schiller Consulting, Inc, 2012.

[22] *Does Net-to-Gross Really Matter? When Results Affect Cost-Effectiveness Analysis, It Just Might*, Lutz, T., Violette, D. and Rathbun, P., AESP 2015 Annual Conference, 2015; *Custom Free Ridership and Participant Spillover Jurisdictional Review*, prepared for Sub-committee of the Ontario Technical Evaluation Committee, by Navigant, May 29, 2013; *Saving Energy Cost-Effectively: A National Review of the Cost of Energy Saved through Utility-Sector Energy Efficiency Programs*, Friedrich, K., Eldridge, M., Kushler, M. Witte, P, and York, D., American council for an Energy Efficient Economy. Report Number U092, September, 2009; *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects*, California Public Utilities Commission, October, 2001.

[23] Appendix B contains additional methodological details from our presentations to the Oversight Committee in January, 2015.

additional effort in order to get an appropriate sample frame of non-participants, which are often not included in program records. Studying non-participant spillover and market effects may also require addition of another study method in tandem, such as Expert Judgment or Delphi studies. These additions result in higher study costs, but, on balance, these studies provide more information.

A research agenda meeting the needs of stakeholders will determine which of the methods within this range of costs will be selected. Through synergies with an evaluation effort that includes both process (with their attendant surveys[24]) and impact evaluation (where fast-feedback[25] surveys can be conducted of participants) components, the cost of NTG research can be reduced substantially. High-rigor/high-cost methods are often only applied to one or two programs in a utility's portfolio, in cases where the programs' importance justifies the cost. If savings for a particular program are expected to be subject to intense scrutiny, it may benefit the utility to utilize the most rigorous estimation option available, and may justify the added expense. By contrast, programs for which almost all prior research finds NTG values close to 1.0 are less likely to warrant high-rigor/high-cost research.

Table 6 presents the costs of the two types of studies: high-cost and low-cost. Actual costs will vary according to the particular characteristics of a program and the intended use of the information gathered. The cost figures presented in are suggestive, not absolute—they are intended to provide some context for the relative costs of different approaches.

[24] Implementing an NTG survey at the same time as a process evaluation is conducted can allow for some of the NTG questions to be integrated into some of the surveys used in the process evaluation. Usually, not all aspects of the NTG effort can be integrated, but this can reduce costs of survey methods by about 10% when the two efforts can be conducted at the same time.

[25] A fast-feedback study is where participants are given a short survey right after participation, usually focused on Free Rider questions, with possibly some participant spillover questions. Presenting this survey to participants right after participation is completed can reduce recall bias and can attain higher response rates. This method represents current industry practice and can be combined with an impact evaluation or integrated into implementation. It can reduce the costs of the study by 10% to 15% for the free rider factor.

Table 6. NTG Estimation Methods and Potential Costs

Method	Definition	Applicable NTG Research Viewpoints	Lower-Cost/Lower-Rigor	Higher-Cost/Higher-Rigor
Billing Analysis with Randomized Control Trial	Customers assigned at random to participant and control groups. Regression analysis of energy use over time estimates the net savings as the difference between the participants and controls.	Resource	$25,000 for basic analyses up and no primary data collection to assess combined offers.	$80,000, including follow-up surveys on actions taken, combined offers (e.g., lighting kits), and participation in other utility programs.
Billing Analysis with Quasi-Experimental Design	Customers generally self-select into the participant group, and the control group is developed as part of the evaluation research process. Net savings are estimates using regression analyses that are similar to those used in randomized control trials.	Resource	$20,000 if only billing data is used. If participant and non-participant control surveys are needed to gather additional control/independent variables, then $50,000.	If participation model were to be developed to address self-selection bias and future estimates of participation and participation drivers, the cost would be $75,000.
Survey-Based Approaches	Surveys are perhaps the most common method for estimating NTG ratios. Respondents may include participants, nonparticipants, trade allies, and other market actors, and the NTG ratio is determined through scoring algorithms deriving free ridership, spillover, and other market effects.	Resource and Market	Per program: Residential—approximately $40,000 for customer surveys, with related programs adding another $20,000. Commercial & Industrial (C&I)—approximately $60,000 due to complexity and need for telephone surveys. An additional related C&I program would add $30,000.	Good studies would not cost much more than the low-cost analysis for participants. Sample sizes could be increased to give greater precision and address drivers of NTG. However, to get at non-participant spillover, there may be a need to survey non-participating vendors and trade allies. The high-cost analysis for this type of effort would be $100,000 for a custom C&I program, with additional programs (e.g., new construction) adding $50,000. The higher cost is due to the difficulty in identifying nonparticipants and issues with response rates that influence survey design.
Common Practice Baseline	Common practice baseline approaches determine gross savings relative to what customers would have commonly done in the absence of the program, implying that it is also an ex ante estimate of net savings and that little (if any) further adjustments are necessary to obtain ex post net savings. It is important to recognize that common-practice baselines require that all measures in the program have to have a	Deemed or Market	This is done on a measure-by-measure basis and involves an analysis of the market through vendors, customers and trade allies such as specifying A&E firms. In some cases, work performed in a neighboring jurisdiction can be used. For 5 to 10 measures, the cost may be on the order of $100,000.	To apply this to both residential and C&I would require information on many energy-efficiency measures to establish current baselines of energy use. Usually this data is built up over time, but the entire database could cost $500,000 with ongoing costs of $100,000 per year in updates. This is in line with the ongoing work in the Pacific Northwest.

Method	Definition	Applicable NTG Research Viewpoints	Lower-Cost/Lower-Rigor	Higher-Cost/Higher-Rigor
	common baseline established for them, and costs quickly increase as the number of measures increase.			
Market Sales Data	Market sales data determines overall net effects of programs by comparing the pre- and post-program market shares in the program area to those in a non-program comparison area.	Market	This is uncertain, as it can be inexpensive if some sales data are available for the program ($25,000).	Some sales data from third party data consolidators can be expensive to purchase. In addition, if data are not available from states deemed as reasonable control states, it simply may not be possible. Cost can be $100,000 or more.
Top-Down Econometric Modeling	Top-down NTG econometric methods rely on aggregate (e.g., class and system) energy consumption data and an overall level of program efforts, which is generally measured in terms in program expenditure, to estimate total program savings across geographic areas such as utility service territories or states. It is important to recognize that this method does not provide program NTG information. Only NTG estimates for the entire portfolio of EE activities is provided. As a result, this is usually used as a companion study to assess EE in terms of the overall contribution to changes in energy use, and other studies provide program-specific information.	Resource	The challenge here is developing the data by census tract, zip code, or other geographic unit to allow for an adequate number of cross sections to be available for the analysis. This would cost at a minimum $125,000. Although if looking to pool muni data with investor-owned utility (IOU) data and believe that to be reasonable, the cost might be slightly lower. Recent work indicates that $125, 00 and up for these studies. Updates to these studies are cost less as only the incremental years' data need to be added to the data base.	To do this right could be very expensive and require a year or two of lead time to allocate energy-efficiency intensity measures to geographic areas. The cost for a data intensive top-down study within a single state might be as high as $500,000 to $1 million.
Structured Expert Judgment	Expert judgment approaches include Delphi Panels, but may also consist of expert judgment survey methods. They estimate NTG ratios by assembling an expert panel to estimate market effects for measures or programs through a structured process facilitating consensus.	Resource, Market, and Deemed	For both residential and C&I programs, this could be as low as $40,000.	A thorough analysis with participants combined from multiple utilities could be up to $80,000 to $100,000 using online Delphi panels.
Deemed Estimates	Deemed or stipulated NTG ratios have historically been used in Iowa (i.e., NTG = 1.0). They are determined in advance of the program, often by one or more of the above NTG approaches.	Deemed	Deemed values should never just be determined arbitrarily. A low-cost approach would be based on secondary data for the measures or programs where that research	Developing deemed values from a process similar to the common practice baseline approach (which are deemed in their own right, as they are ex ante but

Method	Definition	Applicable NTG Research Viewpoints	Lower-Cost/Lower-Rigor	Higher-Cost/Higher-Rigor
			exists. $50,000 would be a lower bound on investment in secondary research in order to provide sufficiently rigorous findings based on other jurisdictions.	based on more information) might cost as much as $500,000.
Historical Tracing	Historical tracing (case study) methods develop a chronological narrative of the various market influences, which can include programs, codes and standards, tax policy, and other market interventions, and establishing the relative influence of each as in determining the NTG ratio for the program(s) of interest.	Resource and Market	This is a combination of expert judgment and modeling—the low-cost option for residential homes might be $50,000, and $60,000 for commercial due to engineering modeling.	Complex programs that have been in place for a longer period of time would cost more, but not too much. $60,000 for residential program and $70,000 for C&I.

Source: Navigant Team research and the Uniform Methods Project, National Renewable Energy Laboratories (NREL), 2014, http://www.nrel.gov/extranet/ump/

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4.2 NTG Best Practices and Research Trends

The remainder of this section reviews NTG approaches currently in use around the country, including information on best practices and trends in NTG estimation, and considers tradeoffs between accuracy, confidence and precision in NTG estimation. In response to feedback from the Oversight Committee, it also maps the NTG methods discussed above to specific programs for Alliant Energy, Black Hills Energy and MidAmerican Energy.

Each method commonly used in NTG research has circumstances and program types for which it is best suited:

- **RCTs** are generally considered, from the energy resource viewpoint, to be the gold standard of NTG estimation techniques and provide highly rigorous and defensible results. However, they require advance planning and are not always feasible given program and logistical constraints. Other methods—such as **market sales data** approaches—hold significant potential, particularly for those with a market perspective, but they are often difficult to perform due to limitations on the availability of relevant and complete sales data. Likewise, **top-down modeling** approaches are often too complex and involve too many difficult-to-derive inputs and assumptions to perform well. Furthermore, top-down methods cannot provide the necessary program-specific information to improve program performance from a market perspective or relevant information to use for program-specific deemed NTG estimates.
- On the other side of the spectrum, **survey-based** approaches are widely applicable, and if well-designed and well-implemented, provide reliable results from both resource and market perspectives.[26] Hence, they are widely used in NTG research. **Quasi-experimental design** approaches—particularly matching methods—are commonly used in place of an RCT for certain program types because they can produce similar results without the necessity of pre-planning and implementing a full RCT design. This is especially helpful in opt-in program situations where it is difficult or impossible to randomly assign customers to treatment and control groups.
- As discussed further below, **structured expert judgment** and **historical tracing** approaches can be used to assess select NTG components (e.g., spillover and market effects), but are usually paired with another approach to discuss free riders, spillover or market effects. Formal Delphi versions with expert panels have been used to address overall NTG in some states.
- **Common baseline approaches** are used in the Northwest, but are not common elsewhere. Still, a key insight from these approaches is that the definitions of baselines as defined in technical reference manuals (TRMs) can affect the way gross and net savings are estimated. The premise behind this method is that a “current” baseline can be estimated ex ante, i.e., before the program is implemented. These baselines are most often determined by the equipment that is typically purchased in the market at the current time, and defined as the

[26] Customer surveys are generally focused on free ridership and spillover, and tend to reflect an energy resource view of NTG. Conversely, distributor, retailer, contractor and other trade ally surveys have a market and market effects focus, and often ask respondents to provide sales, market share and price data, reflecting more of a market NTG view.

average energy efficiency of currently purchased equipment. A variant is to use the value of the highest efficient unit available, or at least a unit with higher-than-average efficiency.

One of the purposes of this research is to help Iowa utilities identify best practices and recent trends in NTG estimation. **Triangulation of methods** is regarded as current industry practice and is increasing in popularity due to its ability to enhance the rigor of results, and to better represent instances of overlapping energy resource and market NTG viewpoints.[27] This practice refers to using data from multiple sources and methods in order to limit bias and measurement error.[28] This methodology also affords evaluators the ability to weight the estimates produced by various methods used in tandem differently based on the perceived likelihood of bias and reliability of the estimates produced.[29]

As an example of triangulation, evaluators of a large residential equipment program that contributes a large portion of overall portfolio savings may want to approach NTG estimation using surveys of participants, trade allies, and contractors, in tandem with billing data analysis using a matching approach to create treatment and comparison groups. The matched billing data approach will provide a picture of differences between the purchases of program participants and nonparticipants, providing an alternate view of net savings in addition to survey-based free ridership, participant, and non-participant spillover findings. This approach also exemplifies the blending of market and resource views.

In order to explore non-participant spillover and longer-run market transformation effects, evaluators may additionally employ a structured expert judgment approach such as a Delphi Panel, in which experts provide input as to the likely state of the market and non-participant purchase decisions in a hypothetical world where the program is absent. These experts will also provide another source of information reinforcing free ridership and spillover findings. To complete the circle, the evaluators may choose to supplement the analysis with collection of market data, which also helps to solidify results on market effects and non-participant spillover. By analyzing changes in market sales before, during, and/or after the program, evaluators can infer how the program has influenced the trajectory of the market and created market effects. As with the first two methods, adding in this second pair of methods creates a triangulated approach using four different methods in tandem, and further blending resource and market views to create a more nuanced and holistic perspective appropriate to consideration of a key program within the utility's portfolio.

4.3 Confidence, Precision, and NTG Algorithms

The Navigant team and most industry NTG practitioners recognize that the accuracy and precision of results generated by a given method may differ based on how that method is implemented. For

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[27] Violette, Daniel M. & Rathbun, Pamela. Op Cit.

[28] Baumgartner, R. (2013). "Survey Design and Implementation Cross-Cutting Protocols for Estimating Gross Savings." Chapter 12 in *The Uniform Methods Project: Methods for Determining Energy efficiency Savings for Specific Measures.* *www.nrel.gov/docs/fy13osti/53827.pdf*.

[29] Megdal, L.; Patil, Y.; Gregoire, C.; Meissner, J.; Parlin, K. (2009). "Feasting at the Ultimate Enhanced Freeridership Salad Bar." Paper presented at the International Energy Program Evaluation Conference, Portland, OR. www.anevaluation.com/pubs/Salad%20Bar%202009%20IEPEC%20paper%205-12-09.pdf.

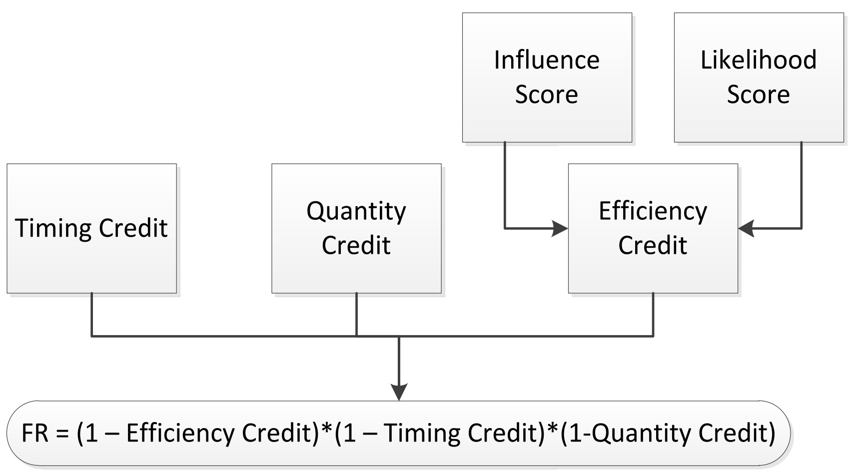
instance, if survey questions are poorly structured or a non-representative group of consumers is surveyed, surveys may provide biased (incorrect) results. Given a large enough sample size, these same surveys can have a high calculated confidence and precision for particular questions being asked. However, this is not the same as having the same degree of confidence and precision around the NTG algorithms (and resulting NTG estimates) that are derived from the questions. In everyday terms, this means a poorly designed and implemented survey with a large enough sample size may yield a very precisely estimated wrong answer.

A thorough approach includes understanding this difference between accuracy and precision—particularly in free ridership and spillover algorithm development—and using alternative approaches to limit bias and maximize the accuracy of results. One way to increase accuracy and limit bias is to ensure that the chosen NTG estimation method is well-designed and well-implemented. The triangulation approach described above also helps to deal with this issue by providing multiple estimates, which can then be compared against each other.

Another means of increasing confidence in the results—or at least build consensus on the efficacy of the approach—derives from explicitly identifying assumptions relating to NTG calculations. To illustrate the point, and the sensitivity of survey-based NTG component algorithms, an algorithm developed for a residential HVAC rebate program in Massachusetts is used as an example.[30] In this example, free ridership (FR in the following figures) was derived from a participant survey in three steps, as depicted in Figure 2, with credit given to the program (a.k.a., partial free ridership) from:

- Accelerated timing of the installation
- An increase in the quantity of measures installed
- An increase in the efficiency of the measure

Figure 2. Example Free Ridership Calculation

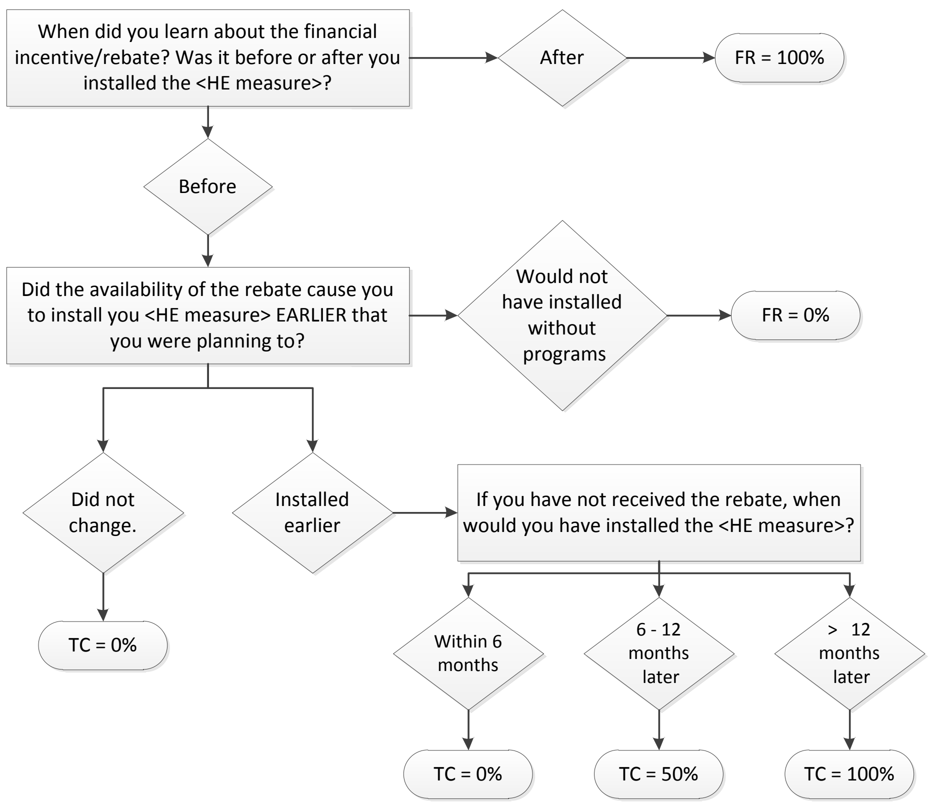


[30] Seiden, K., et al., (June, 2013) "2012 Residential Heating, Water Heating, and Cooling Equipment Evaluation Net-to-Gross, Market Effects, and Equipment Replacement Timing, " prepared for The Electric and Gas Program Administrators of Massachusetts, http://ma-eeac.org.

Source: Seiden, K., et al., Op Cit.

Figure 3 shows the example algorithm for assigning the timing credit (TC). Notice that the magnitude of the TC ultimately depends on whether the participant would have installed the energy efficiency measure more than six months or more than one year in the future. These are subjective values based on experience and often reflect a negotiated algorithm solution based on the experience and judgment of evaluators, program administrators, and other stakeholders developing and reviewing the algorithm.[31]

Figure 3. Example Free Ridership Timing Credit



Source: Seiden, K., et al, Op Cit.

Similarly, the free ridership quantity (Figure 4**)** and efficiency credits (Figure 5) in this example also include relatively arbitrary adjustments that are based on negotiated assumptions around how survey answers should be treated rather than empirical data. Sensitivity analyses are often performed to assess the influence certain assumptions have on the final values of a free ridership

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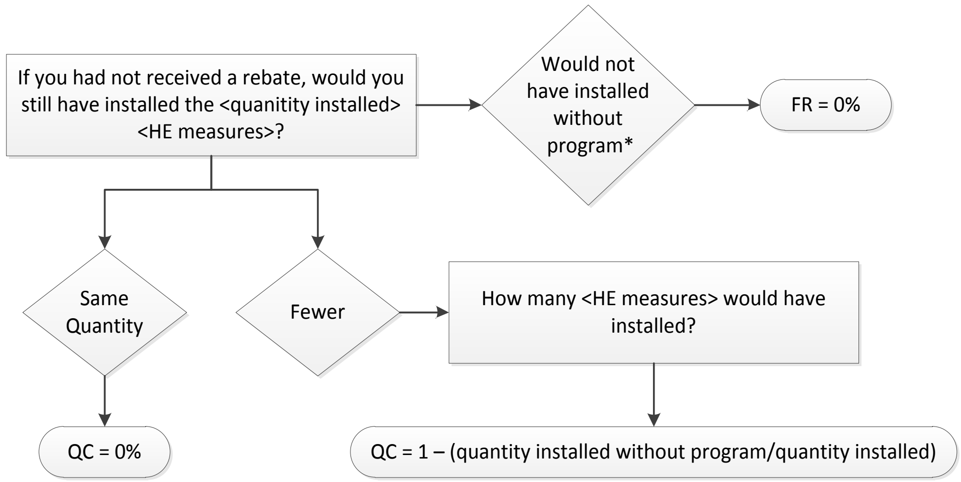
[31] As an example of the variability around these algorithms, Pennsylvania recently completed statewide NTG methods protocols that, rather than having a timing credit, simply used a one year cutoff as part of an intention score (i.e., if the respondent would have delayed/canceled the installation by more than one year they receive credit towards the attribution algorithm). See "GM-024: Common Approach for Measuring Free-riders for Downstream Programs," Pennsylvania Statewide Evaluation Team, December 23, 2013.

algorithm. In Figure 5 below, for example, the scale values linked to the answers of 1 through 5 on the likelihood of installation question. Instead of 75% for answer 4 – a value of 80% could be tested to see what impacts it has on the free rider score. Similar sensitivities can be used to assess the robustness of the analyses.

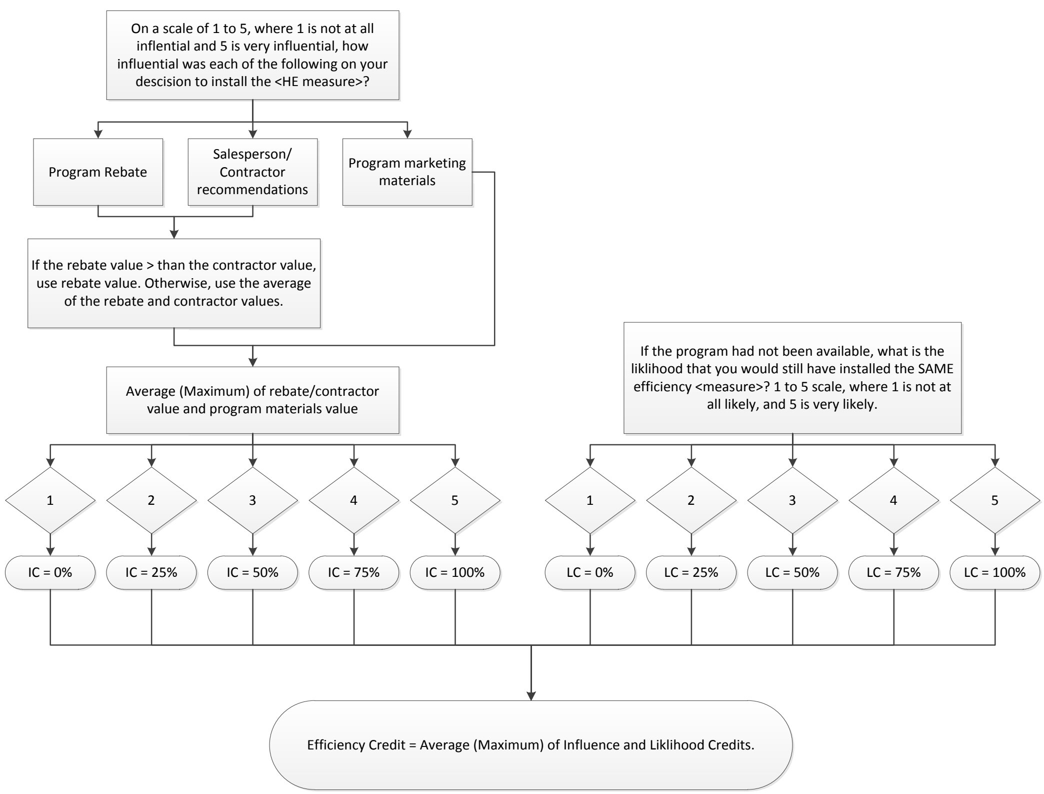
Returning to the overall free ridership algorithm presented in Figure 2, the Massachusetts Program Administrators and other stakeholders recognized and incorporated algorithm uncertainty by conducting sensitivity analysis around the assumptions driving partial free ridership, leading to a greater understanding and appreciation of the difference between survey confidence and precision and the accuracy of resulting free ridership estimates. Sensitivity analysis can be a very useful tool in providing evidence that resulting NTG values are not unduly influenced by subjective scoring algorithm choices such as those described above.

Figure 4. Example Free Ridership Quantity Credit



Source: Seiden, K., et al, Op Cit.

Figure 5. Participant Free Ridership Efficiency Credit



Source: Seiden, K., et al, Op Cit.

4.4 Mapping Methods to Iowa Programs

Iowa's IOUs administer a wide variety of programs to encourage energy efficiency in their customers. Because of the considerable variety in programmatic offerings, there is no one-size-fits-all approach to estimating NTG values for these programs. As stated earlier in the report, Navigant holds that while a portfolio-level deemed approach may have been justified by research in the past, current industry practice suggests a portfolio-wide single NTG value deemed approach is no longer appropriate. Some considerations when mapping an individual program to an appropriate NTG method include: resource vs. market viewpoints, overall size of the program and its importance within the savings portfolio, whether the program is aimed at a small number of diverse participants or many similar customers, the ability to design and implement a randomized control trial prior to program launch, variability of net savings relative to gross savings, cost considerations, relationships with trade allies, trade allies' degree of involvement in the program and data availability issues.

Building upon the program data from each Iowa utility contained in Section 2 (Table 3 through Table 5) the Navigant team mapped each program in the green shaded rows to the methods and associated costs listed in Table 6. The resulting utility-specific Tables 7 to 9 to delineate candidate NTG method(s) by program based on the Navigant Team's experience in designing and implementing NTG research for utilities with programs similar to those offered by Iowa's utilities. These tables present a range of methods and cost estimates for the various NTG estimation options by program to provide the Oversight Committee with information to begin considering the costs and benefits of various approaches. Additionally, these tables provide the foundation for developing NTG research agendas based on program characteristics and the value of information to be gained from research specific to individual Iowa programs.

Table 7. Mapping Candidate NTG Estimation Methods to Alliant Energy Programs

Program Name	Total 5 Year Plan Program Budget	Program Budget as Percent of Total Portfolio Expenditure	Custom Measures	Many, Similar Participants	Degree of Upstream Influence Invisible to Consumers	Variability of Net Savings Relative to Gross Savings	NTG Viewpoints	Potential Method I	Potentenial Method 2	Cost Range	
Residential Prescriptive	$65,209,023	18%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$100K	$400K
Custom Rebates (all)	$46,436,752	13%	X		Med/Low	High	Resource, Market and Deemed	Surveys of participants, contractors, distributors and manufacturers	Method I plus structured expert judgement	$80K	$200K
New Home Construction	$5,122,346	1%	X	X	High	Med	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$80K	$200K
Home Energy Assessment	$16,595,359	4%		X	Med/Low	Med	Resource and Market	Surveys of participants, contractors and trade allies	Billing analysis using matching methods	$50K	$175K
Commercial New Construction Program	$6,224,671	2%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$80K	$200K
Change-a-Light	$12,562,177	3%		X	High	Med	Resource and Market	Surveys of participants, contractors and trade allies	Method I plus sales data approach	$100K	$400K
Appliance Recycling (all)	$8,683,739	2%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$80K	$200K
Nonresidential Prescriptive	$44,093,861	12%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$100K	$400K

Source: Navigant Team research and the Uniform Methods Project, National Renewable Energy Laboratories (NREL), 2014, http://www.nrel.gov/extranet/ump/

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Table 8. Mapping Candidate NTG Estimation Methods to Black Hills Energy Programs

Program Name	Total 5 Year Plan Program Budget	Program Budget as Percent of Total Portfolio Expenditure	Custom Measures	Many, Similar Participants	Degree of Upstream Influence Invisible to Consumers	Variability of Net Savings Relative to Gross Savings	NTG Viewpoints	Potential Method 1	Potentenial Method 2	Cost Range	
Residential Prescriptive	$12,956,800	45%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$75K	$300K
Residential New Construction Program	$2,660,900	9%	X	X	High	Med	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$60K	$150K
Residential Evaluation Program	$3,496,500	12%		X	Med/Low	Med	Resource and Market	Surveys of participants, contractors and trade allies	Billing analysis using matching methods	$30K	$130K
Nonresidential Prescriptive Program	$4,371,700	15%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$75K	$300K
Nonresidential New Construction Program	$1,086,800	4%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$60K	$150K
Nonresidential Custom Program	$289,500	1%	X		Med/Low	High	Resource, Market and Deemed	Surveys of participants, contractors, distributors and manufacturers	Method I plus structured expert judgement	$50K	$150K

Source: Navigant Team research and the Uniform Methods Project, National Renewable Energy Laboratories (NREL), 2014, http://www.nrel.gov/extranet/ump/

Table 9. Mapping Candidate NTG Estimates Methods to MidAmerican Energy Programs

Program Name	Total 5 Year Plan Program Budget	Program Budget as Percent of Total Portfolio Expenditure	Custom Measures	Many, Similar Participants	Degree of Upstream Influence Invisible to Consumers	Variability of Net Savings Relative to Gross Savings	NTG Viewpoints	Potential Method 1	Potentenial Method 2	Cost Range	
Residential Equipment Program	$114,749,062	22%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$100K	$400K
Residential New Construction Program	$30,260,120	6%	X	X	High	Med	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$80K	$200K
Residential Assessment Program	$26,682,083	5%		X	Med/Low	Med	Resource and Market	Surveys of participants, contractors and trade allies	Billing analysis using matching methods	$50K	$175K
Industrial Partners Program	$39,803,537	8%	X		Med	High	Resource, Market and Deemed	Surveys of participants, contractors, distributors and manufacturers	Method I plus structured expert judgement or Sales Data	$80K	$200K
Commercial Energy Solutions	$54,239,586	10%	X		Med	High	Resource, Market and Deemed	Surveys of participants, contractors, distributors and manufacturers	Method I plus structured expert judgement or Sales Data	$80K	$200K
Nonresidential Equipment Program	$48,480,366	9%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$100K	$400K
Commercial New Construction Program	$43,393,302	8%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies	Method I plus structured expert judgement	$80K	$200K
Upstream Lighting	$13,978,913	3%		X	High	Med/High	Resource, Market and Deemed	Surveys of participants, contractors and trade allies, in tandem with billing analysis using matching methods or a quasi-experimental design, and/or structured expert judgment	Method I plus sales data approach	$100K	$400K

Source: Navigant Team research and the Uniform Methods Project, National Renewable Energy Laboratories (NREL), 2014, http://www.nrel.gov/extranet/ump/

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5. State-Specific NTG Approaches, and Relationship to Policy Objectives and Perspectives

Section 5 Contents:
• Methods for Estimating NTG Values
• NTG Best Practices and Research Trends
• Confidence, Precision, and NTG Algorithms
• Mapping Methods to Iowa Programs

Another consideration in choosing NTG evaluation methods is the regulatory landscape and policies regarding NTG research. Each state is relatively unique in this regard, including Iowa, so understanding state-level policy differences is useful in conducting cross-state NTG comparisons. The Oversight Committee explicitly recognized this issue in defining the goals and objectives of this study, and asked the Navigant team to clarify how key policies and regulatory considerations are related to the choice of NTG policies and approaches, and to put these considerations into the context of Iowa's regulatory framework. Navigant used the American Council for an Energy-Efficient Economy (ACEEE's) 2014 report as a key resource for investigating the state of policies in various jurisdictions around the country.[32]

This section provides a high-level review of NTG policies around the country, as well as case studies of several states with policies and regulatory frameworks of interest to Iowa, and maps specific policy mechanisms such as lost revenue recovery, risk-reward mechanisms, and integrated resource planning regimens to NTG policies. As states, regulators and policymakers bring diverse NTG perspectives to the table, we consider NTG policy, regulatory environments and statues in the context of the three perspectives on NTG research: energy efficiency resource views, market views and deemed views.

5.1 Summary of NTG Policies

To better understand the NTG landscape, the Navigant Team conducted a literature review that examined state energy policy documents and websites, evaluation reports, and prior studies[33] that sought to summarize the NTG policies across the United States. Furthermore, we reached out to both members of our own team as well as other industry experts that do NTG work in each state to confirm our understanding of the policy. This validation step was particularly important for providing insight

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[32] *Examining the Net Savings Issue: A National Survey of State Policies and Practices in the Evaluation of Ratepayer-Funded Energy Efficiency Programs*. American Council for an Energy-Efficient Economy (ACEEE), 2014

[33] A number of different sources were used in developing the state by state NTG and DSM policies (see bibliography for full citations), including Downs (2014), Fagan (2009), Haeri (2012), Edison Foundation (2013), Missouri Energy Initiative (2014), Morgan (2012), and Wilson (2013).

Fagan, J.; Messenger, M.; Rufo, M.; Lai, P. (2009). "A Meta-Analysis of Net to Gross Estimates in California." Paper presented at the 2009 AESP conference. Navigant (2013a). *Custom Free Ridership and Participant Spillover Jurisdictional Review*. Prepared for the Sub-Committee of the Ontario Technical Evaluation Committee, May. www.ontarioenergyboard.ca/documents/TEC/Evaluation%20Studies%20and%20Other%20Reports/Ontario%20NTG%20Jurisdictional%20Review%20-%20Final%20Report.pdf. U.S. Environmental Protection Agency (EPA). 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 and understanding into many of the NTG nuances and complexities that often are not fully provided in public documents, in particular the different use of semantics that may appear the same but have different meanings in different states.

While Iowa currently defines itself as a net state with a NTG value of 1.0, a number of states appear as gross savings states (e.g., Pennsylvania), but encourage (and sometimes require) NTG estimates to help improve program design. In fact, there is no state that we aware of that would prohibit NTG research for this purpose. To ensure a common denominator platform for comparison, however, our research focused on NTG policy with regards to the reporting of energy savings and assessment against savings goals.

Appendix A contains the detailed state-by-state findings of our research. The sections below summarize our findings across a number of NTG policies, including:

- ***Overall NTG Policy***. This shows whether or not program administrators must report savings and assessment against goals at the gross or the net level. Note that states that assume a NTG of 1.0 are assumed to effectively be gross states since there are no upward or downward adjustments due to program attribution.
- ***Definition of Net Savings (Allowance for Spillover)***. Within the net savings jurisdictions, there is a wide variation of which aspects of NTG are allowed in terms of savings claims. Some states consider net of free ridership—not counting any aspects of spillover—to be net savings. Other states allow different aspects of spillover (i.e., participant and non-participant) to be counted as achieved savings.
- ***NTG Methods Protocols***. Certain states (such as California and Massachusetts) have developed NTG method protocols that recommend specific approaches and in some cases specifics regarding the calculations (e.g., survey batteries and analysis algorithms for self-report approaches). The use of these may be recommended, or in certain states (e.g., Pennsylvania), an emerging practice is to require the use of the Methods protocols.
- ***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 our definition of prospective NTG (below), which is typically based on researched values that can vary by program and measure.
- ***Prospective versus Retrospective Application of Net Savings Values***. Another emerging practice is the move toward 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, therefore, they are essentially locked until an updated value is derived and applied prospectively.

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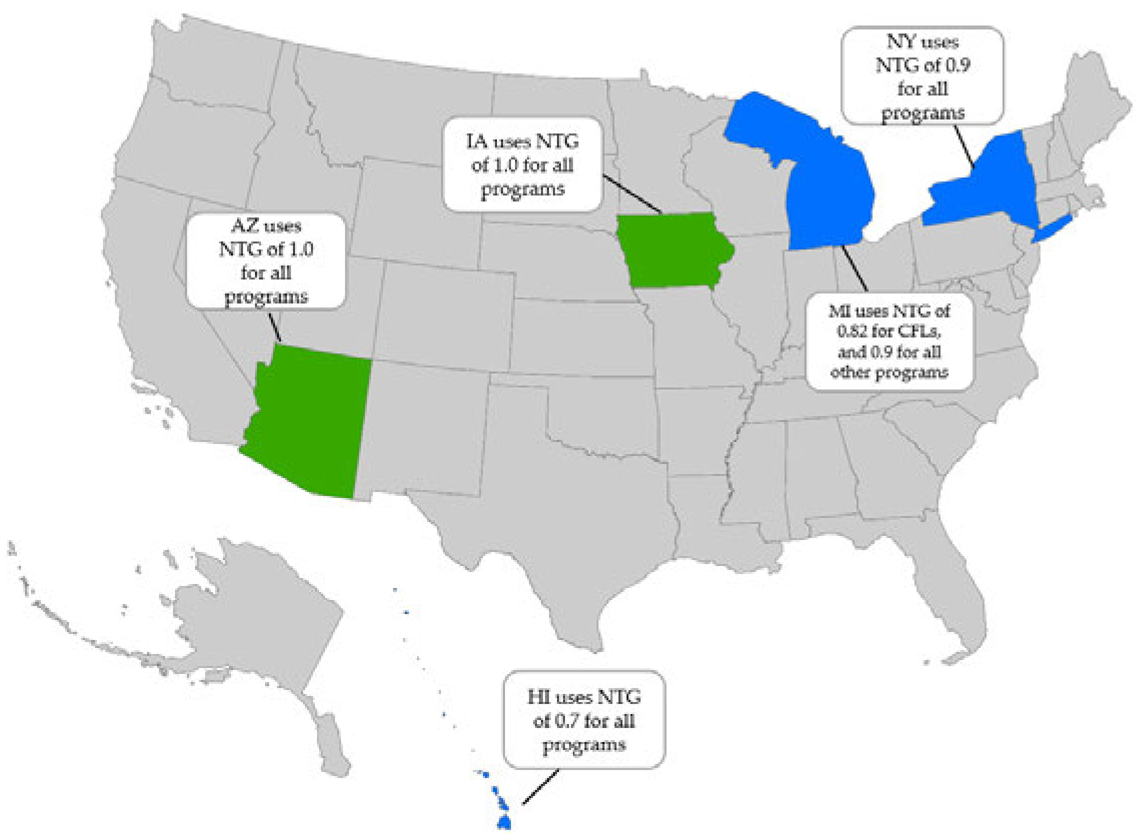
5.2 Overall NTG Policy: Gross versus Net

While some states adopt a 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. As shown in Figure 6, there are several states that have similar policies to the NTG policy currently adopted by Iowa of 1.0 for all programs, while other states deem a value other than 1.0 for all programs, and Michigan deems all values at 0.9, with the exception of CFLs which have their own deemed NTG value.

Figure 6. Net States with Deemed NTG Values



Source: Navigant Team research

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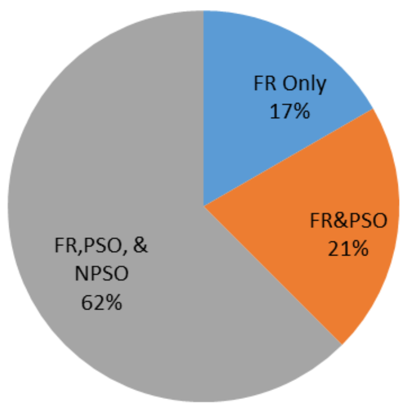
5.3 Definition of Net Savings (Allowance for Spillover)

As shown in Figure 7, nearly two-thirds (62%) of those jurisdictions that use net savings allow for free ridership, participant spillover, and non-participant spillover, while 21% allow for free ridership and participant spillover but do not allow for non-participant spillover.[34] Only 17% of the jurisdictions with net savings (a total of four 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).

The broader inclusion of participant and non-participant spillover would be most reflective of the resource view perspective, whereby the emphasis would be on estimating and quantifying all aspects of program attribution; but, to a lesser extent, the market perspective would examine these same components as part of the research in understanding how markets have shifted over time due to program interventions.

Figure 7. Inclusion of Free Ridership (FR), Participant Spillover (PSO), and Non-Participant Spillover (NPSO) in NTG Ratios (n=24)



Source: Navigant Team research

5.4 NTG Methods Protocols

As discussed in Section 4, there are numerous methods that can be used to estimate NTG ratios. As part of its 2006-2008 evaluations, California developed recommended methods for use in estimating NTG ratios. Two sets of methods were developed, one for residential programs and one for non-residential

[34] Note that we including market effects as a subset of non-participant spillover, rather than breaking it out separately, because we are 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 in the U.S. 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

programs, and both have received periodic updates.[35] Massachusetts also developed detailed guidance for NTG approaches and methodologies, issuing both residential and C&I methods documents in 2011.[36]

The NTG guidance documents in both California and Massachusetts focused on the selection of methods (i.e., which methods are most appropriate for specific program types) as well details regarding the approaches that should be taken for specific programs, in particular programs using the self-report approach. The documents even list example questions and scoring algorithms to determine NTG ratios.

More recently, Pennsylvania has instituted common NTG approaches,[37] and Illinois, as part of the most recent 3-year program cycle beginning in 2014, has also required that utilities and their evaluators coordinate on NTG methods that will be filed as part of the Technical Reference Manual.

Because most portfolios offer such a diversity of programs, the recommended NTG methods have generally selected certain program types (e.g., downstream rebates) in prescribing the more detailed NTG approaches, although there has been a more recent effort to expand the types of programs. Pennsylvania and Illinois, for example, both included appliance recycling programs and are working on common approaches for estimating NTG for upstream lighting.

The primary reason for developing common approaches to NTG estimation is to help ensure that differences over time or between program administrator service territories are due to actual differences in program attribution as opposed to differences in research methodologies. In addition, bringing together program administrators and their evaluators is perceived as an opportunity to refine and improve existing methods.

The primary drawback of common approaches, however, is that they can be perceived as inflexible, and thus inappropriate for programs that do not exactly 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 remain as flexible as possible (e.g., giving example questions that can be adopted to specific program designs and features), plus, in some cases, allowing evaluators to propose alternative methods that can attempted with regulatory approval.

The language in the Illinois final DSM orders for the 2014-2016 plans captures both the strengths and limitations of common approaches:[38]

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[35] "Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers, Prepared for the Energy Division," Prepared for the California Public Utilities Commission by The Nonresidential Net-To-Gross Ratio Working Group, October 16, 2012.
[36] "Cross-Cutting Net to Gross Methodology Study for Residential Programs – Suggested Approaches (Final)," Prepared for the MA Program Administrators by NMR Group, Inc. with contributions by Tetra Tech and KEMA, July 20, 2011; and "Cross-Cutting C&I Free-Ridership and Spillover Methodology Study Final Report," Prepared for the MA Program Administrators by Tetra Tech, NMR Group and Kema, May 20, 2011. http://ma-eeac.org/studies.
[37] "Common Approach for Measuring Free-riders for Downstream Programs", Prepared by Jane Peters and Ryan Bliss, Research Into Action as part of the Statewide Evaluation (SWE) for the Pennsylvania Electric Distribution Companies (EDCs) and the Pennsylvania Technical Utility Staff (TUS), December 23, 2014.
[38] For example, the Nicor Gas Final Order can be located at http://www.icc.illinois.gov/downloads/public/edocket/378494.pdf

> "The Commission notes that this directive is not to create entirely 'new' NTG methodologies for every energy-efficiency program, but rather to assess NTG methodologies and survey instruments that have been used to evaluate energy-efficiency programs offered in Illinois, and to compile the most justifiable and well-vetted methodologies (or potentially combine certain components from the existing approaches to better represent the most justifiable and well-vetted method consistent with best practices) in an attachment to the Updated IL-TRM that would get submitted to the Commission for approval. The Commission notes that the IL-NTG Methods will be flexible and adaptable to multiple program designs and budgets and tailored to appropriately assess the specifics of each of the program administrators' energy-efficiency programs, consistent with standard NTG methodologies adopted in other states that were filed in this proceeding. The Commission agrees with Staff that in the interest of efficiency, the current program evaluators should take the lead in compiling and formalizing standard methodologies for NTG in Illinois taking into consideration SAG input."

5.5 Fixed or Researched Net Savings

Three states—Hawaii, Michigan, and New York—rely on fixed NTG values that differ from 1.0 for all programs within the energy-efficiency portfolios. As shown in Table 10, 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 used a similar approach during the first year of program implementation in 2011 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.

Using fixed, portfolio level NTG values is an approach under the deemed view perspective, implicitly implying that having distinct NTG values for each program and/or measure are likely too imprecise, and that overarching adjustments – in some cases based on findings from other jurisdictions – are adequate.

Table 10. Values for Fixed NTG Ratios

State	Fixed NTG Ratio
Hawaii	0.7
Michigan	0.9 (0.82 for CFLs)
New York	0.9

Source: Navigant Team research

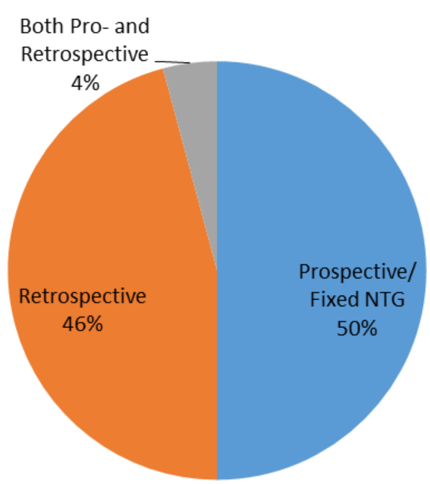
5.5.1 Prospective versus Retrospective Applications

Because NTG ratios can be so volatile and the elasticity of the findings is 1.0 (i.e., a 1% drop in NTG is a 1% drop in attributable savings), program administrators have perceived significant risk and uncertainty with retrospective NTG application. Thus, many states have now moved to the use of NTG results prospectively, rather than retrospectively. As described above, prospective NTG 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 8, half of the jurisdictions with net savings (50%) use either a fully prospective/fixed NTG or a combination of prospective and retrospective.[39]

While this method can significantly reduce risk for program administrators, to be effectively implemented it requires careful planning in terms of the timing and nature of the NTG research so that the results are applicable going forward. Research needs to be updated as markets and incentive structures change, and secondary research from other similar programs may be helpful in determining NTG ratios.

The use of retrospective NTG application would be most consistent with the resource view perspective: savings should be real, quantifiable, and only claim what is actual occurring. The use of prospective NTG application, however, would be more reflective of the market view perspective (i.e., NTG has some uncertainty and what's most important is impacting the market), as well as the deemed view (i.e., NTG has significant uncertainty so it's essential to lock down values prior to program implementation).

Figure 8. Use of Prospective vs. Retrospective NTG (n=24)



Source: Navigant Team research

5.6 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 may be perceived as more important. In addition,

[39] California, as part of the Efficiency Savings and Performance Initiative (ESPI), allows prospective NTG for some measures but retrospective NTG for measures that are determined to be less stable in terms of program attribution.

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, including:

» **Energy Efficiency Resource Standards (EERS):** State-level policy that sets long-term mandatory energy savings targets for utilities and energy-efficiency program administrators.

» **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. Can be based on decoupling (see above) or by adjustments (rate adjustment).

» **Risk-Reward Mechanisms**: Allows utilities to earn bonuses for meeting or exceeding goals, or imposes financial penalties for savings shortfalls.

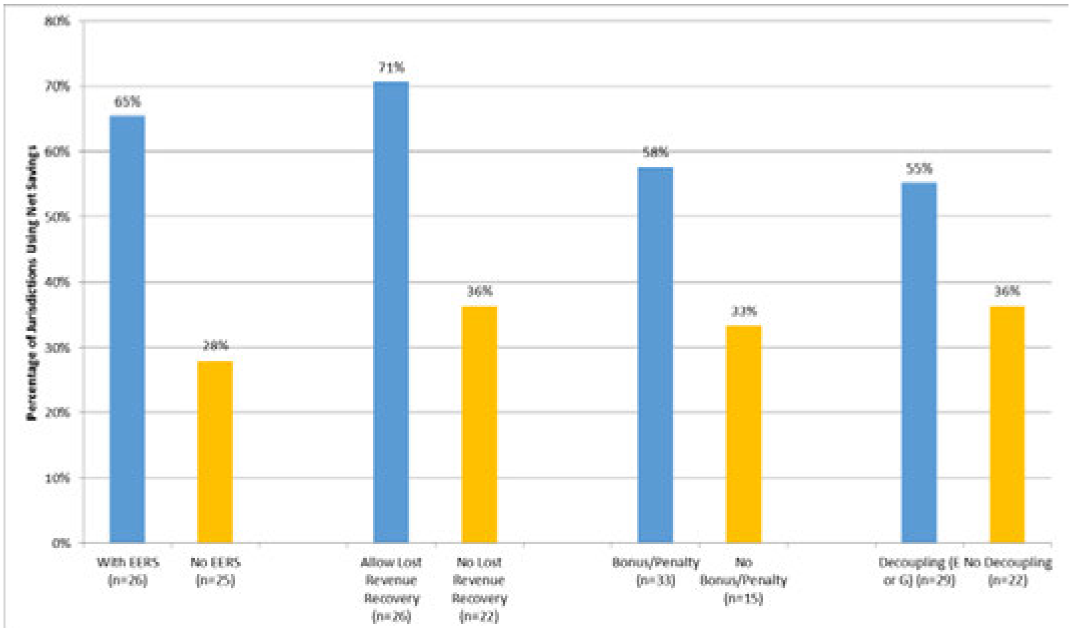
The charts below focus on trends and correlations between the NTG policies and the broader DSM policy objectives. Note the sample sizes are small, and each subset of analysis (e.g., examining only states that have net savings policies) leads to even smaller sample sizes. The results, therefore, need 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 at a gross versus a net level; 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 9, jurisdictions that have an EERS allow lost revenue recovery and have bonuses or penalties tend to also require net, rather than gross, savings. These differences are substantial; for example, 71% of the jurisdictions that allow for lost revenue recovery also require net savings, while only 36% of the jurisdictions that do not allow for lost revenue recovery require net savings. 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 at stake on the outcome of the savings assessment also tend to use net, rather than gross, savings.

Interestingly, decoupling is also associated with net savings. This may reflect program administrators' interest in mitigating risk due to DSM—and possibly net savings—through the use of decoupled rates.

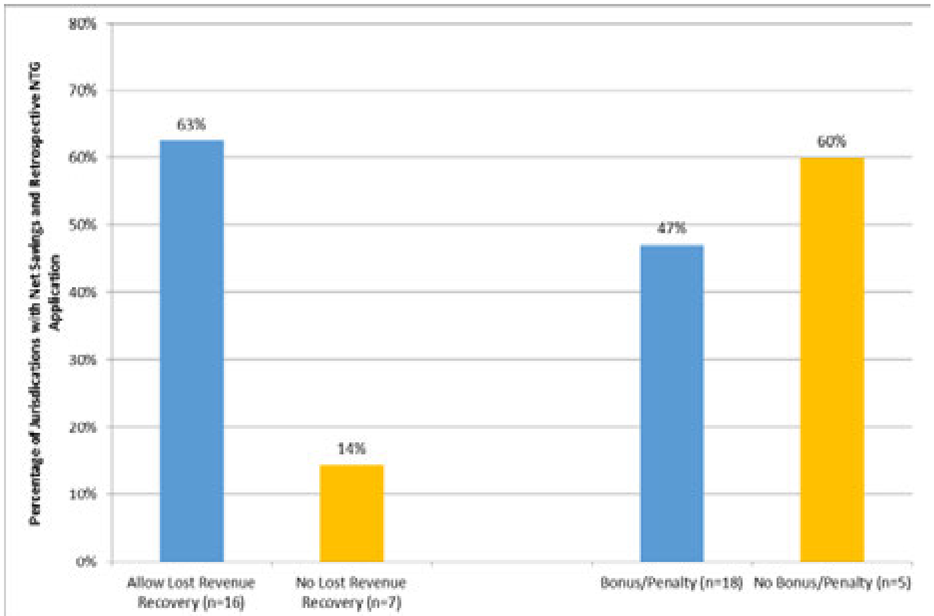
Figure 9. Percentage of Jurisdictions with Net Savings that also have a DSM Policy



Source: Navigant Team research. Note, for example, the first blue bar indicates that 65% of the states that have an EERS require net savings and the second blue bar says that 71% of the states that allow for lost revenue recovery also require net savings.

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 two DSM financial policies: lost revenue recovery and risk-reward mechanisms. As shown in Figure 10, jurisdictions with lost revenue recovery are much more likely to have retrospective application of NTG findings versus areas without lost revenue recovery (63% vs. 14%). The relationship of risk-reward mechanism and the use of prospective versus retrospective NTG application was less clear, particularly since only five states with net savings did not have a bonus or penalty.

Figure 10. Percentage of Jurisdictions with Retrospective NTG Application by Other DSM Policy (States with Net Savings Only)[40]



Source: Navigant Team research

5.6.1 Relating Findings to Iowa NTG Policy

In examining the findings, it is important to note that although Iowa has established goals (i.e., an EERS), it does not have decoupling, lost revenue recovery, or risk-reward mechanisms. In general, these policies tend to lessen the financial stakes in the outcome of the savings findings, and tend to be associated with the use of gross, rather than net, savings. In addition, those states that do not have lost revenue recovery but still require net savings tend not to require retrospective NTG application (i.e., they tend to use prospective NTG).

[40] Note that since California has both prospective and retrospective NTG it is not included in this chart.

5.7 Case Studies

The Navigant Team selected a number of states as case studies to compare NTG and other DSM policies in relation to Iowa. Navigant selected states based on similarity to Iowa in terms of DSM policies (e.g., Maine and New Jersey), geographic proximity to Iowa (e.g., Illinois), comprehensiveness (e.g., Massachusetts), and new entry into DSM (e.g., Pennsylvania).

As shown in Table 11, Navigant selected two NTG policies (gross vs. net and prospective vs. retrospective application) as well as two DSM policies (lost revenue recovery and risk-reward mechanism) to focus on as part of the case studies. In addition, the comparison introduces program activity based on program budgets and energy savings as assessed by the American Council on an Energy Efficient Economy (ACEEE) scorecard report.[41]

Table 11. Selected States for Case Studies

State	ACEEE State Scoring on Utility and Public Benefits Programs		Selected NTG Policies		Selected DSM Policies	
	2013 Electricity Score (10 pts.)	2013 Natural Gas Score (4 pts.)	Gross or Net	(If Net) Prospective or Retrospective	Lost Revenue Recovery (Y/N)	Risk-Reward Mechanism (Y/N)
Iowa	6	3.5	Net	N/A	N	N
Illinois	5	2	Net	Prospective	N	Y (Penalty)
Maine	4.5	1.5	Net	Prospective	N	N
Massachusetts	10	4	Net	Prospective	Y	Y (Bonus)
New Jersey	5.5	2	Gross	N/A	N	N
Pennsylvania	4	0.5	Gross	N/A	N	Y (Penalty)

Source: ACEEE and Navigant team research

[41] Note that the scores presented here are based only on the combination of the electric program budgets and savings (maximum of 10 points) and the gas program budgets and savings (maximum of 4 points) as presented in the ACEEE report; the presence of DSM enabling policies, as well as other scores that feed into the overall state ranking (e.g., transportation), are not included. See "The 2014 State Energy Efficiency Scorecard", ACEEE, Report Number U1408, Table 8, pp. 23-24, October 2014.

5.7.1 Illinois

Like Iowa, Illinois has an EERS, but its DSM policy differs substantially from Iowa in that program administrators face a penalty if goals are not met. In addition, decoupling is allowed for gas utilities. ACEEE ranks both the electric and gas programs slightly behind Iowa as measured by program budgets and savings. Illinois does use net savings, which are applied prospectively. As of the program year beginning in 2015, the prospective NTG values are developed as part of the TRM, which is finalized approximately 3 months prior to the beginning of each program year. Illinois is in the process of developing statewide NTG methods protocols.

5.7.2 Maine

The DSM policies in Maine are quite similar to Iowa in that Maine has an EERS, but does not have lost revenue cost recovery, bonuses or penalties, or decoupling. As assessed by ACEEE for 2013, electric DSM activity for Maine was considered slightly less aggressive compared to Iowa for electric programs (4.5 out of 10.0 for Maine vs. 6.0 for Iowa), and was further behind on gas DSM (1.5 for Maine vs. 3.5 for Iowa). Maine does require NTG, which is researched as part of the evaluation process but applied through annual updates to the TRM (i.e., NTG is applied prospectively).

5.7.3 Massachusetts

Massachusetts differs substantially from Iowa in that it has had some of the most aggressive DSM programs in the United States for many years (top ranked by ACEEE for both gas and electric in terms of budget and savings), allows lost revenue recovery, and has a bonus reward mechanism. Massachusetts requires net savings, which, beginning with the 2013-2015 program cycle, are applied prospectively over the entire 3-year program cycle. Massachusetts has developed statewide NTG methods protocols.

5.7.4 New Jersey

Like Maine, New Jersey also has very similar DSM policies as Iowa. New Jersey, for example, does not have an EERS, lost revenue recovery, or bonuses or penalties. Decoupling is allowed, but only for gas. The state's electric programs are slightly less aggressive than Iowa (5.5 for New Jersey compared to 6.0 for Iowa), while its gas programs lag behind Iowa (2.0 for New Jersey vs. 3.5 for Iowa). New Jersey is a gross state, and thus does not require NTG research. A review of the New Jersey Clean Energy website found limited impact evaluation reports, and the ones that were conducted focused only on gross savings and did not provide NTG ratios.[42]

5.7.5 Pennsylvania

Pennsylvania differs from Iowa in that program administrators face a penalty if savings goals are not met. The state's electric programs, as scored by ACEEE, are considered behind Iowa (4.0 for Pennsylvania compared to 6.0 for Iowa), and its gas programs are substantially behind Iowa (0.5 for Pennsylvania compared to 3.5 for Iowa). Pennsylvania is a gross state, but does require the electric distribution companies to conduct NTG research to inform program design and cost-effectiveness. In addition, Pennsylvania is in the process of developing statewide NTG methods protocols.

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[42] www.njcleanenergy.com

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6. Benefit / Cost Analyses of NTG Research

Section 6 Contents:
• Methods for Estimating NTG Values
• NTG Best Practices and Research Trends
• Confidence, Precision, and NTG Algorithms
• Mapping Methods to Iowa Programs

A fundamental consideration by stakeholders in determining whether and what type of net savings[43] or NTG research to perform, is whether the benefits justify the costs. This cost/benefit calculation is not unique to NTG research—it is the most basic consideration in any investment decision. In this sense, the decision of whether and how much NTG research to conduct is similar to other investment decisions. In the utility industry, this might be investing in more generation capacity or demand-side program, investment in better transmission lines, investment in community outreach to improve customer satisfaction—each of these investment costs is weighed against its expected benefits in determining whether or not the expense is justified. Similarly, in the case of NTG research, regulators, stakeholders and utilities might want to assess the usefulness of improvements in information and reductions in "at risk" benefits outweigh the costs of conducting formal net savings research.

An important part of this analysis is an equity view. If a program claims it is achieving 5 million kWh per year under the assumption that the NTG is 1.0; but, it turns out that the true NTG value is .5; then, 50 percent of the assumed kWh savings would have occurred anyway and the program is credited with 2.5 million kWh that it was not responsible for. It is hard to argue that this is efficient from a ratepayer's point of view as they are paying for savings that would have occurred anyway. This is considered to be an efficiency loss, not a full net loss as the program's benefit-cost ratio even at 2.5 million kWh could exceed one. However, this program could be more efficient[44] and ratepayers likely could have saved money and/or invested program dollars to generate more savings.

A caveat is in order to this discussion of cost/benefit analysis. Navigant cautions against over-simplifying the NTG research performance question to a simple "yes" or "no" answer, as with a math problem that can be "solved." There is not one correct "solution" to be reached in deciding whether or not and what level of NTG research to conduct. For each stakeholder and each program there are multiple considerations, and a variety of potentially valid NTG research agendas, each of which has its own merits based on the stakeholder's perspective and goals. In this context, cost/benefit analysis is only one consideration, yet it is an important and deserving of attention.

[43] The terms "net savings research" and "NTG research" are often used synonymously. This can be confusing in that some net savings estimation approaches only produce a net savings number, and a net-to-gross (NTG) value is not determined. This is true for Random Control Trials and Quasi-Experimental designs where the method directly produces net savings values rather than an interim NTG value used to calculate net savings from gross savings. In this chapter, the term used for general net savings research is the short hand NTG term.

[44] It is generally assumed that most all EE programs will have some free riders as it is impossible to tailor each incentive and each informational activity perfectly for each participant. As a result, some averaging occurs and there are some participants that likely would have participated in the program anyway. A program with zero free riders is probably so tightly designed that it is missing out on participants that would have more than made up for the free riders. This tension regarding an optimal number (or desired number) of free riders and program efficiency is present in any program design. Also, free riders can be offset by spillover and spillover related market effects.

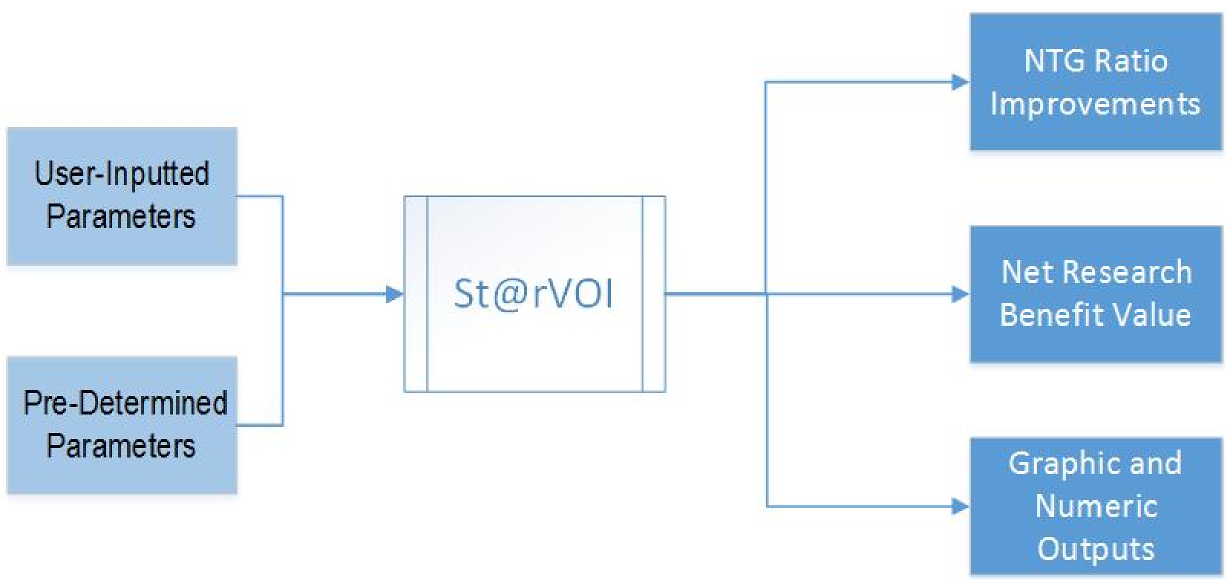
6.1 Analysis Overview—Modeling the Value of Information (VOI) from NTG Research

The modeling approach taken by the Navigant team can be viewed as a "value of information" analysis as it compares the change in benefits resulting from better information on NTG values to the cost of obtaining the information through NTG research. Benefits are expressed as the net energy resource benefits at risk due to assuming a 1.0 deemed value when that is not the case. The NTG research can manage these risks by using the NTG research to prospectively affect program design. The Oversight Committee should therefore view the analysis as reflecting an energy resource NTG or net savings perspective.

The Navigant team developed an interactive Analytica-based tool which is similar to a spreadsheet but more useful in conducting real-time scenario and sensitivity analyses, as well as producing flowcharts illustrating relationships. For reporting purposes we call the tool made for this analysis in Iowa St@rVOI (Stochastic at Risk Value of Information calculator).[45] We presented initial results and conducted additional model runs in-person with Oversight Committee members in May, 2015. In conducting this analysis we noted the uncertainty in monetizing NTG research benefits. Although it is virtually impossible to exhaust all reasonable scenarios and sensitivities, certain trends were apparent and are highlighted in this section. Still, we encourage the Oversight Committee to view this modeling exercise as *directional rather than definitive*.

Based on different combinations of inputs and parameter assumptions, the tool provides results on the predicted net savings, cumulative five-year plan net research benefits from the improved information, and other key metrics regarding the cost-effectiveness of NTG research. The flow of information is shown below.

Figure 11. St@rVOI Net Research Benefits Tool Overview



[45] Analytica is a modeling platform used primarily to create visual representations of decision models, and is capable of producing net benefit results in graphic and tabular forms. This software allowed the Navigant team to incorporate uncertainty into this application in an intuitive manner.

User-inputted parameters include:

- **Distribution of Net Savings Estimates**—Uncertainty is built into the program by creating a distribution based on collected researched NTG values for similar programs in other jurisdictions. Based on that distribution, the risk percentile determines the likelihood of net savings research resulting in a NTG value very different from 1.0. The higher the percentile, the higher the risk of finding a NTG value far from 1.0.
- **NTG Improvement Factor**—The model assumes NTG research provides information leading to constructive program design improvements. The NTG improvement factor is the rate at which the accuracy increases net savings increases due to program design improvements based on the additional research.
- **Research Frequency**—Research frequency is how often during each five-year planning cycle NTG research is conducted. The default assumption is once every five-year planning cycle.
- **Research Benefits**—Research benefits include the different benefits realized through NTG research which may include reductions in benefits at risk, improvements in accuracy of the NTG ratio, improved program design, increased reliability of energy efficiency resources, market effects and other positive outcomes.
- **Research Costs**—Research costs are the direct costs of conducting NTG research. Research costs vary with the method and rigor of the research conducted. The model assumes that spending more on NTG research leads to greater resulting improvements in the NTG ratio and other benefits, due to the study producing better actionable information.

6.2 NTG Research Cost Inputs

Research costs are a key input to the net research benefit calculation tool. Table 4 in Section 4.1 describes a range of costs associated with the various methods that may be applied to NTG research for particular programs. The low-end research cost estimate is most representative of what will typically be seen in NTG research costs for most utilities and programs using industry standard practices. The high-end cost is more representative of special cases in which a program undergoes greater than usual scrutiny, the program or market is undergoing rapid change, or other situations require an especially high level of research rigor. Other cost considerations include the frequency of research and the ability to combine NTG research efforts with process evaluation efforts to reduce costs. These additional cost considerations are accounted for in the model as parameters which can be varied directly on a by-program basis.

6.3 NTG Research Benefit Inputs

The most basic NTG research benefit included in the model is the net program benefit under the utility cost test. Navigant has chosen the utility (or Program Administrators') cost test values as the basis for the main research benefit input to the model based on the fact that it reflects the resource view while also providing changes in a utility's revenue requirements and the reduced (or increased) changes in rate payers costs (both participants and non-participants). Other benefit-cost frameworks could just as easily been used. The model uses as its base benefit input value the net program benefits under the utility cost test, as reported in each utility's regulatory filings.[46]

The tool allows users to include additional program benefits including energy efficiency resource reliability, program design, portfolio construction, program implementation efficiency, investment confidence improvements. Additionally, NTG research can help utilities and stakeholders better understand how utility-run programs influence and change the market for energy efficiency. The model assumes that NTG research benefits cannot be realized unless the utility takes action based on the results of research. NTG research provides better information to utilities, which allows them to implement changes in program design and implementation. Based on these changes, the utility is able to achieve higher NTG values over time.

The net benefits of NTG research will be significantly affected by the assumed levels of benefits at risk. If the utility assumes a NTG ratio of 1.0 and NTG research reveals the true NTG value is closer to 0.6, this would imply that roughly 40% of the benefits currently being attributed to the program are not in reality being realized by the program. We can describe these misattributed benefits as "benefits at risk," and the "risk percentile" as the likelihood of the actual NTG value being significantly below the assumed NTG value of 1.0. St@rVOI also allows the user to draw researched NTG values from different percentiles of risk in order to gauge the effects on net benefits of NTG research. The higher the risk percentile, the more benefits at risk, the larger the potential net benefits of NTG research.

Figures 12, 13, and 14 demonstrate, for a generic program, the effect of different risk percentile assumptions on the benefits at risk. The main finding conveyed by this series of figures is that the higher the risk percentile, the greater the value of benefits at risk.

[46] Alliant Energy, Black Hills Energy and MidAmerican Energy all provided regulatory filing documents with the most up-to-date utility cost test values for Navigant to use as benefit inputs for each program. The source documents referenced for each utility are as follows: For Alliant Energy, we referenced the *Interstate Power and Light Company—2014-2018 Energy Efficiency Plan*, prepared for the IUB, Docket No. EEP-2012-0001, November 30, 2012. For Alliant Energy we also referenced the *IPL Energy Efficiency Plan—Compliance*, prepared for IUB, January 31, 2014, Corrected Revised January 25, 2013. For Black Hills Energy Navigant referenced the *Black Hills Energy—Energy-Efficiency Plan 2014-2018*, prepared for the Iowa Utilities Board (IUB), Docket No. EEP-2013-0001, April 1, 2013. For MidAmerican Energy Navigant referenced *MidAmerican Energy Company—2014-2018 Energy Efficiency Plan, Revised Volume II*, prepared for the IUB, Docket No. EEP-2012-0002, February 24, 2014.

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Figure 12. 50th Percentile Risk Example

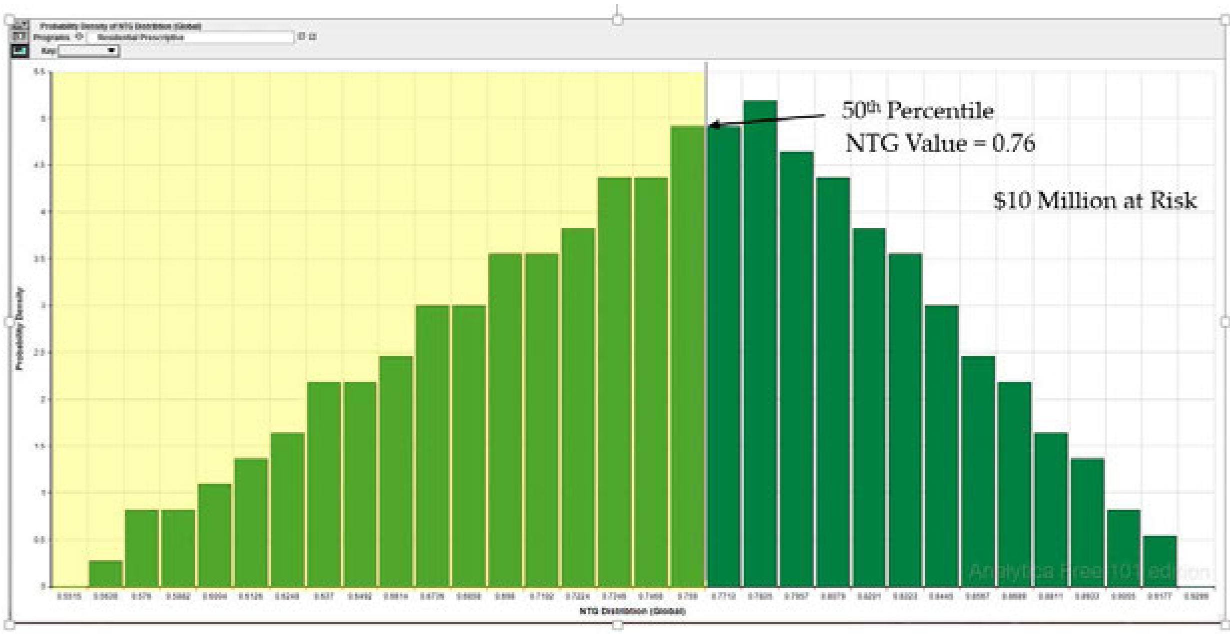

Figure 13. 20th Percentile Risk Example

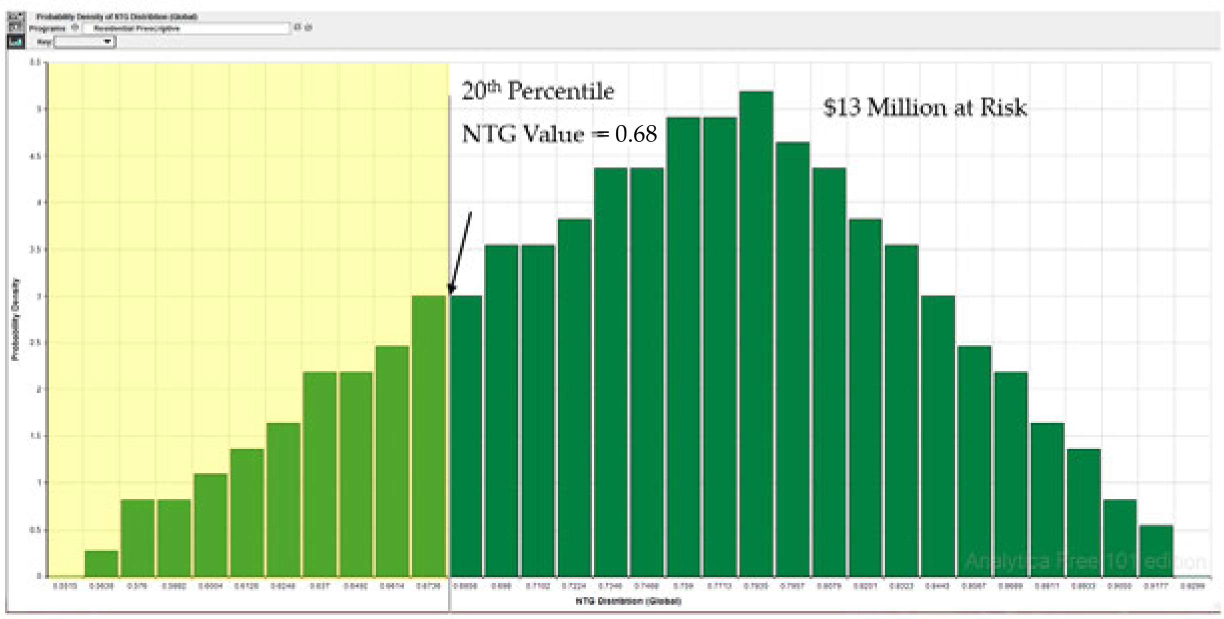

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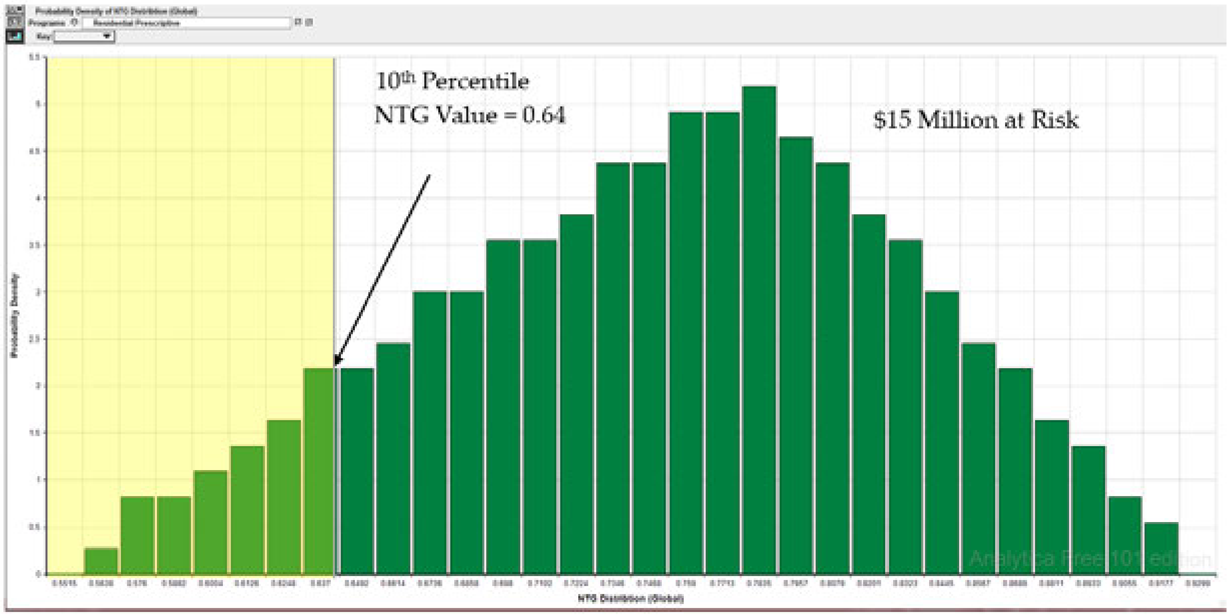
Figure 14. 10th Percentile Risk Example



Additionally, the more frequently NTG research is conducted, the more frequently improvements in research design can be implemented based on better information, and as a result, the greater the improvement in the net savings yield of the program. In order to make the model realistic, it incorporates decreasing returns to research, so that the improvement in the programs' net savings yield is smaller each time a successive round of NTG research is completed. The following series of figures (Figures 15, 16 and 17) illustrate this point by showing that the net savings yield improves more with more frequent NTG research. Note that the vertical axis in each figure, which has the NTG ratio, is not strictly correct; net savings or benefits would be a more accurate mathematical representation of the areas show in each figure. Therefore, the reader should view the NTG ratio dimension on the vertical axes as a simplifying construct to normalize the data and illustrate how research frequency affects net savings in this tool. This is consistent with the notion that these examples are purely for illustrative purposes and are not specific to any program.

Figure 15. Base Case – No Increase in Net Savings due to Zero NTG Research Conducted over a Five Year Plan

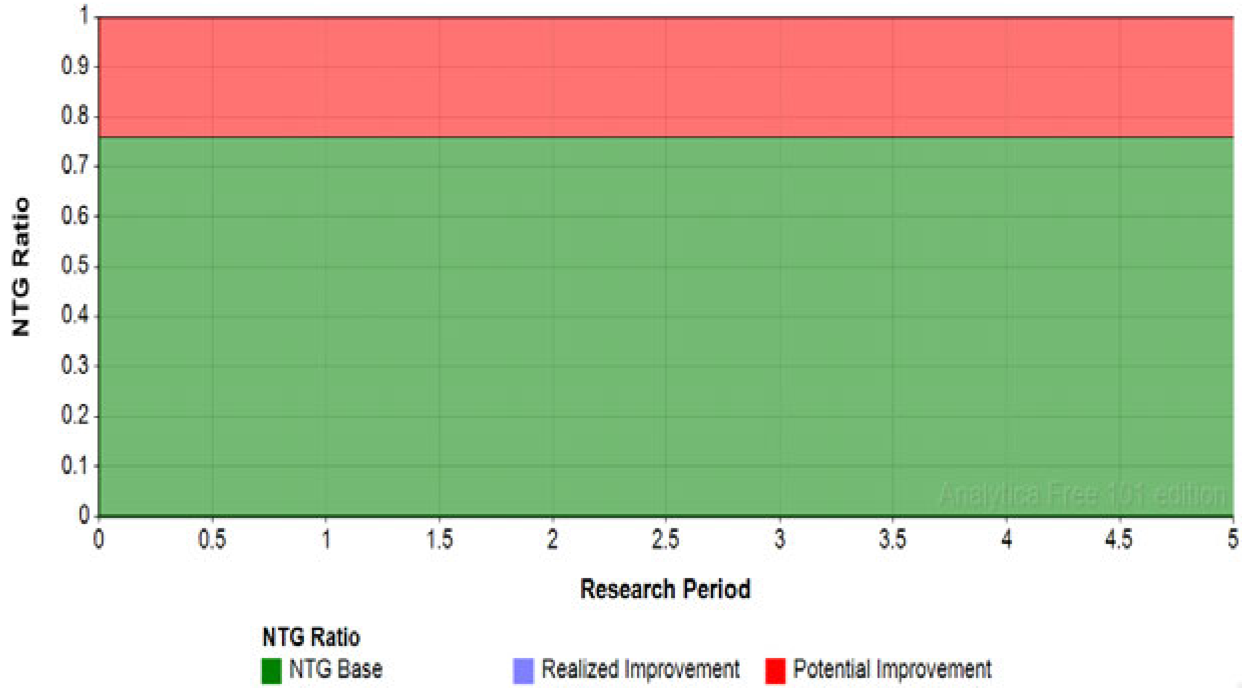


Figure 16. Improvements in Net Savings Based on One Round of NTG Research per Five Year Plan

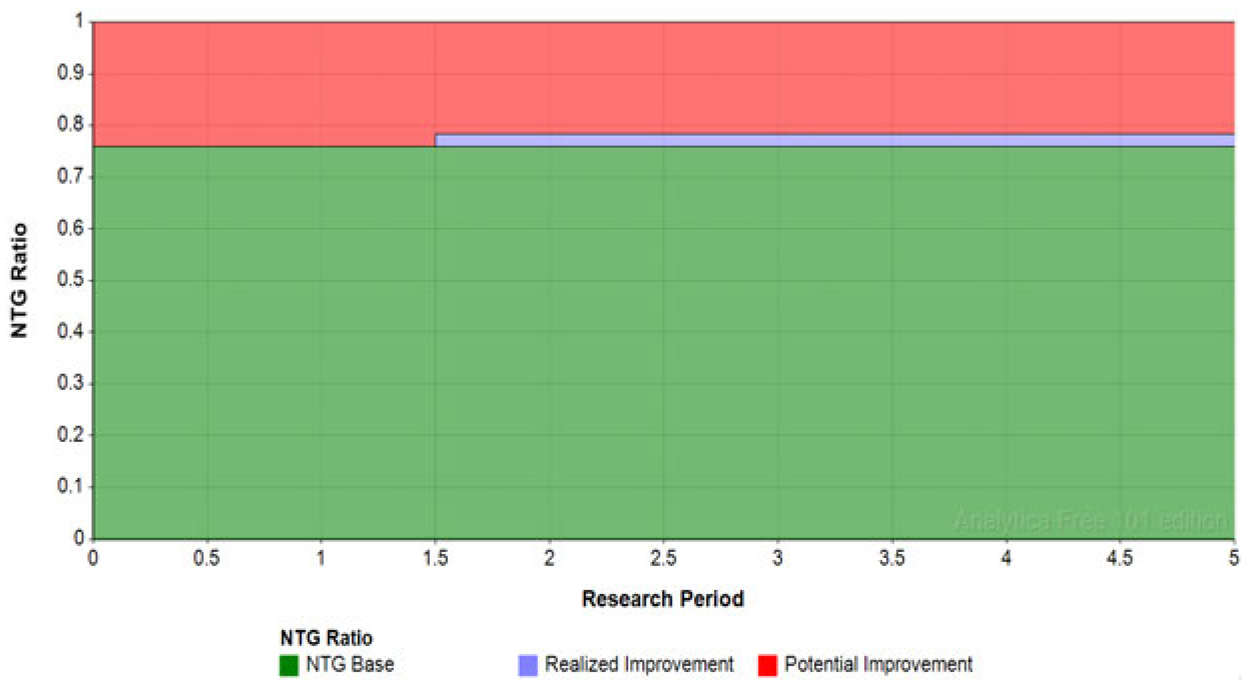
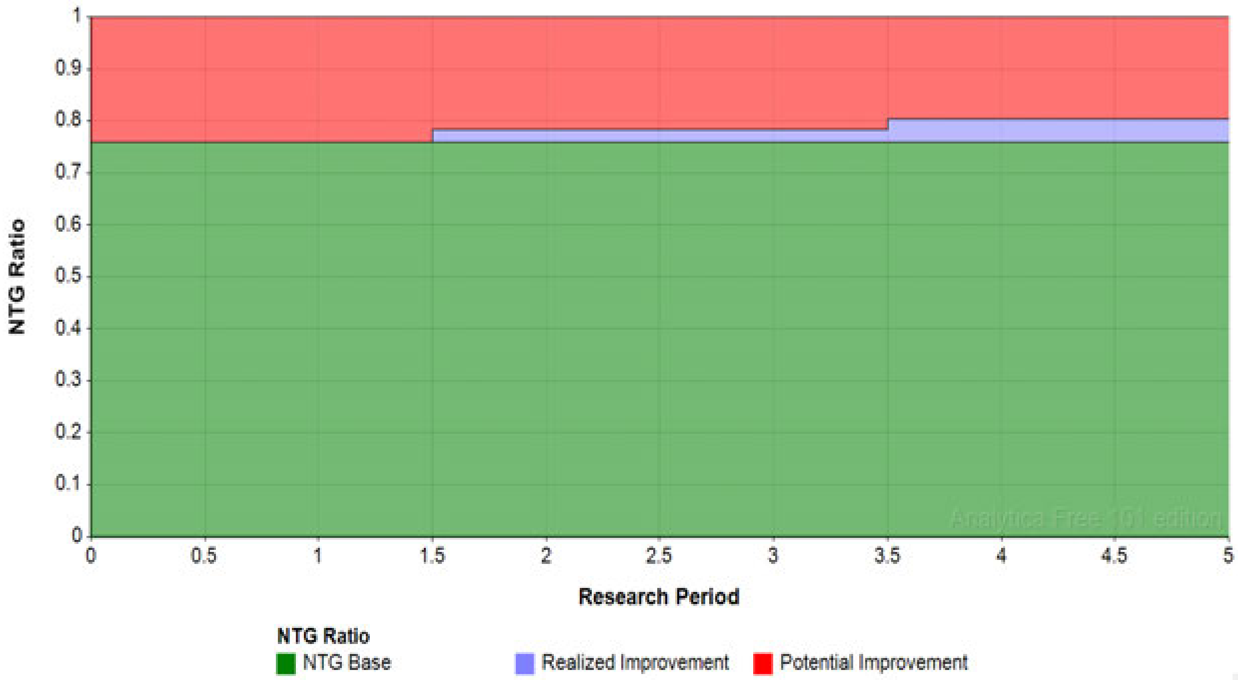


Figure 17. Improvements in Net Savings Based on Two Rounds of NTG Research per Five Year Plan



6.4 Directional VOI Findings

While the St@rVOI tool gives users the ability to analyze changes in NTG research net benefits based on a nearly unlimited number of permutations of different parameters such as risk factors, research frequency, research synergies and program improvement factors, there is limited space in this report to present the results of various scenarios by program. Navigant has chosen several informative scenarios and has included output results for several different scenarios by utility and program as a reference for Iowa stakeholders.

Navigant emphasizes that while we have been explicit about the assumptions underlying these model results, they are nonetheless based on multiple assumptions. Accordingly, less importance should be placed on exact dollar amounts or NTG values, and more on the direction of these results and how changes in key parameters affect NTG research cost-effectiveness. This information allows stakeholders to compare their views on NTG research with information on how the benefits change across scenarios.

As explained in previous sections, distribution of NTG values, research frequency, research costs and assumed program design benefits owing to NTG research can all dramatically affect research benefits. In order to present relevant and informative results for reference by Iowa utilities and stakeholders, we present the results of three different potential scenarios in this section:

- Scenario 1
  - Medium research cost/rigor
  - Research frequency once per five year plan
  - Median (50th percentile) risk percentile
  - Program design improvement factor of 10%
- Scenario 2
  - Identical to Scenario 1 with the exception of a higher program design improvement factor (20%)
- Scenario 3
  - Identical to Scenario 2 with the exception of higher risks (10th percentile risk)

Table 11 summarizes the low and high range outcomes of Scenarios 1 through 3 for each utility by program. Green indicates programs for which NTG research produces positive net research benefits under all scenarios, red indicates the opposite, and yellow indicates programs for which cost-effectiveness varies by scenario. Again, the results of these scenarios are intended to provide context for assessing how various assumptions may affect the cost-effectiveness of conducting NTG research for specific programs. For some programs it is never cost-effective to perform NTG research, particularly programs with expected NTG values close to 1.0 and programs with very low savings. The full results of these scenarios are presented in Appendix C.

From a deemed perspective, even programs that exhibit only marginally positive net research benefits may be candidates for assigning deemed values based on other jurisdictions' findings, along with infrequent NTG research to validate or calibrate these values. By contrast, the programs which feature most prominently in utilities' energy efficiency portfolios are more likely to warrant NTG research, and this is especially true for programs in larger utilities which have large savings values relative to research costs.

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Table 12. Summary of High and Low Net Research Benefit Outcomes by Program

Alliant	Low Value of NTG Research in Year 5	High Value of NTG Research in Year 5	Low Projected NTG Ratio in Year 5	High Projected NTG Ratio in Year 5
Commercial New Construction	$1,267,610	$3,813,441	0.54	0.68
Custom Rebates	$2,132,920	$7,316,725	0.64	0.79
Nonresidential Prescriptive Rebates	$290,280	$1,183,585	0.72	0.81
Residential Prescriptive Rebates	$142,990	$748,572	0.72	0.81
Appliance Recycling	$53,950	$259,222	0.61	0.67
Change-a-Light	($84,170)	$124,714	0.64	0.74
Home Energy Assessments	($67,730)	($51,548)	0.63	0.77
Black Hills Energy				
Residential Prescriptive	($56,730)	$76,637	0.72	0.81
Nonresidential Prescriptive	($89,270)	($4,885)	0.69	0.81
Residential New Construction	($55,330)	($12,505)	0.68	0.84
Nonresidential Custom	($54,610)	($25,766)	0.64	0.79
Nonresidential New Construction	($61,480)	($45,533)	0.54	0.68
MidAmerican				
Residential Equipment	$477,510	$1,736,588	0.72	0.81
Nonresidential Equipment	$1,039,560	$3,774,746	0.68	0.81
Commercial New Construction	$596,840	$1,887,601	0.54	0.68
Upstream Retail Lighting	$70,470	$558,255	0.64	0.74
Industrial Partners	$210,290	$608,815	0.61	0.67
Commercial Assessment	($18,640)	$106,763	0.63	0.77
Residential Assessment	($29,840)	$101,952	0.68	0.84

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7. Report Summary and Recommendations

Section 7 Contents:
• Summary of Report Findings
• Recommendations for an Iowa Net Savings Research Agenda

The Navigant team has found, through the process of conducting research for this report and interacting with various Iowa stakeholders, that the three perspectives taxonomy is representative of Iowa stakeholder positions. While some stakeholders display a more energy efficiency resource-based perspective, others hold a decidedly deemed view.

However, all stakeholders expressed interest in a market view on NTG research, concurrent with understanding market trends, trade ally relationships, and being able to identify ways in which utility programs have changed energy efficiency markets over time. Most stakeholders expressed some degree of flexibility, as evidenced by their willingness to adopt a view under certain scenarios that differed from their overall perspective. Some stakeholders with a predominantly energy efficiency resource perspective, for example, conceded that for certain programs a deemed perspective and approach were justified. Similarly, some stakeholders with deemed perspectives agreed that under certain circumstances, formal NTG research could be justified for major programs.

7.1 Summary of Report Analyses and Findings

Iowa utilities are already conducting NTG research for certain programs due to the nature of typical impact evaluation methods.

- Particularly in the case of demand reduction, load management and residential behavior (i.e.- Home Energy Report) programs, Iowa utilities are already generating evaluated net savings values.
- Both Alliant Energy and MidAmerican Energy implement Demand Reduction or Load Management programs that are currently evaluated to produce net savings estimates.
- MidAmerican offers a residential behavior program for which it estimates net savings values.

For many programs, continuing with deemed values is appropriate.

- Stakeholders agreed that for minor programs such as education or tree planting programs, and for low income programs and some multifamily programs, a deemed NTG value of 1.0 is the most appropriate choice, and formal NTG research is not currently necessary or justified.
- There was also general agreement that for large, core programs where NTG research is shown to be cost-effective under most scenarios and assumptions, and for some programs demonstrating marginally positive net research benefits, primary research would be justified.
- Some utilities expressed the desire not to rely exclusively on customer surveys to estimate free ridership and spillover, as these may over-estimate free ridership and under estimate spillover (failing to account for market transformation) in mature markets.

- Most stakeholders expressed agreement that in the case of programs which exhibit negative net research benefits under almost all scenarios, and even some which demonstrate only marginally positive benefits, secondary research to obtain deemed NTG values for these programs or suites of programs would be in order, and that these values may differ from 1.0.

A market perspective provided common ground for the majority of stakeholders on the Oversight Committee and participating utilities.

- All parties expressed interest in pursuing market characterization studies or other methods appropriate to a market view in order to better understand Iowa markets, trends and trade ally relationships.
- Stakeholders also expressed interest in understanding changes in energy efficiency markets over time attributable to the influence of utility programs.
- Alliant Energy and MidAmerican Energy both expressed willingness to conduct NTG research using point-of-sale (POS) data, manufacturer and trade ally research or other market perspective approaches.

Stakeholders are generally in agreement about prospective versus retrospective use of NTG values, but differed in views on whether NTG changes should be applied to current or only future plans.

- Stakeholders generally agreed that changes in NTG values should be prospective.
- There was no consensus on whether these prospective NTG values should be applied to utilities' current plans or just to future plans
- Utilities expressed the desire for prospective changes in NTG values to be applied only to future plans rather than the current plan.
- As justification for this view, some utility stakeholders suggested that because process and impact evaluation activities are already determined for the current plan, there would be no opportunity cost-reductions in NTG research through synergies with evaluation activities if utilities were mandated to apply prospective changes in NTG values during their current plan.
- Environmental stakeholders stated that the settlement makes clear that changes in NTG values may affect the current plan, and they expressed a strong preference to apply changes to the current plan on these grounds.

Navigant's VOI analysis highlighted the inherent uncertainty around net benefits to conducting NTG research, and the sensitivity of net benefit results to different key assumptions.

- Analysis demonstrated that there are programs where under a wide variety of scenarios and assumptions, and allowing for a high degree of uncertainty, net research benefits are positive.
- Analysis also demonstrated the opposite case—there are a number of programs for which NTG research is not cost-effective under most realistic scenarios.
- There are a number of programs for which the net benefits of NTG research depend on the assumptions made—these programs may or may not warrant research under different scenarios.

- Utility size and scope has a large influence on the cost-effectiveness of conducting NTG research. Smaller utilities such as Black Hills, which provide only gas, have fewer programs exhibiting positive net benefits to NTG research under most scenarios.

Navigant's research revealed the potential for cost-reductions through joint research efforts where there are similar programs.

- There was general agreement by stakeholders that cost-sharing in the form of jointly conducted NTG studies for particular programs or suites of programs would be in order.
- Particularly for Black Hills Energy, cost-sharing and jointly conducted research could make NTG research feasible for a larger number of programs.
- Both Alliant Energy and MidAmerican Energy indicated that conducting joint research with Black Hills Energy would be feasible for some programs.

The most appropriate process for implementing prospective NTG changes remains unresolved, yet there was some agreement on the current annual review process as the appropriate venue.

- There was no agreement between stakeholders on the most appropriate process for making NTG value changes prospectively.
- Various parties concurred that an annual review process is already in place, through which stakeholders are able to weigh in on proposed changes moving forward, and this existing forum was considered as an appropriate venue for the process of changing NTG values prospectively.
- Utilities and other stakeholders did not come to complete agreement on how much of the NTG research process should be left to utilities' discretion, versus how many decisions on NTG research should be made collaboratively in a public forum. However, utilities affirmed that based on the settlement terms, all program and measure changes are intended to be transparent to stakeholders and to be made available for comment before they are submitted to the Board.

7.2 Recommendations for an Iowa Net Savings Research Agenda

The Navigant team recommends that Iowa stakeholders build on the momentum generated through dialogue and involvement in the creation of this NTG research report to develop an Iowa appropriate NTG research agenda. Iowa stakeholders agree on a number of key issues, and a framework for an Iowa NTG research agenda has already been developed. Articulation of a complete NTG research plan will require stakeholders to compromise on unresolved issues. However, as summarized above, general areas of agreement have been identified, providing the foundation for facilitating a final NTG research agenda.

This foundation blends market, deemed and resource views in an Iowa NTG research agenda that is flexible and responsive, and meets the needs of all stakeholders. Tables 13 and 14 reiterate key information on the cost-effectiveness of NTG research by specific utility program, and specific NTG research actions for the Oversight Committee's consideration, based on the findings in this report. Both of these tables are initially presented in the Executive Summary.

Table 13. Summary of High and Low Net Research Benefit Outcomes by Program

Alliant	Low Value of Primary NTG Research	High Value of Primary NTG Research
Commercial New Construction	$1,267,610	$3,813,441
Custom Rebates	$2,132,920	$7,316,725
Nonresidential Prescriptive Rebates	$290,280	$1,183,585
Residential Prescriptive Rebates	$142,990	$748,572
Appliance Recycling	$53,950	$259,222
Change-a-Light	($84,170)	$124,714
Home Energy Assessments	($67,730)	($51,548)
Black Hills Energy		
Residential Prescriptive	($56,730)	$76,637
Nonresidential Prescriptive	($89,270)	($4,885)
Residential New Construction	($55,330)	($12,505)
Nonresidential Custom	($54,610)	($25,766)
Nonresidential New Construction	($61,480)	($45,533)
MidAmerican		
Residential Equipment	$477,510	$1,736,588
Nonresidential Equipment	$1,039,560	$3,774,746
Commercial New Construction	$596,840	$1,887,601
Upstream Retail Lighting	$70,470	$558,255
Industrial Partners	$210,290	$608,815
Commercial Assessment	($18,640)	$106,763
Residential Assessment	($29,840)	$101,952

Table 14. NTG Research Recommendations for Consideration by the Oversight Committee

Continue with a deemed NTG value of 1.0 for programs with low net benefits and savings, and where research has found programs are likely to have a NTG value close to 1.0.
Continue to apply state-of-the-industry net savings research methods to demand management programs such as demand response and direct load management programs, and for residential behavior programs such as Opower HERs.
Conduct secondary research to determine and establish deemed values other than 1.0 for programs where the costs of NTG research are not justified, but research shows a NTG value of 1.0 to be unlikely. These are generally the programs in yellow and orange in Table 12.
Conduct primary NTG research to estimate NTG values and/or common practice market baselines for key programs contributing large savings to the utility's DSM portfolio, using any or multiple methods outlined in this report. Most of these programs are represented in green in Table 12, though there may be additional programs for which the utility conducts primary research.
For programs warranting primary NTG research, market-based methods may be used as the primary research methodology, providing a comprehensive understanding of energy efficiency markets, facilitating development of common practice market baselines, and/or generating estimates of the FR and SO components of NTG values.
NTG research should begin immediately rather than during the next five-year planning cycle, and resulting NTG values should be applied prospectively. Particularly for the green programs in Table 1, research should begin during the current planning cycle to facilitate updates to the Iowa TRM and utility program designs prior to finalizing the next set of five-year plans.
NTG research should be conducted at a minimum once per each five-year planning cycle, but for programs contributing large savings to the portfolio, programs in rapidly changing markets, primary research may need to be conducted every 2 to 3 years and possibly more frequently. Ultimately, the research findings will provide guidance as to when additional / new NTG research should be conducted.
Periodic review of all established deemed NTG value should be conducted to ensure they remain relevant and appropriate.

Glossary

A&E Firm:	Architecture and engineering firm
Accuracy:	Proximity of a researched value to the actual value
ACEEE:	American Council for an Energy-Efficient Economy
AESP:	Association of Energy Services Professionals
Analytica:	A software package for creating, analyzing and communicating quantitative decision models.
Attribution:	Resource savings credited to an energy efficiency program?
Benefits at Risk:	Benefits attributed to a program but not being realized in reality due to free ridership
C&I:	Commercial and industrial
Common Practice Baseline:	Using estimates of current typically installed equipment as baseline for comparison—estimating savings as difference between efficiency of equipment installed minus the CPB
Confidence:	The level of certainty with which something is estimated
CI:	Confidence interval
CPP:	Clean Power Plan
CPUC:	California Public Utilities Commission
Decoupling:	A regulatory tool that serves as a means of helping utilities overcome the throughput incentive. A decoupling mechanism separates a utility's revenue from its unit sales volume without affecting the design of customer rates.
Deemed:	An assumed Net to Gross value which may be based on secondary research but not primary
Deemed Perspective:	A NTG research viewpoint that views primary NTG research as overly uncertain and views secondary research sources as sufficient for supplying NTG values that are "close enough" to actual program NTG values
Delphi Panel/Study:	A structured communication technique utilizing a panel of experts to converge on a NTG value, input (FR or SO) or other market information estimate
DLC:	Direct Load Control
Downstream Program:	A program in which the consumer directly receives the incentive on efficiency equipment rather than the distributor, contractor, or manufacturer.
DR:	Demand Response
DSM:	Demand Side Management
EE:	Energy Efficiency
EERS:	Energy Efficiency Resource Standard
EE Resource Perspective:	A NTG research view in which energy efficiency and other demand side programs are viewed as resource investments and the focus is on ensuring the return on investments in EE and precisely estimating NTG values, FR and SO.
EPA:	Environmental Protection Agency

ESCO:	Energy Service Company
ESPI:	Efficiency Savings and Performance Initiative
Fast-feedback Survey:	A short survey given to program participants immediately after participation, used to estimate free ridership.
FR:	Free ridership
GIAC:	Green Iowa AmeriCorps—A group working with Black Hills Energy to implement certain weatherization programs.
Gross Savings:	Savings from energy efficiency programs prior to applying a NTG value to subtract off free ridership and add in spillover.
HER:	Home Energy Rating
HERS Rating:	Home Energy Rating System score
Historical Tracing:	A Net to Gross estimation method which involves developing a chronological narrative of market influences.
HVAC:	Heating, Ventilation, and Air Conditioning
IECP:	International Energy Cooperation Program
Impact Evaluation:	An evaluation determining the savings associated with energy efficiency or DSM programs.
IOU:	Investor owned utility
IUA:	Iowa Utility Association
IUB:	Iowa Utilities Board
Lost Revenue Recovery:	Allows a utility to recover the lost revenue attributable to DSM programs by increasing revenue by that same amount.
Market Perspective:	A Net to Gross viewpoint in which a focus in made of the energy efficiency programs influence on the broader market.
MEEA:	Midwest Energy Efficiency Alliance
NAPEE:	National Action Plan for Energy Efficiency
Net Savings:	Savings from energy efficiency programs, after using the NTG value to account the effects of free ridership and spillover by subtracting FR and adding SO to the gross savings value.
NPSO:	Non-Participant Spillover
NREL:	National Renewable Energy Laboratory
NTG:	Net-to-Gross
NTGR:	Net-to-Gross Ratio
OCA:	Office of Consumer Advocate
POS:	Point of Sale
Precision:	A measurement of how tight the confidence bounds around a researched value is.
Process Evaluation:	A program evaluation focusing on process aspects such as participant and trade ally program satisfaction, delivery and implementation issues.
Prospective Application:	NTG values are applied into future years.
QED:	Quasi-experimental design
RCT:	Randomized Control Trial
Retrospective Application:	Net to Gross values are applied into past years.
Risk Reward Mechanism:	Incentives (penalties) associated with exceeding (falling short of) net or gross savings targets.

Risk Percentile:	The likelihood of actual Net to Gross values being significantly lower than the assumed value.
SO:	Spillover
St@rVOI:	Stochastic at Risk Value of Information calculator. The Analytica tool created by Navigant to estimate program-level net NTG research benefits.
Stochastic:	A property of a parameter having a random probability distribution or pattern that may be analyzed statistically but may not be predicted precisely
SEJ:	Structured expert judgement
Top-Down Model:	Macroeconomic model
TRCT:	Total Resource Cost Test
TRM:	Technical Reference manual
UCT:	Utility Cost Test
UMP:	Uniform Methods Project
Upstream Program:	An energy efficiency program in which the incentives are targeted towards equipment distributors, contractors, or manufacturers, rather than the consumer.
VOI:	Value of Information

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Appendix A. State Net-to-Gross Policy Summaries

	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, Deemed net (prospective), or Adjusted (retro) net?	Energy Efficiency Resource Standard	Decoupling	Lost revenue recovery	Risk/ Reward
Alabama	Gross	No	n/a	N	N	N	Gross	No	No	Yes	Bonus
Alaska	Gross	No	n/a	N	N	N	Gross	No	No	No	No
Arizona	Gross	No	n/a	N	N	N	Gross	Yes	E&G	Yes	Bonus
Arkansas	Net	No	n/a	Y	Y	Y	Retrospective	Yes	G, Pending E	Yes	Bonus
California	Net	No	n/a	Y	N	Y	Deemed and Retrospective	Yes	E&G	No	Both
Colorado	Net	No	n/a	Y	Y	Y	Retrospective	Yes	No	Yes	Bonus
Connecticut	Net	No	n/a	Y	Y	Y	Deemed	Yes	E, Pending G	Yes	Bonus
Delaware	Gross	No	n/a	N	N	N	Gross	No	Pending G	Pending	No
DC	Gross	No	n/a	N	N	N	Gross	No	E	No	Bonus
Florida	Net	No	n/a	Y	Y	Y	Retrospective	No	No	Yes	Bonus
Georgia	Net	No	n/a	Y	Y	Y	Deemed	No	G	No	Bonus
Hawaii	Net	Yes	0.7	N	N	Y	Deemed	Yes	No	No	Bonus
Idaho	Gross	No	n/a	N	N	N	Gross	No	E	No	No
Illinois	Net	No	n/a	Y	Y	Y	Deemed	Yes	G	No	Penalty
Indiana	Gross	No	n/a	Y	Y	Y	Gross	Yes	G	Yes	Bonus
Iowa	Gross	No	n/a	Y	Y	Y	Gross	Yes	No	No	No
Kansas	Net	No	n/a	N	N	Y	Retrospective	No	No	Yes	Bonus
Kentucky	Gross	No	n/a	N	N	N	Gross	No	No	Yes	Bonus
Louisiana	Gross	No	n/a	N	N	N	Gross	No	No	Yes	Bonus
Maine	Net	No	n/a	Y	N	Y	Deemed	Yes	No	No	No
Maryland	Gross	No	n/a	N	N	N	Gross	Yes	E&G	Yes	No
Massachusetts	Net	No	n/a	Y	Y	Y	Deemed	Yes	E&G	Yes	Bonus
Michigan	Net	Yes	0.9 for all except CFLs, which are 0.82	Y	Y	Y	Deemed	Yes	E&G	Yes	Bonus
Minnesota	Gross	No	n/a	N	N	N	Gross	Yes	G, Pending E	No	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, Deemed net (prospective), or Adjusted (retro) net?	Energy Efficiency Resource Standard	Decoupling	Lost revenue recovery	Risk/ Reward
Mississippi	Gross	No	n/a	N	N	N	Gross	No	No	Pending	Pending
Missouri	Net	No	n/a	Y	Y	Y	Deemed	No	No	Yes	Bonus
Montana	Gross	No	n/a	N	N	N	Gross	No	No	Yes	Pending
Nebraska	Gross	No	n/a	N	N	N	Gross	No	Pending G	No	No
Nevada	Net	No	n/a	N	N	Y	Retrospective	Yes	G	Yes	No
New Hampshire	Gross	No	n/a	N	N	N	Gross	No	No	No	Bonus
New Jersey	Gross	No	n/a	N	N	N	Gross	No	G	No	No
New Mexico	Net	No	n/a	N	N	Y	Retrospective	Yes	No	Yes	Bonus
New York	Net	Yes	0.9	Y	Y	Y	Deemed	Yes	E&G	No	Bonus
North Carolina	Net	No	n/a	Y	Y	Y	Retrospective	Yes	G	Yes	Bonus
North Dakota	Gross	No	n/a	N	N	N	Gross	No	No	No	No
Ohio	Gross	No	n/a	N	N	N	Gross	Yes	E	Yes	Bonus
Oklahoma	Gross	No	n/a	N	N	N	Gross	No	No	Yes	Bonus
Oregon	Net	No	n/a	Y	Y	Y	Deemed	Yes	E&G	Yes	No
Pennsylvania	Gross	No	n/a	Y	Y	Y	Gross	Yes	No	No	Penalty
Rhode Island	Net	No	n/a	Y	Y	Y	Deemed	Yes	E&G	Yes	Bonus
South Carolina	Gross	No	n/a	N	N	N	Gross	No	No	Yes	Bonus
South Dakota	Net	No	n/a	Y	N	Y	Retrospective	No	No	Yes	Bonus
Tennessee	Gross	No	n/a	N	N	N	Gross	No	G	No	No
Texas	Gross	No	n/a	N	N	N	Gross	Yes	No	No	Bonus
Utah	Net	No	n/a	Y	Y	Y	Retrospective	No	G	Yes	No
Vermont	Net	No	n/a	Y	Y	Y	Deemed	Yes	E	No	Bonus
Virginia	Gross	No	n/a	N	N	N	Gross	No	G	Pending	No
Washington	Gross	No	n/a	N	N	N	Gross	Yes	G, Pending E	No	Penalty
West Virginia	Gross	No	n/a	N	N	N	Gross	No	No	No	Pending
Wisconsin	Net	No	n/a	Y	N	Y	Retrospective	Yes	E&G	No	Bonus
Wyoming	Net	No	n/a	Y	N	Y	Retrospective	No	G	Yes	No

Appendix B. NTG Methods Presentation to the Oversight Committee, January, 2015

Appendix B is provided as a separate PDF of a PowerPoint file presented to the Oversight Committee on January 8 and January 16, 2015.

Appendix C. Scenario Results—Net Research Benefit Outcomes

Detail results for the Scenarios 1 through 3 as described in Section 6.4 are provided in Tables C-1 through C-3. The green rows indicate programs for which the net benefits of NTG research are positive under a given scenario, red rows indicate that research is not cost-effective for the program under a scenario, and yellow rows indicate marginally positive or negative research benefits. Under Scenario 1, some programs warrant NTG research while others do not.

Moving to Scenario 2 with a higher program design improvement factor (i.e.-greater improvements in program design owing to NTG research), some of the programs for which NTG research was previously not cost effective are now either marginally or fully cost-effective. Scenario 2 demonstrates that higher expected returns to research in terms of resulting program improvements make NTG research more cost-effective.

Finally, moving to Scenario 3, in which a higher risk percentile is assumed (meaning an increased likelihood of finding a researched NTG value farther from 1.0), again, the cost-effectiveness of NTG research for certain programs improves, because the incremental benefit of better information is greater. Once again, several programs which previously had negative net benefits to NTG research now have marginally or fully positive net research benefits under Scenario 3. Scenario 3 demonstrates that the farther we believe the true NTG value to be from 1.0, the larger the potential benefits of NTG research, and accordingly, the more cost-effective NTG research may be.

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Table C-1. Scenario 1 Results

Alliant	Total Research Benefits (Thousands)	Total Research Costs (Thousands)	Net Research Benefits (Thousands)	Pct. Change in Net Benefits	Projected NTG Ratio in Yr. 5
Commercial New Construction	$1,360.61	$93.00	$1,267.61	1.3%	0.64
Custom Rebates	$2,225.92	$93.00	$2,132.92	0.9%	0.76
Nonresidential Prescriptive Rebates	$457.28	$167.00	$290.28	0.5%	0.78
Residential Prescriptive Rebates	$309.99	$167.00	$142.99	0.4%	0.78
Home Energy Assessments	$7.27	$75.00	-$67.73	-9.3%	0.74
Change-a-Light	$115.83	$200.00	-$84.17	-0.8%	0.71
Appliance Recycling	$146.95	$93.00	$53.95	0.5%	0.63
Black Hills					
Nonresidential Custom	$12.39	$67.00	-$54.61	-4.1%	0.76
Residential Prescriptive	$68.27	$125.00	-$56.73	-0.7%	0.78
Nonresidential Prescriptive	$35.73	$125.00	-$89.27	-2.0%	0.79
Nonresidential New Construction	$8.52	$70.00	-$61.48	-10.2%	0.64
Residential New Construction	$14.67	$70.00	-$55.33	-2.7%	0.82
MidAmerican					
Residential Equipment	$644.51	$167.00	$477.51	0.6%	0.78
Nonresidential Equipment	$1,206.56	$167.00	$1,039.56	0.7%	0.78
Commercial New Construction	$689.84	$93.00	$596.84	1.2%	0.64
Commercial Assessment	$56.36	$75.00	-$18.64	-0.3%	0.74
Upstream Retail Lighting	$270.47	$200.00	$70.47	0.3%	0.71
Industrial Partners	$285.29	$75.00	$210.29	1.1%	0.63
Residential Assessment	$45.16	$75.00	-$29.84	-0.5%	0.82

Table C-2. Scenario 2 Results

Alliant	Total Research Benefits (Thousands)	Total Research Costs (Thousands)	Net Research Benefits (Thousands)	Pct. Change in Net Benefits	Projected NTG Ratio in Yr. 5
Commercial New Construction	$2,721.22	$93.00	$2,628.22	2.7%	0.68
Custom Rebates	$4,451.83	$93.00	$4,358.83	1.8%	0.79
Nonresidential Prescriptive Rebates	$914.56	$167.00	$747.56	1.4%	0.81
Residential Prescriptive Rebates	$619.99	$167.00	$452.99	1.2%	0.81
Home Energy Assessments	$14.54	$75.00	-$60.46	-8.3%	0.77
Change-a-Light	$231.65	$200.00	$31.65	0.3%	0.74
Appliance Recycling	$293.90	$93.00	$200.90	2.0%	0.67
Black Hills					
Nonresidential Custom	$24.77	$67.00	-$42.23	-3.2%	0.79
Residential Prescriptive	$136.54	$125.00	$11.54	0.1%	0.81
Nonresidential Prescriptive	$71.47	$125.00	-$53.53	-1.2%	0.81
Nonresidential New Construction	$17.04	$70.00	-$52.96	-8.8%	0.68
Residential New Construction	$29.34	$70.00	-$40.66	-2.0%	0.84
MidAmerican					
Residential Equipment	$1,289.03	$167.00	$1,122.03	1.5%	0.81
Nonresidential Equipment	$2,413.11	$167.00	$2,246.11	1.6%	0.81
Commercial New Construction	$1,379.68	$93.00	$1,286.68	2.6%	0.68
Commercial Assessment	$112.73	$75.00	$37.73	0.7%	0.77
Upstream Retail Lighting	$540.94	$200.00	$340.94	1.4%	0.74
Industrial Partners	$570.59	$75.00	$495.59	2.5%	0.67
Residential Assessment	$90.31	$75.00	$15.31	0.2%	0.84

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Table C-3. Scenario 3 Results

Alliant	Total Research Benefits (Thousands)	Total Research Costs (Thousands)	Net Research Benefits (Thousands)	Pct. Change in Net Benefits	Projected NTG Ratio in Yr. 5
Commercial New Construction	$3,906,440.96	$93,000.00	$3,813,440.96	2.3%	0.54
Custom Rebates	$7,409,725.12	$93,000.00	$7,316,725.12	3.1%	0.64
Nonresidential Prescriptive Rebates	$1,350,585.10	$167,000.00	$1,183,585.10	2.2%	0.72
Residential Prescriptive Rebates	$915,571.71	$167,000.00	$748,571.71	2.0%	0.72
Home Energy Assessments	$23,451.75	$75,000.00	-$51,548.25	-7.0%	0.63
Change-a-Light	$324,713.70	$200,000.00	$124,713.70	1.2%	0.64
Appliance Recycling	$352,222.03	$93,000.00	$259,222.03	2.5%	0.61
Black Hills					
Nonresidential Custom	$41,233.64	$67,000.00	-$25,766.36	-1.9%	0.64
Residential Prescriptive	$201,636.70	$125,000.00	$76,636.70	0.9%	0.72
Nonresidential Prescriptive	$120,114.75	$125,000.00	-$4,885.25	-0.1%	0.69
Nonresidential New Construction	$24,467.28	$70,000.00	-$45,532.72	-7.5%	0.54
Residential New Construction	$57,495.19	$70,000.00	-$12,504.81	-0.6%	0.68
MidAmerican					
Residential Equipment	$1,903,588.13	$167,000.00	$1,736,588.13	2.3%	0.72
Nonresidential Equipment	$3,941,746.48	$167,000.00	$3,774,746.48	2.6%	0.68
Commercial New Construction	$1,980,601.38	$93,000.00	$1,887,601.38	3.9%	0.54
Commercial Assessment	$181,762.77	$75,000.00	$106,762.77	1.9%	0.63
Upstream Retail Lighting	$758,254.91	$200,000.00	$558,254.91	2.3%	0.64
Industrial Partners	$683,815.10	$75,000.00	$608,815.10	3.1%	0.61
Residential Assessment	$176,952.40	$75,000.00	$101,952.40	1.6%	0.68

SEC INTERROGATORY #52

INTERROGATORY

[B/6/5, p. 5] Please file the Summit Blue study referred to.

RESPONSE

Attached to this response is the Custom Projects Attribution Study completed by Summit Blue dated October 31, 2008.

Witness: D. Bullock
D. Johnson

CUSTOM PROJECTS ATTRIBUTION STUDY

FINAL

Submitted To:

DSM Evaluation
Union Gas Limited – A Spectra Energy Co.
Enbridge Gas Distribution

October 31, 2008

Submitted to:

Christine Zivanov
Union Gas Ltd.
777 Bay St., Suite 2801
P.O. Box 153
Toronto, ON M5G 2C8

Judith Ramsay
Enbridge Gas Distribution Inc.
500 Consumers Road
P.O. Box 650
North York, ON M2J 1P8

Submitted by:
Summit Blue Consulting, LLC
1772 14th Street, Suite 230
720-564-1130

Contacts:
Brent Barkett
720-564-1130
bbarkett@summitblue.com

Jeff Erickson
608-845-2585
jerickson@summitblue.com

Gay Cook
416-604-9393
gcook@summitblue.com

ACKNOWLEDGEMENTS

We gratefully acknowledge the services of Bob Bach of Energy Profiles Ltd. and Gerry Meade and Stu Slote of Summit Blue for implementing the field surveys efficiently and effectively. We also gratefully acknowledge the services provided by Ray Kolynchuk of Global Target Marketing. Ray and GTM managed the field work for the customer surveys. They provided valuable insights and quality assurance discipline to the design and execution of the surveys, which were administered using the staff and facilities of Consumer Contact, Ltd. Gay Cook was the primary author of the History and Critique chapter.

TABLE OF CONTENTS

E EXECUTIVE SUMMARY

Enbridge Gas Distribution (EGD and Union Gas deliver DSM programs to customer in their respective franchise areas.

In 2006, the Ontario Energy Board (OEB) convened a Generic Proceeding on the subject of natural gas DSM. Through the Proceeding, the OEB approved the utilities' DSM plans for the three-year period 2007 through 2009, including assumptions for measure savings and free ridership. Items identified as priorities for evaluation research included a free ridership study of the Custom Projects programs.

This report presents the results of market research conducted by Summit Blue Consulting, LLC/Summit Blue Canada, Inc. ("Summit Blue") during the winter of 2007-2008 to measure free ridership and spillover for the Custom Projects programs.

E.1 Definitions

To assist the reader in understanding the terms used throughout the document, Summit Blue has provided definitions for the following terms:

Free Ridership: Free riders are customers who received an incentive through an efficiency program, yet would have installed the same efficiency measure on their own had the program not been offered. This includes partial free riders, defined as customers who, at some point, would have installed the measure anyway, but the program persuaded them to install it sooner than otherwise.

Spillover represents energy savings that are due to the program but not counted in program records. Spillover can be broken out in three ways:

- **Participant inside spillover** represents energy savings from other measures taken by participants at participating sites not included in the program but directly attributable to the influence of the program.
- **Participant outside spillover** represents energy savings from measures taken by participants at non-participating sites not included in the program but directly attributable to the influence of the program.
- **Non-participant spillover** represents energy savings from measures that were taken by non-participating customers but are directly attributable to the influence of the program. Non-participant spillover is sometimes called the "Free-Driver effect."[1]

[1] See for example California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals. TecMarket Works. Prepared for the California Public Utilities Commission. April 2006. Page 226.

Net-to-Gross Ratio: Gross impacts are the program impacts prior to accounting for program attribution[2] effects. 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.

E.2 Study Overview

The study included the following research tasks performed during the winter of 2007-2008:

- Development of a project analysis plan detailing the study's methodology
- A history and critique of the methods that have been used to estimate free ridership and spillover in nonresidential programs.
- On-site interviews (plus a few telephone interviews) with participants and participating trade allies.
- Telephone interviews with customers who had a program-supported energy audit but had not implemented any measures through the program.
- Telephone surveys with nonparticipants to look for and quantify nonparticipant spillover.
- An analysis and scoring of the data to produce the free ridership and spillover estimates.

E.3 Free Ridership Results

The total free ridership rate across both utilities and all sectors is 48% as shown in Table E-1. The free ridership rate for EGD is 41% and it is 54% for Union Gas. Summit Blue recommends that the utilities use the utility-specific total free ridership values of 41% and 54% as the best estimate of free ridership. Those results are based on larger sample sizes than the sector-specific results and proved more stable in the sensitivity analysis. The sector-specific results are based on smaller sample sizes and should only be used to support program management, for example to support targeting and marketing decisions.

[2] For purposes of this study, attribution is defined as the influence the program has had on customers installing the target measure when they otherwise would not have done so, including inside spillover influences to take additional energy efficiency measures.

Table E-1. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

E.4 Spillover Results

Participant inside spillover, representing additional energy efficiency measures installed at the participant's same facility without going through the program, is 5% of gross reported savings for both EGD and Union.

Participant outside spillover, representing additional energy efficiency measures at *different* facilities without going through the program, is 5% combined across both utilities.

Customers who received an audit, implemented a recommended measure, but did not receive incentives through the program for that measure can be considered audit-only spillover. The audit-only spillover survey and analysis was completed for EGD only as Union Gas was unable to find any companies who had an audit in 2005 and had not implemented one of the recommended measures through the program. As a result, the savings inspired by the Union Gas audits will appear in the program tracking data rather than in spillover. For EGD, 35% of the gross recommended savings from energy audits were achieved, representing the audit-only spillover.

A screening survey of 1,228 non-participants found that 5.4% of non-participants were influenced by the program to implement measures (and did not receive a financial incentive). The study could not accurately calculate the m^3 savings from the respondents so the non-participant spillover was not factored into the net-to-gross ratio.

Summit Blue recommends the utilities use following spillover rates:

Table E-2. Spillover Results

Spillover Type	EGD	Union	Base
Participant Inside Spillover	5%	5%	Of gross reported savings
Participant Outside Spillover	5%	5%	Of gross reported savings
Audit-Only Spillover	35%	0%	Of gross audit-recommended savings
Nonparticipant Spillover	0%	0%	

E.5 Net-to-Gross Ratio

The net-to-gross ratio is defined as 1 - free ridership ratio + spillover ratio. As discussed above, spillover is in several parts: participant inside and outside spillover, audit-only spillover, and non-participant spillover. We know that 5.4% of the non-participants have spillover but cannot calculate its quantity so the calculation of net-to-gross in this report excludes it. Summit Blue recommends that the utilities use the utility-specific total net-to-gross ratios of 79% for EGD, 56% for Union, and 67% across both utilities as shown in the following table. As with the free ridership results, these recommended net-to-gross results are based on larger sample sizes than the sector-specific results.

Free ridership is calculated quite frequently in impact analysis studies. In the early days of attribution research, spillover was not often considered but over the past few years more and more jurisdictions are taking spillover into account along with free ridership. For example, California is now implementing studies to measure market transformation effects and spillover from its programs. NYSERDA takes both free ridership and spillover into account. Minnesota believes free ridership and spillover effectively cancel each other out. It is increasingly viewed that if programs are going to see their results discounted for free ridership that a more accurate view of net impacts can be had by adding in spillover. In 2006, Summit Blue researched the free ridership and spillover rates that have been found in studies in recent years. The 79% net-to-gross ratio for EGD is in the same range as several of the programs examined. The 56% ratio for Union Gas is lower than those found in this research.

Table E-3. Net-To-Gross Ratio

Utility	Sector	Free Ridership	Participant Inside + Outside Spillover	Audit-Only Spillover %	Net-to-Gross Ratio
EGD	Agriculture	40%			
EGD	Commercial Retrofit	12%			
EGD	Industrial	50%			
EGD	Multifamily	20%			
EGD	New Construction	26%			
EGD	Total	41%	10%	11%	79%
Union	Agriculture	0%			
Union	Commercial Retrofit	59%			
Union	Industrial	56%			
Union	Multifamily	42%			
Union	New Construction	33%			
Union	Total	54%	10%	0%	56%
Total	Agriculture	18%			
Total	Commercial Retrofit	27%			
Total	Industrial	53%			
Total	Multifamily	26%			
Total	New Construction	28%			
Total	Total	48%	10%	5%	67%

Free Ridership Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

E.6 Limitations

Three areas typically form the basis for research projects' constraints and limitations including: budgetary constraints, time constraints and reliability of data. This study, like most research, encountered constraints and limitations and they are documented below.

Budgetary Constraints

- Given sufficient time and budget, it is possible to survey every participant in a program and produce a precise calculation of a given characteristic across the entire population. However, it is typically not possible or desirable (except perhaps for very small programs) to have a budget large enough for that level of effort. As a result, free ridership studies are most often done with a sample of participants. The estimate based on that sample has an error bounds around it, and the error bounds is determined by the sample size and the variance in the result from the sample. As with most such studies, the current study used a sampling approach but with a sample designed to be sufficient to provide a result at the 90/10 confidence level, which means we are 90% confident that the mean free ridership from the sample is within 10% of the mean free ridership in the population.

Time Constraints

- The study was conducted on custom projects that were completed between the fourth quarter of 2006 and the third quarter of 2007. It is possible that the characteristics of participants and projects in a custom project program may change over time in response to changing conditions in the region. Ideally, changes in program implementation efforts also discourage free riders from participating and thus also bring about a change in the population of participants. To the extent that the characteristics of the population of participants changes over time, the results of a given study have less predictive power for the new population. When a relatively small number of participants has a particularly large impact on the free ridership value, as with the current study, changes in the population of participants could have a significant effect on future free ridership results.

- Self-report free ridership studies like the current study depend— by design— on respondents recalling events from the past. Ideally, the interviews on which to base these studies are done as soon as possible after pivotal decisions are made for each project. C&I custom projects often have a long lead time, sometimes measured in years. Thus some projects in the current study could have been incubating from as early as 2004. The time lag between when a project is conceived or key decisions are made and when the free ridership interview was completed may mean that crucial information is unavailable to the interviewer. Key decision-makers may have forgotten details or even moved from the participating company. The study included efforts to remind respondents of the history of their interaction with the program but this can never bring the entire history of a decision back to mind. While the risks here could skew results toward higher or lower free ridership values, it is more likely that these factors will produce higher free ridership values than the opposite.

Reliability of the Data

- The free ridership interviews were completed by four separate individuals. Most were done in-person and some Union Gas interviews were done by phone. The key questions that affect the free ridership results were precisely worded and all interviewers were carefully trained. However the interviews were designed to be more like free-flowing conversations than highly-scripted surveys. The interviewers were instructed to probe for details and follow lines of thought to their natural conclusions rather than stick strictly to a set script. As a result, some variations from one interviewer to the next are inevitable and they may affect the bottom line results. The results were examined to look for evidence of interviewer bias but no patterns were evident.

- As discussed above, the study is dependent on respondents' memory of past events. This is magnified in some circumstances when one respondent is responsible for providing answers on several different projects. The sample was picked at the project level, that is, projects were picked for the sample rather than participants. However, participants may have implemented more than one project in the study period. In those cases, we surveyed the respondent once but asked them separately about the individual projects. Given the reliance on Channel Partners, in the Union Gas sample 77 projects were covered by interviews with 52 respondents. The extent to which respondents were unable to distinguish in their head between one project and another will be reflected in the inaccuracy of their responses.

1 INTRODUCTION

This section gives a brief background on the purpose of the research, describes the utility programs, and introduces the organization of the report.

In 2006, the Ontario Energy Board (OEB) convened a Generic Proceeding on the subject of natural gas DSM. Through the Proceeding, the OEB approved the utilities' DSM plans for the three-year period 2007 through 2009, including assumptions for measure savings and free ridership. Items identified as priorities for evaluation research included a free ridership study of the Custom Projects programs.

Summit Blue Consulting, LLC/Summit Blue Canada, Inc. ("Summit Blue") were retained by Union Gas Ltd. (Union Gas) and Enbridge Gas Distribution (Enbridge) (jointly, the Utilities) to conduct a forward-looking evaluation of program influence attribution for free ridership and spillover associated with the Custom Projects programs offered by the Utilities.

The study included the following research tasks performed during the winter of 2007-2008:

- Development of a project analysis plan detailing the study's methodology
- A history and critique of the methods that have been used to estimate free ridership and spillover in nonresidential programs.
- On-site interviews (plus some telephone interviews) with participants and participating trade allies.
- Telephone interviews with customers who had a program-supported energy audit but had not implemented any measures through the program.
- Telephone surveys with non-participants to look for and quantify non-participant spillover.
- An analysis and scoring of the data to produce the free ridership and spillover estimates.

1.1 Utility Programs

Both Union and Enbridge operate DSM programs that include custom projects for the Commercial and Industrial sectors. Custom projects cover opportunities where savings are linked to unique building specifications, uses and technologies. Each project is assessed individually for participation in the program.

1.2 Report Organization

This chapter (Chapter 1) outlines the purpose of the study, background on utility programs and the report organization. Chapter 2 describes the methodology used to assess free ridership and spillover. Chapter 3 presents a history and critique of free ridership methodologies. Chapter 4 presents the sampling strategy and sample disposition. Chapter 5 presents the results of our research. Chapter 6 presents supplementary results. Finally, Chapter 7 presents our conclusions.

2 METHODOLOGY

This section presents a high-level overview of the methods and data sources used to conduct the study. Full details are included in Appendix A in the revised Analysis Plan.

2.1 Free Ridership

Free ridership and spillover were estimated using data from surveys with participants, non-participants, trade allies, and utility staff. This approach is based primarily on participant self-reported information along with other perspectives to triangulate the net-to-gross estimates.

Experienced utility industry consultants conducted the interviews and most were done on-site at the participant's premise. To address the possibility of respondent bias, the interviews approached each topic from a variety of directions. The interviewer had the discretion to probe for supporting information and the analysis process checks for consistency across answers. Interviewees were promised confidentiality and assured that their answers will not affect the incentives or support they have received from the program. To address the possibility of interviewer bias, each interviewer was trained in the purpose of the research and the importance of objectively probing and recording responses. Four different interviewers performed the interviews and the data from their interviews were compared to look for uneven application of the methodology.

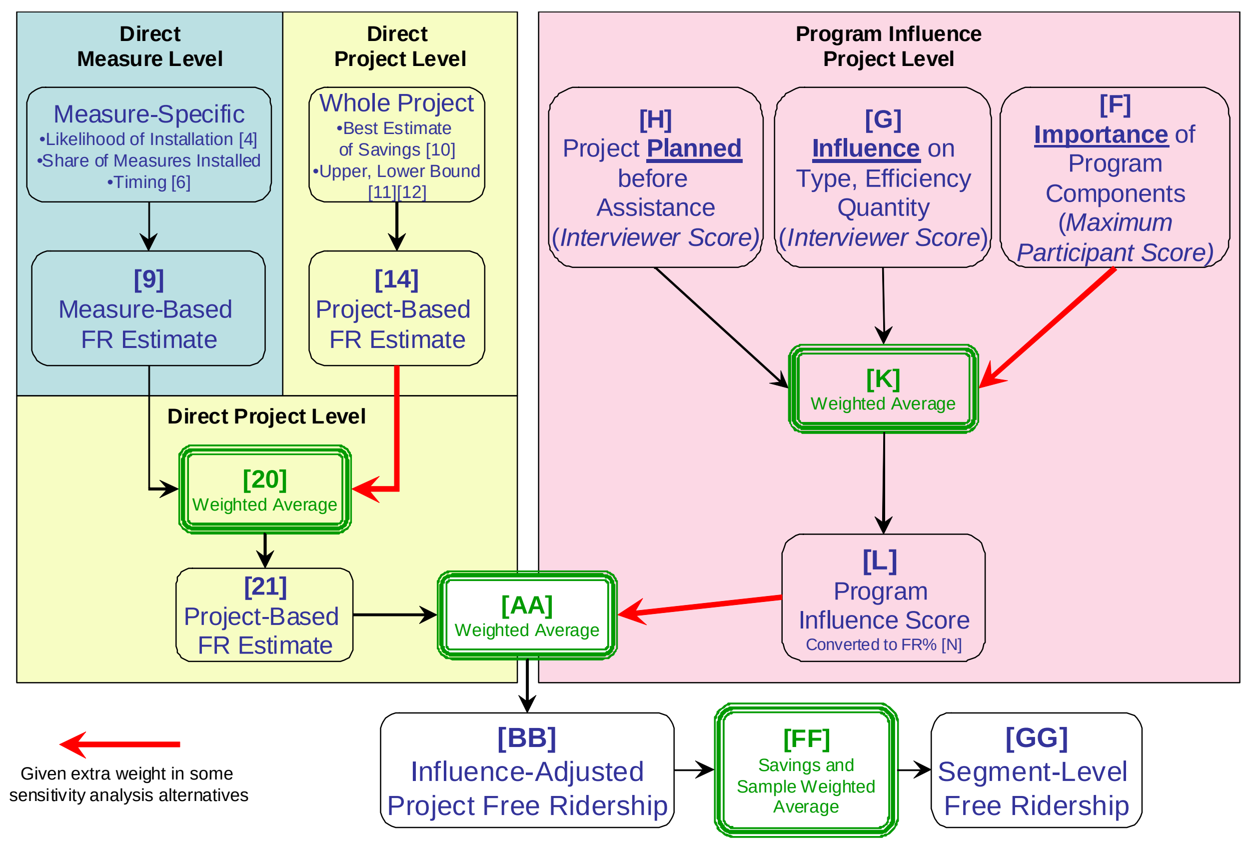
Figure 2-1 presents an overview of the survey and analysis approach. Key points in the diagram are labeled with numbers and letters in square brackets, which we will refer to below. Free ridership was discussed with each respondent in both **direct questions** aimed at obtaining respondent estimates of the appropriate (full or partial) free ridership rate to apply to them (represented by the large box on the left side of the diagram), and in **supporting or influencing questions** used to verify whether direct responses are consistent with participants' views of the program's influence on their equipment investment decisions (represented by the large box on the right side of the diagram). The direct questions were asked at the measure level [4] and [6] and at the whole project level [10]. They were then combined into a single, project-level direct free ridership score at [21]. Direct and program influence scores are combined into the final project-level free ridership score at [BB]. That project-level score is weighted by program-reported savings and sample weights [FF] to calculate the final savings-weighted free ridership percentage [GG].

Key calculations were examined in a sensitivity analysis to determine their effect on the final result. Three assumptions feeding into those calculations were found to have the most effect on the end result. Those assumptions relate to the weight given to various answers or answer categories in averages with other answers. The key calculations are shown at [20], [K], and [AA] in the calculation overview diagram. The sensitivity analysis tested the effect of increasing the weight given to [14] in the calculation at [20], the weight given to [F] in the calculation at [K], and the weight given to [L] in the calculation at [AA] (each represented by a thicker, red arrow).

Free ridership results were first calculated on the measure level. The measure-level gross and net savings are summed up across all customers and then net savings divided by gross savings produces the final savings-weighted, program-wide free ridership result. (Sample weights are applied during the summing step.)

Enbridge Gas Distribution designates some projects as "advancement" when they judge that the program moved a project forward in time. The designation of a project as an advancement project does not affect the annual savings but it does affect the TRC calculation. In their TRC calculations for advancement projects, EGD discounts the benefits and adjusts the incremental costs to account for the period which the program has moved projects forward in time. The current study addresses first-year annual savings only, it does not extend benefits and costs over time and does not include a cost/benefit analysis. On a measure-by-measure basis, respondents were asked if the program influenced them to install the equipment more than one year earlier than they otherwise would have otherwise [6]. If it did, the measure-level free ridership score is discounted in [9] in the diagram below. Several different scales were examined for discounting the free ridership score based on the number of months the project was brought forward in time. The final, utility-level free ridership score did not move significantly in that analysis. Because this study was focused on first-year savings only, it was agreed that the appropriate approach was to include this adjustment for all projects, including advancement projects. This is in keeping with standard practice in calculating free ridership. All respondents were asked the timing question [6] and their answers were accounted for in [9] whether they were being asked about an advancement project or not. Given the math of the calculation, the only possible effect of removing the timing question for advancement projects would be to **increase** the free ridership rate.

Figure 2-1. Free Ridership Analysis Overview



2.2 Spillover

Spillover represents energy savings that are due to the program but not counted in program records. Spillover can be broken out in three ways:

- **Participant inside spillover** represents energy savings from other measures taken by participants at participating sites not included in the program but directly attributable to the influence of the program.

- **Participant outside spillover** represents energy savings from measures taken by participants at non-participating sites not included in the program but directly attributable to the influence of the program.

- **Non-participant spillover** represents energy savings from measures that were taken by non-participating customers but are directly attributable to the influence of the program. Non-participant spillover is sometimes called the "Free-Driver effect."[3]

Summit Blue estimated **participant inside and outside spillover** through questions in the participant and trade ally surveys and through the Audit-Only Survey. Summit Blue estimated non-participant spillover through the non-participant survey.

The surveys did not address whether the respondent received funding from other sources to facilitate the energy efficiency measures. The survey questions were designed to designed to determine if the Custom Projects program was influential in the decision to install the spillover measure and if so the share of the savings from the extra equipment that can reasonably be attributed to the influence of the program. Given that approach, funding from other sources, if any, would not change the conclusions drawn from the survey. Even with other funding, if the utility program support was critical in convincing the respondent to implement the energy efficiency measure, then it should get credit for some of the savings.

2.2.1 Participant Inside and Outside Spillover

The spillover questions were incorporated in the participant and trade ally surveys and the spillover analysis was implemented in concert with the free ridership analysis.

For **inside spillover**, respondents are asked whether their experience with the programs caused them to install additional energy efficient equipment at the site that did not go through the program. This establishes whether inside spillover exists. For those respondents reporting that additional measures were installed, they are asked to identify in which year(s) the measures were installed, and to describe how the program influenced their decisions to install additional energy efficient equipment at their facility. An additional question is asked to determine the ratio of the savings from these additional measures compared to the savings from the measures installed under the program. That is, they are asked the percent of savings as a multiple of the savings achieved under the program (**savings multiplier**). Finally,

[3] See for example California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals. TecMarket Works. Prepared for the California Public Utilities Commission. April 2006. Page 226.

respondents are asked to estimate the share of the savings from these additional measures that can “reasonably be attributed to the influence” of the program **(net-to-gross percentage)**.

Inside spillover is zero for those without additional measures (or those who failed to answer all of the questions), and it is the product of the savings multiplier and the net-to-gross percentage for those with inside spillover. Similar to the free ridership analysis, individual spillover estimates are weighted both by relative energy savings for each respondent, as well as by sample stratification to determine an inside spillover value for the group as a whole.

Similar to inside spillover, for **outside spillover**, respondents are asked first whether the influence of the program caused them to install any additional energy efficiency equipment, outside of the program, at other sites beyond what they would have done without their experience with the program. If they respond yes, they are asked several follow-up questions designed to provide an estimate of the level of savings from these actions that could be attributed to the program.

For outside spillover, the savings as a percent of the in-project measure is multiplied by the share of savings attributed to the program to calculate the outside spillover value.[4] Similar to the free ridership analysis, individual spillover estimates are weighted both by relative energy savings for each respondent, as well as by sample stratification to determine an outside spillover value for the group as a whole.

2.2.2 Audit-Only Spillover

Participants who received an audit, implemented a recommended measure, but did not receive incentives through the program for that measure can be considered spillover. These kinds of participants would not be included in either the participant or non-participant surveys. We implemented a survey specifically with this population and focusing solely on spillover measures to provide an additional estimate of program spillover.

The interviewer asks the respondent if they recall receiving the audit. If they do not, the interviewer attempts to speak to someone else who might recall the audit. The interviewer asks the participant about each measure recommended in the audit. (Although we will limit this to the measures with the largest savings if there are more than 5 measures recommended.) The interviewer examines whether the respondent remembers the recommendation and whether it has been installed and when. If the participant installed a measure, the interviewer asks the following:

1. On a scale of 1 to 5 where 1 is “no influence” and 5 is “a great deal of influence”, how much influence did the audit have in your decision to implement this measure?

2. What share of the savings from this measure can reasonably be attributed to the influence of the program?

The analysis of audit-related spillover savings is fairly straightforward. The program tracking data have measure-specific savings estimates from the audit. The two influence scores are converted to the same scale and averaged. That average is applied to the audit savings to calculate audit-related spillover savings.

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[4] A cap of five outside spillover projects per respondent is used to prevent outliers from skewing the results.

2.2.3 Non-Participant Spillover

Summit Blue estimated non-participant spillover using a survey targeted at non-participants only. The approach to the data collection and analysis took the following steps:

1. Obtain sample of non-participants from the utilities

2. Execute telephone screening survey to identify customers who had implemented relevant measures and were influenced by the program.

3. Conduct engineering follow-up interview to estimate savings from those measures influenced by the program.

The screening survey went through the following steps:

1. Find someone knowledgeable about the replaced or modified equipment.

2. Are they aware of the program? If no, terminate.

3. Did the company participate in the program in the past 3 years? If yes, terminate.

4. Has the company modified or installed equipment that might fall under the program’s incentives since the beginning of 2005? (List target equipment.) If no, terminate.

5. Determine what effect, if any, the program had on their decision. If none or little, terminate.

6. Obtain permission for the follow-up engineering call.

In the engineering follow-up call Summit Blue engineers asked enough questions about the equipment to make an engineering estimate of the energy savings it produces.

3 History and Critique of Free Ridership Methodologies

This chapter was designed to analyze the methods used to assess both free riders and spillover for customized programs targeted to the commercial and industrial sector. Summit Blue conducted a literature review of methodology development and assessment and current practice, compared the various methods, and drew conclusions on the most appropriate method to use for C&I custom projects programs.

The recommended method to assess free riders and participant spillover is self-report in-person and telephone surveys with participants and market players. Issues such as self-selection bias would be controlled by using enhancements such as interviews with multiple decision makers at sampled sites, multiple question areas to address program influence on decision making, and well-thought out scoring algorithms. The market share method of estimating free ridership is not appropriate for custom projects with large customers mainly because the programs are focused on custom projects rather than promotion of specific equipment. Market sales methods rely on good equipment sales data and work best with programs targeted at measures that are uniform across applications and very specific definitions of technology. Econometric methods including billing analysis and discrete choice modeling are not applicable for C&I custom programs because large customers may skew the results, custom projects are less amenable to standardized approaches, difficulties with identifying comparable non-participant groups cast doubt on the validity of the model, the lack of good historical data (except for consumption) limits their scope, and the need to estimate a proportion rather than magnitude of net savings and the requirement to assess spillover limit their usefulness.

Self-report and econometric analyses have merit and often provide similar results. For example, a study by Torok in 1999 found consistent results from self-report, billing, and discrete choice analysis; net-to-gross (NTG) results for self-report and discrete choice methods differed by less than one percent. The study looked at the three methodologies used to estimate net impacts for Pacific Gas & Electric’s Commercial Energy Efficiency Program, which provided prescriptive rebates for equipment as well as funding for custom projects (gas or electricity). The authors preferred the two stage discrete choice model, but recommended the continued use of multiple approaches. Most econometric methods for NTG require survey information; the more they rely upon self-report data, intentions, and psychographic data, the more they are likely to have some of the same measurement issues as the survey-based approach. Billing analysis can produce biased results because of participant self-selection into programs; this can be dealt with by various statistical methods which unfortunately require excluding large customers as they can skew the results.

3.1 Background & Development of Methodology

This section briefly outlines the history of evaluation of social actions and the development of evaluation methodology to assess free riders and spillover effects.

Evaluation is rooted in the empirical study of social problems in Britain in the 1660s with the first evaluative studies published in the 1800s, looking at the impact of education on crime or the usefulness of public works, for example. However, until quite recently, most policies and programs did not include provision for evaluation, assuming the remedies provided would solve the problems. "*People working in education and health fields were among the first to do systematic studies of the outcomes of their work*"[5] starting in the early 1900s. In the 1940s, private foundations began funding evaluations of innovative social programs they sponsored, such as a youth worker program to prevent delinquency in suburban neighborhoods near Boston. By the 1950s, the U.S. federal government was sponsoring new curriculum efforts with funding for evaluations of the success of the curriculums. In the mid-60s, the War on Poverty marked the beginning of large-scale government-funded evaluation—the Elementary and Secondary Education Act of 1965 included a requirement for evaluation. Robert Kennedy was the moving force behind this, seeing "*evaluation as a tool to provide parents with the necessary information.*"[6] The same period saw the rise of cost-benefit analysis in the RAND Corp, Department of Defense and elsewhere; evaluation branched out into other areas such as environmental protection, energy conservation, military recruitment, and control of immigration. In the 1970s, the inauguration of a series of social experiments to test policy and program ideas prior to enactment—using pilot programs—was a high point in evaluation history. *"By the end of the 1970s evaluation had become commonplace across federal agencies."*[7] Evaluation was a growth industry until 1981 when funding for new social initiatives was cut drastically and then made a comeback in the late 80s and early 90s.

The major shift toward more accurate measurement of program-related energy savings came about in the mid-to-late 1980s, a time of least-cost planning and large increases in utility spending on energy efficiency programs. Most analysts used definitions for cost-effectiveness tests based on the 1987 California Public Utilities Commission Standard Practice Manual of Economic Analysis of Demand-Side Management Programs; these only addressed free rider impacts; not spillover. The authors found that the most widespread approach to measuring free riders and spillover was through surveys where respondents self-report the impact of the program on their actions. Many of the early studies asked a single yes/no question to determine free ridership. By 2002, methods of inquiry were more sophisticated, with a string of questions and answers to understand partial free riders.

The methodology to assess free riders has been developing over many years, but the assessment of spillover is a more recent development. Vine in 1993 noted that free drivers (customers who install spillover measures) are more likely to be a significant problem for programs in existence for several years with high participation levels and that *"research on free drivers is limited."*[8] He suggested that there were three approaches available to enhance measurement of free drivers: (1) use a historical baseline from the early years of the program; (2) use survey methods – non-participants and trade ally interviewing; and (3) use community(ies) outside the area as a comparison group. A study done by Quantec in 2002[9] provides a snapshot of what was happening about a decade later, finding several studies on free riders but few on free drivers. The study also found there was no agreement on the best way to measure free riders and spillover and no regulatory agreement on which impacts required estimation.

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[5] Weiss, Carol H. (1998). *Evaluation 2nd Edition: Methods for Studying Programs and Policy*. Upper Saddle River, New Jersey: Prentice Hall.

[6] Weiss, p. 12.

[7] Weiss, p. 14.

[8] Vine, Ed. *The Human Dimension of Program Evaluation.* Lawrence Berkley Lab, LBL-33601, 1993.

[9] Quantec, *Assessment of Energy and Capacity Savings Potential in Iowa Volume 2: Free Riders and Spillover – A Look Back, A Path Forward,* prepared for the Iowa Utility Association, 2002.

A notable feature of recent evaluation history is the growth of activity at state and local levels, the increasing use of qualitative methods for evaluation, and the development of professional associations in evaluation. According to Weiss in 1998, "*Not too long ago the only kind of evaluation with professional legitimacy…was quantitative evaluation, preferably using randomized experimental design.*"[10] However, some evaluators relied more on words than on numbers and did not collect data through stricter interview questions or quantitative records and their books and articles provided a "*spirited exchange with supporters of quantitative methods.*" Eventually, many key figures in evaluation concluded that there was room for both approaches and that they could complement each other. A common attribute of the quantitative approach is the collection of information through standardized instruments and usually include one or more comparison groups. The classical means to assess attribution is through a randomized experiment; without this ability, the evaluator uses a quasi-experimental design.[11] All of the methods discussed in this chapter, including self-report, are quantitative.

3.2 Methods to Assess Free Riders and Spillover

This section compares and critiques the key methods to assess net program impacts – self-report, econometric, and market share approaches.

Methods to estimate free ridership and spillover range from assuming a net-to-gross ratio (NTG) of 1.0 to triangulation of several methods (e.g., California's enhanced protocol). Iowa uses a NTG ratio of 1.0 based on a study done in 2002,[12] currently being updated by Summit Blue as part of a technical potential study. The new study is reviewing the literature on attribution and selected evaluation studies and found that several jurisdictions that look at both free riders and spillover are finding NTG ratios of about 1.0 (see Table 3-1)[13] and will likely recommend that "*this policy should not be changed.*"

In the early days of attribution research, spillover was not often considered but over the past few years more and more jurisdictions are taking spillover into account along with free ridership. It is increasingly viewed that if programs are going to see their results discounted for free ridership that a more accurate view of net impacts can be had by adding in spillover.

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[10] Weiss, p. 14.

[11] Vine, Ed. *The Human Dimension of Program Evaluation.* Lawrence Berkley Lab, LBL-33601, 1993.

[12] *Assessment of Energy and Capacity Savings Potential in Iowa Volume 2: Free Riders and Spillover – A Look Back, A Path Forward*, prepared for the Iowa Utility Association by Quantec, July 25, 2002.

[13] Personal correspondence with Gary Cullen, Summit Blue Consulting, October 2007.

Table 3-1. Selected Findings on NTG Ratios

		NTG Ratio
Residential	Efficiency Vermont[14] Energy Trust of Oregon[15]	1.19 1.00
Non-residential	NYSERDA (overall)[16] NYSERDA (CIPP)[17] Wisconsin Power & Light (Shared Savings)[18]	1.09 0.97 0.91

It is difficult to capture long-term market effects with an annual assessment of free ridership. A study done for Massachusetts regulators[19] noted that an annual snapshot of free-ridership and spillover measured without adequately considering the market effects associated with over a decade and a half of energy efficiency programs in Massachusetts will result in potentially biased estimates of net savings. Energy efficient technologies having high market share and few alternatives as a result of these market effects can mean energy efficiency programs now will have high free-ridership.

However, many other jurisdictions do conduct studies to assess the annual impact of free ridership and spillover using several methods. The most common methods used are described briefly below and in more detail in the rest of the section.

- **Self-Report** methods rely on responses to survey questions asking end users and/or vendors what they would have done in the absence of the program support. These methods are primarily used to determine if participating end users would have installed program measures without the program. However, these methods can also determine what additional efficiency improvements participating customers have made outside the program, how participating vendor sales practices would have been different without the program, and how nonparticipating vendor and customer practices have changed since the advent of the program.

- **Econometric Methods** consist of statistical models that compare participants' and non-participants' energy and demand patterns, their knowledge about efficiency options, and/or the trade-offs they are willing to make between efficiency options and the costs of purchasing and installing them. They

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[14] *Final Report: Phase 2 Evaluation of the Efficiency Vermont Residential Programs*, prepared for the Vermont Department of Public Service, prepared by KEMA, Inc, December 2005.

[15] *2003-2004 Home Energy Savings Program Residential Impact Evaluation,* prepared for the Energy Trust of Oregon, prepared by Itron, Inc., December 2006.

[16] *New York Energy $mart Program Evaluation and Status Report for the Year Ending December 31, 2006,* New York State Energy Research and Development Authority, March 2007.

[17] *Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation*, prepared for New York State Energy Research and Development Authority by Summit Blue Consulting and Quantec, April 2006.

[18] *Shared Savings Decision-Making Process Evaluation Research Results,* prepared for Wisconsin Power & Light by Summit Blue Consulting, April 11, 2006.

[19] *Standardized Methods for Free Ridership and Spillover Evaluation – Task 5 Final Report (Revised).* (PA Consulting Group Inc. 2003).

include billing analysis, econometric models, and discrete choice models and often include survey inputs as well as other non-program-related factors such as weather and rates.

- **Billing analysis** determines the effect of efficiency measures and/or a program by analysis of (usually monthly) consumption data from participating customers, often along with similar data for nonparticipating customers.
- **Other econometric models** expand on billing analysis methods to compare participants' and non-participants' energy and demand patterns, adjusting for external variables that could account for changes in use and patterns.
- **Discrete choice analysis** uses data on equipment or practice choices by participating and nonparticipating customers together with other information about customers to model choices participants would have made in the absence of the program.[20]

- **Market share methods** include the *market sales* approach which relies on aggregate data of total sales of a particular technology in a specific location, and compares this sales volume with a baseline estimate of the volume that would have been sold in the absence of the program. This method is generally used to assess transformations of markets and depends on completeness and accuracy of sales data and the validity of the baseline estimate. A similar method is *saturation data analysis* which uses observations at two points in time of the share of existing equipment stock that is high efficiency. Translating these successive observations into incremental attributable sales requires information (estimates or assumptions) about equipment turn-over rates, stocking practices, and changes that would have occurred over the time period without the program. Collecting reliable saturation data is typically expensive and not repeated frequently.

3.2.1 Econometric Methods

Billing analysis involves the use of multivariate regression models with historical utility billing data (kW and kWh) to calculate annual demand and energy savings. In general, billing analysis is used with complex equipment retrofits and controls projects and provides retrofit performance verification for projects where whole-facility baseline and post-installation data are available. Billing analysis usually involves collecting historical whole-facility baseline energy use data and a continuous measurement of the whole-facility energy use after measure installation. Energy consumption is calculated by developing statistically representative models of historical whole-facility energy consumption, and the model yields statistically adjusted engineering coefficients to modify gross engineering estimates and calculate net energy impacts.

The advantage of billing analysis is that it estimates the magnitude of net impacts rather than a fraction of total impacts attributable to the program; however, the method also has limitations. The net billing model specification incorporates both participants and nonparticipants into one model, and the resulting sample is not randomly determined. In particular, participants self-select into the program and therefore are unlikely to be randomly distributed; the unobserved characteristics that influence the decision to participate must be accounted for in the model to avoid producing biased coefficient estimates. The Inverse Mills method which includes a ratio in the model to account for self-selection was developed to

[20] Delphi methods which collect judgmental estimates from a panel of experts and develop a consensus or central range estimate are typically used only if more objective methods are not available.

correct for this bias but has several limitations: 1) large customers can exert such a significant influence that they overly bias results; 2) the usable sample is reduced by the need for good historical billing data for each customer; and 3) the method does not produce an estimate of spillover, rendering it an incomplete model of net impact[21]. Billing analysis also depends on finding a comparable non-participant population, which can be very difficult for custom projects. It also will have difficulty identifying energy savings if the expected savings are a small percentage of the total facility energy use or if other major events occur at facilities that significantly affect energy use (e.g., changes in plan schedules, adding new or closing old production lines).

Other econometric models expand on billing analysis methods to compare participants' and non-participants' energy and demand patterns, adjusting for external variables that could account for changes in use and patterns. Econometric models are used to analyze co-relational relationships, usually with the hope of determining causation. They are used to estimate macroeconomic trends and in microeconomics to estimate virtually any sort of social relationship (much as metric models, involving these same regression techniques, are used in other social sciences). The use of statistical/econometric models to estimate net impacts can avoid both the concern over the potential for bias and cognitive dissonance issues with survey research by analyzing participant and non-participant actions, characteristics and attitudes to predict free ridership and spillover. The disadvantage of this method is its inability to estimate spillover upstream in the distribution channel. A robust statistical analysis includes surveys designed to minimize self-reporting bias while collecting data on other program and participant characteristics. This level of sophistication requires a relatively large expenditure on evaluation, which can impact the cost-effectiveness of a marginal program. In California, econometric methods are preferred in situations with enough participants and comparable non-participants, and when the program is large enough to justify the expense. However, programs with either a very small number of participants or non-participants or where comparability is a severe problem are not amenable to these methods and need to rely on a survey-based method. Ed Vine of the Lawrence Berkeley Lab[22] identified the key analytical issue to assess the NTG ratio is determining an appropriate control group. Certain types of building, e.g., large industrial firms, may have unique facilities that have no comparative buildings, for example.

Another method of estimating the net-to-gross ratio is a two-stage **discrete choice model**. Discrete choice analysis uses data on equipment or practice choices by participating and nonparticipating customers together with other information about customers to model choices participants would have made in the absence of the program. This model is used to simulate the decision to purchase various types of commercial equipment. Once estimated, the model is used to determine the probability of purchasing high-efficiency equipment in the absence of the program. The probability of purchasing any given equipment option A can be expressed as the product of two probabilities—the probability that a purchase is made multiplied by the probability that equipment option A is chosen given that a purchase has been made. This method can work when the equipment examined is relatively simple in description and where choices exist in the market for different efficiency levels for that piece of equipment. Thus this can work well with prescriptive rebate programs where the types of equipment that meet and do not meet program requirements can be spelled out in detail ahead of time. Given that custom programs *by their very nature* do not follow this pattern, discrete choice models do not function well attempting to make sense of the choices involved in their necessarily more complex systems.

[21] Torok 1999.

[22] Vine, Ed. *The Human Dimension of Program Evaluation, Lawrence* Berkley Lab, LBL-33601, 1993

3.2.2 Self-Report Surveys

Generally, the simplest and lowest cost NTG method is using the survey-based stated intentions method with a telephone survey for data gathering. Although research has shown that this method can provide biased results, coming at the question of what the participant would have done in the absence of the program from a variety of different perspectives (directly asking, decision-making criteria, where they were in the process, etc.) and assessing these together is one way the survey methods have used to triangulate on the correct construct.[23].

The self-report approach used in the current study was based on Summit Blue's assessment of approaches taken in a variety of jurisdictions. Much of that research has been summarized in a paper by Schare and Ellefsen (2007)[24] that discusses the approach used to estimate free ridership for several New York State Energy Research and Development Authority (NYSERDA) programs The method used for NYSERDA evolved from previous NYSERDA evaluations and work done in California (described in more detail in the following section) and Massachusetts.

In 2002, Massachusetts regulators asked for a study to create a standardized free ridership survey method to be used by all Massachusetts utilities for program evaluations.[25] The objective was to develop standardized sampling techniques, data collection approaches, survey questions, survey instrument(s), and an analysis methodology that each of several sponsors[26] can use to determine free-ridership and spillover factors for C&I programs. This standardization project was designed to provide a methodology to meet the regulatory requirements to report annual program impacts (along with disaggregated free-ridership and spillover values)—an annual snapshot of the market as it currently operates.

The approach used in the current study was enhanced in subsequent studies of Wisconsin Power and Light's Shared Savings program and Arizona Public Service programs.

The method used in the current study overcomes a key limitation of self-report approaches—the difficulty of systematically converting opinions of participating customers into quantifiable free ridership values. It also provides a highly defensible approach to estimating net program impacts, which are critical inputs to benefit-cost analyses and policy decisions on the direction of energy efficiency programs.[27] The approach is based on participant self-reports and offers unique benefits of a clearly defined and repeatable method to quantify free ridership, while also incorporating qualitative information from program participants often used only as supporting illustration. The core principles of the approach include the following:

[23] TecMarket Works, *California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals*, April 2006.

[24] Schare, S. & Ellefsen, J. *Advancing the "Science" of Free Ridership Estimation: An Evolution of the Self-Report Method for New York Energy $mart^{SM} Programs, 2007.*

[25] *Standardized Methods for Free Ridership and Spillover Evaluation – Task 5 Final Report (Revised).* (PA Consulting Group Inc. 2003).

[26] National Grid (Massachusetts Electric, Nantucket Electric), NSTAR Electric, Northeast Utilities (Western Massachusetts Electric), Unitil (Fitchburg Gas & Electric Company), Cape Light Compact).

[27] Schare, S. & Ellefsen, J. Advancing the "Science" of Free Ridership Estimation: An Evolution of the Self-Report Method for New York Energy $mart^{SM} Programs, 2007.

- Set the stage with the respondent by talking about the various ways the participant interacted with the program (including, for example, technical assistance, training, and financial incentives).

- Direct estimation of free ridership from the perspective that is most appropriate for the **project** and to which the respondent can best relate his program experience. This takes the form of either the likelihood that the high-efficiency measures would have been installed without the program, or the share of high-efficiency measures that would have been installed without the program.

- Separate estimation of free ridership addressing the complete project across all measure types and, alternatively, addressing decisions to install specific measures. The dual line of questioning allows respondents to provide a big-picture view of the program's influence on the project as well as to focus on specific measures, which may have been influenced by the program to varying degrees.

- Quantitative incorporation of qualitative responses based on interviewers' probing for details and causality. This aspect of the approach relies on experienced interviewers who are able to apply appropriate judgment to assign influence scores reflecting the degree to which the program affected equipment-purchasing decisions.

- Ask supporting or influencing questions that could be used to verify whether direct responses are consistent with participants' views of the program's influence.

The theory behind attribution analysis is that only impacts caused by the program should be included in net savings estimates; however, absolute proof of causality is unattainable since one can never observe what would have happened in the absence of the program. Consequently, causality "must be justified or rationalized on the basis of *a priori* argument, outside evidence, intuition, theory, or some other informal means."[28] The necessity of this approach to attribution analysis, relying in part on intuition and outside assumptions, is supported by Heckman in his argument that "there is no mechanical algorithm for producing a set of 'assumption free' facts or causal estimates based on those facts."[29]

3.2.3 Triangulation of Methods

California's new evaluation protocols for NTG impact evaluation rely heavily on self-report methods but require triangulation of methods for the enhanced level of rigor. In 2006-2007, California awarded contracts to over 70 consulting firms to perform impact evaluations of all IOU energy efficiency programs; as part of this process the CPUC supported the development of an Evaluation Framework[30] and a set of protocols[31] developed by a NTG Working Group composed of industry leaders in the evaluation field[32]. The Evaluation Framework notes that NTG can be expected to vary depending upon the maturity

[28] Moffitt, R., "*Causal Analysis in Population Research: An Economist's Perspective*," Johns Hopkins Univ., 2003.

[29] Heckman, J., "Causal Parameters and Policy Analysis in Economics: A Twentieth Century Retrospective," *The Quarterly Journal of Economics*, Volume 115, No. 2, 2000, pp. 45-97.

[30] TecMarket Works, *The California Evaluation Framework*, Southern California Edison, 2004.

[31] TecMarket Works, *California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals*, April 2006.

[32] Summary of Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approach, Self-Report_NTG_Checklist_Ridge for CA_sept 07

of the equipment or service, type of delivery in the program, maturity of the program, and customer sector. The California documents classify NTG methods as econometric (comparing participant and non-participants and adjusting for selectivity biases through econometric models) and survey-based (asking participants what they would have done).

California has three levels of rigor that can be applied to NTG analysis—basic, standard, and enhanced. Participant self-report through surveys is the required method for the basic level of rigor; for the standard level of rigor, one of three methods can be used (billing analysis, self-report, econometric or discrete choice). The enhanced level requires triangulation using more than one of the methods in the standard rigor level. The enhanced level must include analysis and justification for the method for deriving the triangulation estimate from the various methodologies used.

Guidelines were developed for using the self-report method to estimate NTG ratios; these are consistent with Summit Blue's methodology:

1) identify the correct respondent
2) use multiple questions
3) assess validity and reliability of each question
4) include consistency checks
5) make the questions measure-specific
5) include and document partial free-ridership
6) assess deferred free-ridership [This is equivalent to EGD's "advancement" approach – see the discussion under section 2.1]
7) develop scoring algorithms
8) explain handling of non-responses and "don't knows"
9) weight the NTG for size of impacts
10) report precision of the estimated NTG
11) pre-test the questionnaire
12) use multiple respondents
13) consider third-party influence.

3.2.4 When to Use Market Share or Self-Report

Market sales methods can also be used to estimate free riders and spillover. A study done for Wisconsin Focus on Energy in 2006[33] developed an approach to assist in determining whether market sales or self-report methods are appropriate for net-to-gross assessment of results for various programs. The screening criteria outlined below provide a description of the screening process used to determine which method to use. For the first two criteria, the quality of available data depends in part on the details involved in data collection which in turn depends on resources available.

[33] *Net-to-Gross Method Selection Framework for Evaluating Focus on Energy Programs*, Goldberg M.L., Bloch, O., Prahl, R., Sumi, D., Ward, B., Winch, R. and Talerico, T., March 16, 2006.

Table 3-2. Screening Criteria for Self Report versus Market Share NTG Approaches

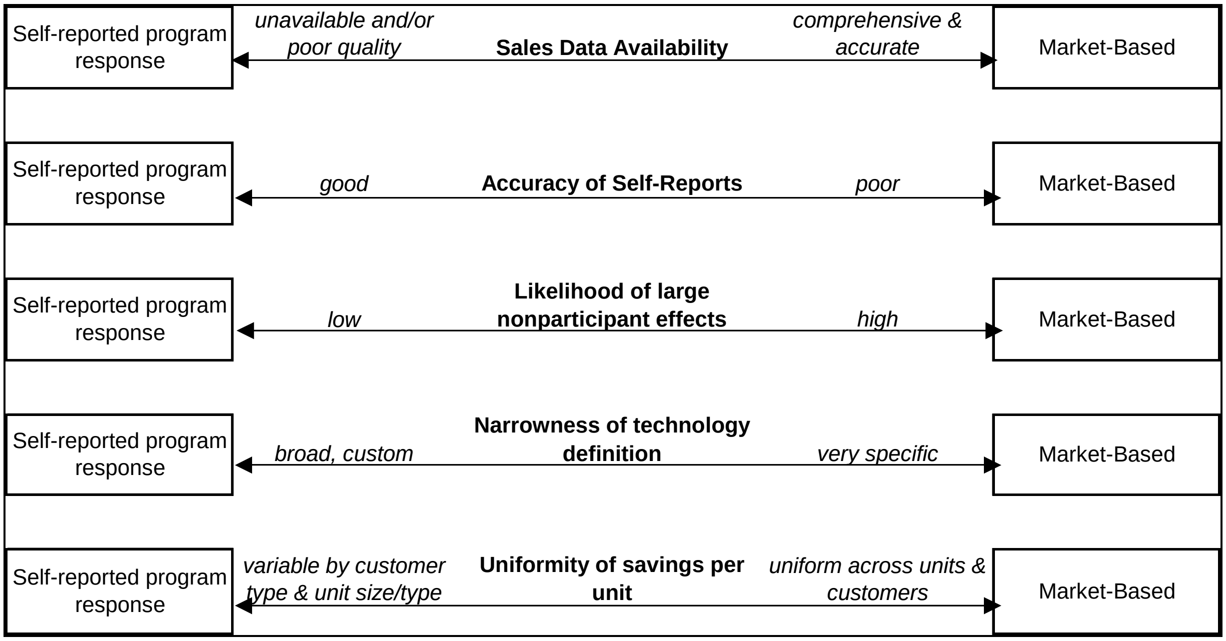
Screening Criteria	Example Screening Questions
Sales Data Availability: The availability of current and baseline market sales data enables estimating free ridership based on such data.	Are current and baseline data readily available? Are the data comprehensive and complete? Able to supplement/overcome shortcomings in data with other data collection techniques? Is the baseline estimate reliable?
Accuracy of Self-Reports: The ability of end users and vendors to report accurately what would have occurred in the absence of the program enables the use of program-response self-report methods.	Can end users/vendors accurately report what would have occurred without program? Supply-side actors can comment on programmatic versus non-programmatic influence on market? Has program altered the supply side in ways a participant would not be able to recognize?
Likelihood of Large Non-participant Market Effects: The likelihood of substantial non-participant market effects may indicate a need for applying methods for adequately capturing such effects.	Is the scale of program large relative to overall market? Are primary sales driving components (promotions, incentives) available at a consistent level throughout the year? Does the program have broad reach across market niches? Does program theory predict significant non-participant effects?
Narrowness of Technology Definition: A market data approach is suggested if the technology is a single type and well-defined, versus encompassing multiple categories, types, or wide variations.	Does program offer "custom" solutions (broad definition) or "prescriptive" measures (narrow definition)? Does program target specific technologies (narrow definition) or a broad range of technologies (broad definition)?
Uniformity of Unit Savings: The choice of method is guided by whether savings per unit is sufficiently consistent across types of units & customers to adequately quantify in terms of total units sold, or needs information on unit characteristics by customer type.	Do units promoted through the program come in widely varying size ranges/savings levels? Is an engineering estimate of necessary? Large variation in customer application of measures? Do savings per unit vary by customer application? Expect savings to vary widely by customer?

Source: Goldberg M.L. et al Net-to-Gross Method Selection Framework for Evaluating Focus on Energy Programs, March 2006.

Taken together, these factors can indicate an overall preference for one method or another. In some cases, the preference will be clear-cut. In others, the two methods may be nearly equally good—or nearly equally poor. The diagram in Figure 3-1 below indicates for each criterion what condition points toward use of market sales approaches and what condition points toward self-reported program responses.

By definition, measures implemented in custom programs do not fall into easily defined buckets for which market sales can be easily or accurately estimated. Even if discrete pieces of equipment can be identified, obtaining relevant and adequate market sales information can be very difficult.

Figure 3-1. NTG Method Selection Screening Criteria[34]



3.2.5 Overview of Pros and Cons

The survey approach is the most straightforward way to estimate free ridership and spillover and is usually the lowest cost approach. As noted by the NAP Guidelines…”survey methods can be used with any program regardless of the number of participants” whereas econometric methods “can only be used with programs with large numbers of participants because the models need large amounts of data to provide reliable results”.[35] In California, econometric methods are preferred in situations with enough participants and comparable non-participants, and when the program is large enough to justify the expense. However, programs with either a very small number of participants or non-participants or where comparability is a severe problem (such as industrial plants with unique facilities) are not amenable to these methods and need to rely on a survey-based method[36]. Market share methods are generally used to assess market transformation programs or in situations where participation is not well defined.

Table 3-3 below shows an overview of the pros and cons of all of the methods discussed above.

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[34] *Net-to-Gross Method Selection Framework*, ibid, Figure 1 p. 4.

[35] National Action Plan for Energy Efficiency. Model Energy Efficiency Program Impact Evaluation Guide 2007.

[36] Vine, Ed. *The Human Dimension of Program Evaluation*, *Lawrence* Berkley Lab, LBL-33601, 1993

Table 3-3. Comparison of Free Rider and Spillover Methodologies

Methodology	Pros	Cons
Billing Analysis	Quantitative estimates of magnitude of net impacts from statistically valid methods based on historical billing data.	Includes participants and non-participants in one model; sample not randomly determined due to self-selection. Could produce biased coefficient estimates if unobserved characteristics, which influence decision to participate, are not accounted for. Needs good historical data for each customer and this can reduce the number of data points. Large customers can overly bias results.[37]
Other Econometric or Discrete Choice Methods	Useful for programs that seek to transform the market. Modeling can provide more accuracy because tests for bias and precision can be included.	Econometric models need good historical data for each customer and this can reduce number of data points. Also needs data to account for variables that might be influencing the results. For discrete choice models it is difficult and costly to get accurate data on types and efficiency levels of existing equipment.[38] Neither method includes trade allies effects.
Self-Report	Simpler and less expensive than all other approaches. Can use all data points unlike billing or econometric analysis which requires historical data. Can be used in a variety of situations. Directly addresses the behaviours the program is seeking to affect. Flexible and so can take into account the complexities of program-participant interaction.	Potential for non-response bias, limited respondent recall of program influence on decision-making, and potential investigator bias in translating responses into free ridership values. Tends to underestimate spillover.
Market Share Approaches	Addresses trends in the entire market for equipment.	By definition, measures implemented in custom programs do not fall into easily defined buckets for which market sales can be easily or accurately estimated. Even if discrete pieces of equipment can be identified, obtaining relevant and adequate market sales information can be very difficult.

[37] Torok, C., Cavalli, J. and O'Drain, M. *Any Way You Slice It: Issues of Behavior and Influence in Net Impact Analysis*, 1999.

[38] Kandel, A. *Theory-Based Estimation of Energy Savings from DSM, Spillover, and Market Transformation Programs Using Survey and Billing Data*. Program Measurement and Evaluation, 2002.

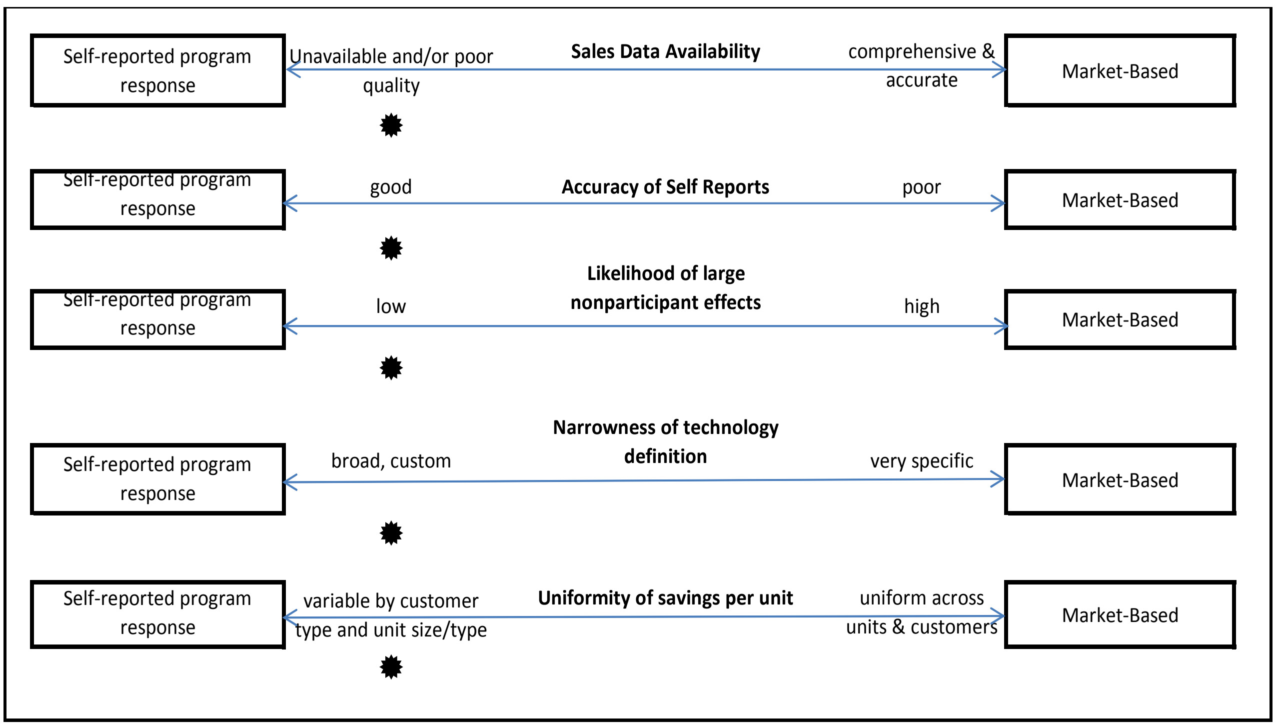
3.3 Best Method to Assess Union-Enbridge Custom Projects Free Riders and Spillover

This section applies the information discussed in the previous section about various methodologies to the Union-Enbridge research requirements to determine NTG for custom projects with large industrial and commercial customers.

It is clear that neither discrete choice models nor market share methods are appropriate methodologies for this research. Discrete choice models must focus on clear, standardized equipment choices. However, the Custom Projects measures are by definition custom and not easily placed into categories that are amenable to discrete choice analysis.

Applying the NTG method selection criteria to the custom projects program, as shown in Figure 3-2 below, clearly indicates that the self-report method is preferred over the market share approach.

Figure 3-2. Applying NTG Screening Criteria to Custom Projects



The self-report method using interviews with customers is more appropriate for this research than billing analysis or other econometric models. Table 3 compares self-report to the other two methods (combined as pros and cons are similar) based on relevant program characteristics. For example, the Custom Projects programs offered by Union Gas and Enbridge Gas Distribution are targeted specifically at large commercial and industrial customers and target complex and unique systems rather than offering prescriptive rebates. In addition, in some segments, e.g., agriculture, most eligible customers participate, making the selection of a non-participant group problematic. As shown in the table, there are problems in applying econometric methods which do not occur with self-report methods. The ideal methodology would be to apply California's Enhanced Level of Rigor which requires triangulation of estimates by at least two methods. This approach is very costly however, and still has the problems identified in Table 3-3 for econometric models.

Table 3-4. Compare Self-Report to Econometric Methods

Program Characteristic	Self-Report Methods	Econometric Methods
Targets large customers.	In-person or telephone surveys can be used with large customers.	Large customers can overly bias results
Non-participants difficult to identify.	Does not require non-participant data for free ridership or inside spillover.	Requires both participants and non-participants in analysis.
May not detect savings at whole building/facility level.	Targets measure level information.	Energy use data generally only available at building/facility level.
External factors likely to be significant.	Survey accounts for relevant external factors.	Need to collect appropriate data to adjust for external factors.
Focused on process changes rather than equipment.	Survey accounts for changes to processes as well as equipment.	Discrete choice and other models focus on equipment choices.

Based on this assessment, Summit Blue recommends using self-report methodology as described in the Analysis Plan, which modifies the methodology developed for other jurisdictions to the specific Union-Enbridge programs.

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4 SAMPLING AND DATA COLLECTION

This section reports on the sample design and data collection process for the study.

4.1 Participant and Trade Ally Survey

The sample was drawn from customers who participated in the Custom Projects Program between the fourth quarter of 2006 and the third quarter of 2007, inclusive. (As a result, the population of participants shown below will not match numbers reported by the utilities.)

There were 594 projects in the population for EGD and 345 for Union. We completed interviews covering 233 projects. For EGD 156 or 26% of the projects were completed and for Union 77 or 22% , which is an average of 25% across both utilities (see Table 4-1). Multifamily projects represented 35% of the population and 31% of the completed interviews. Industrial projects represented 24% of the projects and 18% of the completed interviews.

Table 4-1. Participant and Trade Ally Sample Disposition

	Population			Completes			Percent of Total		
Sector	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**
Agriculture	39	20	59	9	8	17	23%	40%	29%
Building Retrofit	114	138	252	44	21	65	39	15	26
Industrial	111	114	225	23	19	42	21	17	19
New Construction	58	13	71	24	12	36	41	92	51
Multi-Family	272	60	332	56	17	73	21	28	22
Total	594	345	939	156	77	233	26	22	25
Percent of Total									
Agriculture	7%	6%	6%	6%	10%	7%			
Building Retrofit	19%	40%	27%	28%	27%	28%			
Industrial	19%	33%	24%	15%	25%	18%			
New Construction	10%	4%	8%	15%	16%	15%			
Multi-Family	46%	17%	35%	36%	22%	31%			
Total	100%	100%	100%	100%	100%	100%			

4.2 Audit-Only Survey

The sample was taken from customers who had audits in 2005 to provide the optimal balance between providing enough time for the customers to have acted on the recommendations in the audit and ensuring that the audit is not so far in the past that respondents have trouble recalling details of the recommendations. Because the sample will be based on a single year, the result of the analysis can be expressed in spillover per year.

The audit-only spillover survey and analysis was completed for EGD only as Union Gas was unable to find any companies who had an audit in 2005 and had not implemented one of the recommended measures through the program. As a result, the savings inspired by the Union Gas audits will appear in the program tracking data rather than in spillover. EGD provided a sample of 37 customers who had an audit but did not appear in the tracking data as having implemented a relevant measure. We attempted to complete a survey with each of those customers to estimate spillover and completed 24 surveys (including one who did not recall the audit).

4.3 Non-participant Survey

The utilities provided contact information for 1,228 non-participating customers and Global Target Marketing attempted to contact all customers for a screening interview (see Table 4-2). As expected, many respondents (32%) were screened out because they did not implement a measure since 2005. A further 10% were screened out because they were participants and 26% were screened out because they were not aware of the program. Just over one quarter (26%) had implemented a measure since 2005 and were aware of the program but the measure was not influenced by the program. Together, 94.6% of the respondents were screened out for the reasons stated above, leaving a total of 66 customers, or 5.4% of the total population, who were influenced by the program to implement measures (and did not receive a financial incentive).

These 66 customers were asked to participate in a follow up interview to help quantify savings and 38 agreed (3.1% of the total).

Table 4-2. Non-participant Spillover Screening and Engineering Survey Disposition

	Total		Union Gas				Enbridge Large Volume			
			Commercial		Industrial		Commercial		Industrial	
Screened (Total)	1,228	100.0%	1,078	100.0%	41	100.0%	72	100.0%	37	100.0%
Unaware of Energy Efficiency Program	321	26.1%	297	27.6%	3	7.3%	11	15.3%	10	27.0%
Received Financial Incentives	124	10.1%	88	8.2%	20	48.8%	14	19.4%	2	5.4%
Did Not Install/Modify Equipment Since 2005	398	32.4%	354	32.8%	8	19.5%	26	36.1%	10	27.0%
Installed Measure and Aware Of But Not Influenced By Program	319	26.0%	284	26.3%	6	14.6%	16	22.2%	13	35.1%
Installed Measure and Influenced by Program	66	5.4%	55	5.1%	4	9.8%	5	6.9%	2	5.4%
Agreed To Follow-Up	38	3.1%	33	3.1%	3	7.3%	1	1.4%	1	2.7%
Total Follow-up Interviews	27	2.2%	22	2.0%	3	7.3%	-	0.0%	1	2.7%
Total Providing Savings Estimates	5	0.4%	3	0.3%	2	4.9%	-	0.0%		0.0%

Note: The numbers in the middle rows (between the dark lines) sum to the total in the top row. The last three rows are components of the row titled "Installed Measure and Influenced by Program".

5 FINDINGS

The findings are presented in four parts, representing free ridership and three kinds of spillover, inside, outside, and audit-only. The final section combines the free ridership and spillover into one calculation to produce the final net-to-gross ratio.

5.1 Free Ridership Results

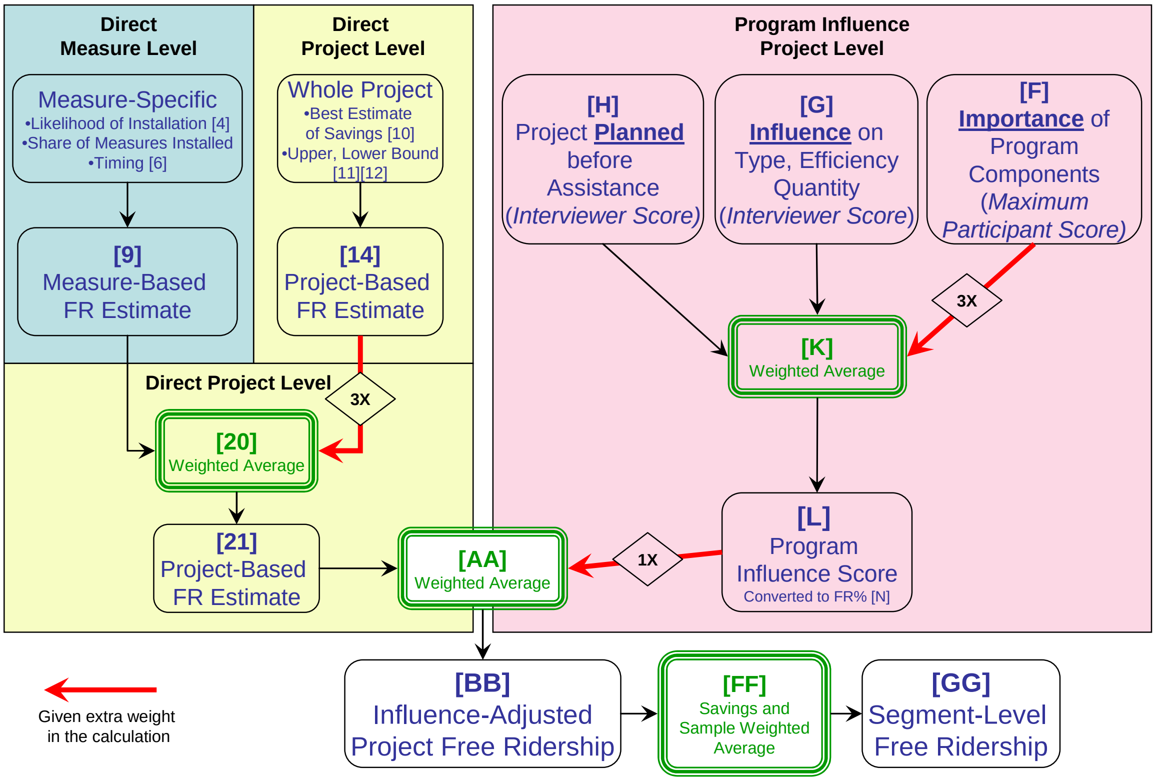
As discussed in the methodology chapter (and in the analysis plan), the calculation of free ridership requires combining answers from several different questions to come up with a single free ridership number for each measure. At several points in the calculation assumptions have to be made about how to combine answers. Should we take the maximum answer from a group of related questions? Should answers be averaged? Should some answers get more weight than others? Some calculation assumptions lend themselves to a clear decision. For example converting a 1-5 score into a free ridership percentage using a straight line conversion seems the obvious choice (where 1=0%, 3=50%, and 5=100%). Other calculation assumptions, do not present a clear answer. For example, when combining the project-based free ridership estimate with the program influence score, should they be averaged? If so, should one carry more weight than another? For those assumptions, we performed a sensitivity analysis, examined the open-ended responses and interview notes, and took into account the program approach to identify the most appropriate calculation approach. The next few paragraphs describe the recommended calculation approach. Following that are the results produced from that approach.

5.1.1 Recommended Calculation Approach

Three assumptions in the calculation had the most effect on the end result and were of the type that required a broad analysis of the program and survey data to suggest the appropriate calculation approach. Those three are shown at [20], [K], and [AA] in the calculation overview diagram in Figure 5-1. After examining all available evidence, we conclude that the most appropriate approach is to give the weights shown in the diamond shapes in those calculations. First, giving triple weight to [14] in the calculation at [20] is appropriate for the following reasons:

- The calculation at [20] averages direct measure level questions [9] and direct project level questions [14]. The direct measure level questions expect the respondent to think discretely about separate components of the project decision. The direct project level question [10] asks them to think about the project as a whole, and considering all program involvement. Given that the utility interacts with the customer over a long period of time, in a variety of ways, and that the measures are typically complex with many factors influencing the decision, it seems less likely that the respondent will be able to successfully think about a component of the decision than about the decision taken as a whole. As a result, the answer to the direct project level question [10] is probably more believable than the measure-based estimate [9]. Because of that conclusion, we weight the project-based estimate more heavily than the measure-based estimate in [20] by a factor of 3.

Figure 5-1. Final Calculation Overview



Second, giving triple weight to [F] in the calculation at [K] is appropriate for the following reasons:

- Point [H] in this calculation is an interviewer score of the amount of planning that went on for the measure before the program got involved. There are several potential weaknesses in the answers to this question that argue for reducing its weight in the calculation at [K]:
    - Program staff were frequently providing assistance to the participants over a long period of time. By the time the measure was installed (and we called on the participant for an interview), respondents may have forgotten the history of the project planning. Those involved in the initial planning may no longer be at the company or in a position to pass along the history of the planning to those ultimately interviewed.
    - Because the program projects are often complex and related to equipment central to a company's output, the fact that plans were in place prior to program involvement does not necessarily imply that the program had no influence. For example, the decision to modify a production line may be driven by changes in the market for their product. Thus plans might be in place to change equipment prior to program involvement but the program involvement could still affect the efficiency of the equipment chosen.
    - Because the program projects are often complex, planning takes place over a long period of time and proceeds through several steps. The program could get involved after initial planning took place – e.g., the decision was made to modify a production line – but before the specifications were written for the equipment affected by the program. Assessing the program's influence on planning in such a circumstance can be difficult to apply in a standard and uniform fashion across projects.

- Point [G] in the calculation at [K] is an interviewer score of the program's influence on the type, efficiency and quantity of the equipment installed. The driving question at [G] was as follows: "Did the assistance you received from [Enbridge/Union] in any way influence your capital funding acquisition process, the type or efficiency level of the equipment or the amount of high efficiency equipment you installed or process changes implemented?" Many of the projects implemented under this program were implemented primarily to address issues other than energy costs. In many cases, the program's hoped-for impact was to increase the energy efficiency of the project rather than inspire the change in the first place. As a result, factors other than energy are often driving decisions about capital funding and the type and quantity of equipment installed and it is unlikely that the program will have much if any affect on those factors. The question at hand was designed to measure the program's influence on those factors in addition to the efficiency of the equipment. This has the effect of diluting the impact of the efficiency issue in the final interviewer score. These weaknesses in this question argue for reducing its weight in the calculation at [K].

- Point [F] represents several questions on the importance of several program components or types of assistance in the participant's decision to install energy efficiency equipment. The questions in [H] and [G] ask the respondent to think about <u>all</u> program assistance as a bundle while focusing on a specific aspect of the decision process. The questions in [F], on the other hand, ask the respondent to think about individual components of program assistance while focusing on the whole decision process. As discussed above, given that the measures are typically complex with many factors influencing the decision, it seems less likely that the respondent will be able to successfully think about a component of the decision (as in [H] and [G]) than about the decision taken as a whole (as in [F]). The [F] series of questions brings in the specific components of the program assistance and, particularly given the drawbacks with [H] and [G], seems more likely to give a more accurate picture of the program's influence.

Finally, giving equal weight to [21] and [L] in the calculation at [AA] is appropriate for the following reasons:

- The conclusions drawn above on [20] and [K] give more weight to questions that address the whole project rather than specific components. They provide two different approaches for the respondent to address the program's influence: estimating savings that would have happened in the absence of the program in [14], and the how important program components were in the decision to install energy efficiency equipment in [F]. Addressing the same general issue from two different perspectives ought to provide a more robust estimate of the true impact.

- Given that the questions at [14] and [F] have already had their weight in the calculation increased, giving more weight to one or the other of these components in the calculation at [AA] would have the effect of ensuring that the final result is largely driven by the answer to one question (or one type of question in the case of [F]). This places too much importance on a single question and is contrary to the philosophy of the general approach which is of triangulating at the answer from a variety of perspectives.

5.1.2 Results

Using the calculation approach defined above produces a total free ridership rate across both utilities and all sectors of 48% as shown in Table 5-1. The free ridership rate for EGD is 41% and it is 54% for Union Gas. Free ridership rates of near 50% are not uncommon in custom programs throughout North America. In a 2006 study Summit Blue performed for Alliant Energy, we found five programs out of 21 with free ridership rates above 40%.[39] Summit Blue recommends that the utilities use the utility-specific total free ridership values of 41% and 54% as the best estimate of free ridership. Those results are based on larger sample sizes than the sector-specific results and proved more stable in the sensitivity analysis. The sector-specific results are based on smaller sample sizes and should only be used to support program management, for example to support targeting and marketing decisions.

Table 5-1. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

5.1.3 Bin Analysis

As discussed above, there are several potential weaknesses in the answers to some of the questions asked of participants. Given that the utility is often involved well in advance of project implementation, it is possible that in the intervening time the institutional memory of the history of the utility's program involvement has been lost. It is also possible that the participant has taken ownership of the information or approach that originally came with support from the utility and now views it as their own, not something brought to them by the utility. Now of course without defining away the possibility of free ridership even existing, we cannot say that prior utility program involvement prior to project implementation is evidence that free ridership does not exist. However, there is one area that is more concrete than simple "prior program involvement" that is worth examining. In some cases, the utilities supported energy audits that looked for and provided support to decisions to implement specific energy efficiency measures. It seems reasonable to conclude that at least in some cases those audits inspired the subsequent installation or modification. It also seems possible that if the audit were some time before implementation, the respondents we talked to may not have been aware of the influence of the audit.

[39] Shared Savings Decision-Making Process Evaluation Research Results. Jeff Erickson, Summit Blue Consulting for Wisconsin Power & Light (Alliant). August 11, 2006.

To examine the possible implications of this issue, we performed a bin analysis. We received from the utilities dates of energy audits or studies done in advance of specific measures that were addressed in our participant interviews. The free ridership savings were placed in two bins based on historical data provided by the utilities. Projects that met any of the following criteria were placed in a "Preceding Audit" bin:

- A utility-sponsored audit or feasibility study preceded the measure implementation and was directly related to the measure installed.
- The same measure had been installed through the program in a previous program year.
- EGD paid part or all of the salary for an on-site energy manager at the facility prior to the measure implementation.

All other projects were placed in a "No Preceding Audit" bin. In this way, on a measure-by-measure basis, we put the m^3 savings that had been defined as free ridership into one of two bins. The results are shown in the following table. As in the previous table, the total free ridership across both utilities is 48% (the bottom right cell in the table). Splitting this into two pieces shows that the total free ridership is made of 25% from projects that had preceding audits and 23% that did not. (Note that 25%+23%=48%, the total free ridership percentage.) The "Preceding Audit" values represent just over half of the total free ridership for the two utilities combined and represent well over half of Union's free ridership.

Table 5-2. Free Ridership Split Based on Preceding Audit

	Preceding Audit			No Preceding Audit			Total		
Sector	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**
Agriculture	6%	0%	3%	34%	0%	15%	40%	0%	18%
Commercial Retrofit	0%	7%	2%	12%	52%	25%	12%	59%	27%
Industrial	12%	44%	31%	38%	12%	22%	50%	56%	53%
Multifamily	0%	0%	0%	20%	42%	26%	20%	42%	26%
New Construction	0%	6%	2%	26%	27%	26%	26%	33%	28%
Total	8%	38%	25%	33%	16%	23%	41%	54%	48%

One possible interpretation of the "Preceding Audit" free ridership values is that they are spillover caused by the audit and the "No Preceding Audit" values are pure free ridership. If the audit altered the participant behavior and/or plans, but the respondent either was not aware of that change or had forgotten about the program's earlier influence, then the "Preceding Audit" values would accurately be described as spillover. If, on the other hand, the earlier measure implementations were also free riders and the audit truly did not significantly affect the decision-making process, then the "Preceding Audit" values would not be spillover.

The preparation for the surveys, the surveys themselves, and the survey process were designed to get to respondents with knowledge of the history of the project and remind participants of their company's past involvement in the program. Given the high free ridership rates, it seemed appropriate to do some additional research in this area. We called back three of the largest participants who had prior audits to verify whether they were aware of the audits and to gauge the impact of the audits on their planning and decision process. In two of the three cases, we judged that our original free ridership estimate was accurate and that the prior audits were not driving factors in the decision. In the third case we adjusted responses from the earlier interview to reflect the new information we received in the follow-up call.

5.1.4 What is Driving the Results?

This section examines various factors that may help explain where the most significant issues with free ridership are.

Sector

Industrial gross m^3 savings represent 84% of the total program savings (Table 5-3) and therefore drive the final results. The Industrial sector accounts for 77% of EGD's gross savings and 89% of Union's.

Table 5-3. Gross m^3 Savings as Percent of Total by Sector

Sector	EGD	Union	Total
Agriculture	3%	3%	3%
Industrial	77%	89%	84%
Multifamily	8%	1%	4%
New Construction	2%	1%	1%
Commercial Retrofit	10%	6%	7%
Total	100%	100%	100%

The EGD Industrial free ridership rate is 50% and Union's is 56% (see Table 5-4, which is identical to Table 5-1). The other EGD sectors have relatively low free ridership rates, with the exception of Agriculture, which is only 3% of the total savings. The other Union sectors (with the exception of agriculture) have fairly high free ridership rates, which explains why the total Union free ridership rate is higher than EGD's, given that their Industrial rates are close.

Table 5-4. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

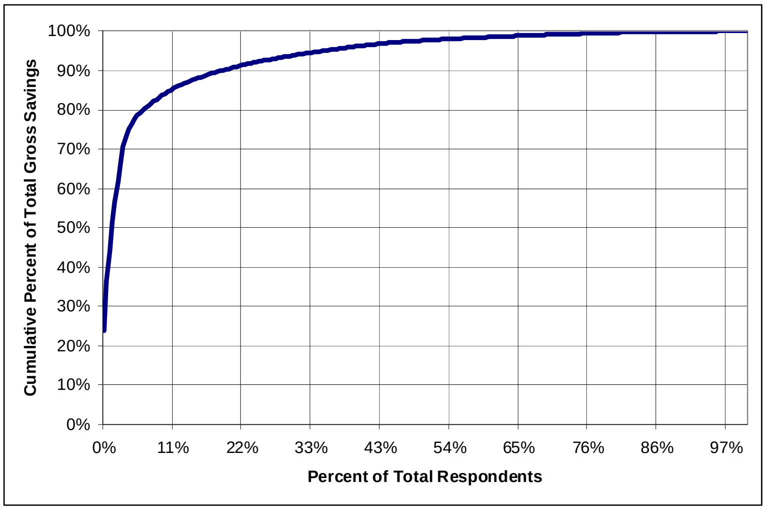
Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

Company Size

Program gross m^3 savings are concentrated in a relatively small number of participants. The top 10% of respondents based on gross m^3 savings consume 84% of total program savings (among those interviewed) (Figure 5-2). The 15 companies with the most m^3 savings together save 80% of total gross m^3 savings. The free ridership rate for those 15 companies is 56% across both utilities. If we eliminate those 15 companies, the free ridership rate drops to 34%.

Figure 5-2. Cumulative Percent of Gross Savings



Measure Type

Machine/Process measures account for 44% of the gross savings and HVAC measures account for 39%; together they drive the final results. The Machine/Process free ridership rate is 56% and HVAC is 46%. Lighting and "Other" measures have fairly high free ridership rates and Hot Water, Envelope, and Controls have fairly low rates.

Table 5-5. Free Ridership By Measure Type

Measure Type	Free Ridership Rate
Machine/Process	56%
HVAC	46%
Lighting	43%
Other	37%
Agriculture	29%
Envelope	22%
Hot Water	15%
Controls	13%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

Other Observations

There are several factors that influence the free ridership results, which can be loosely categorized into factors that increase free ridership, those that decrease free ridership, and those that reflect well on the program but that do not improve the free ridership value.

Factors that increase free ridership

- In many energy efficiency programs for large, complex projects the utility incentive will typically not be particularly large compared to the overall project cost. As a result, the respondents may feel that it has relatively little impact on the direction of their project. (On the other hand, the existence of an incentive can raise the level of interest and still have an effect even if the incentive is not large.)

- Regardless of the size of the incentive, it can only have an impact on decision making if the potential recipient feels the chances of receiving the incentive are reasonably high. Because custom projects can involve multiple vendors any confusion about who will receive the incentive will reduce its overall impact on the decision process.

- Design Engineers and Energy Performance Contractors see themselves as sophisticated energy users, and pride themselves on being knowledgeable and competent on energy efficiency issues and in providing the most energy efficient solutions to their clients. This may imply that approaches that aim to influence these channels are not as effective in changing existing energy efficiency choices.

- Again because custom projects can involve multiple vendors, some vendors may be insulated from the key decision makers by other vendors. As a result, any program activities targeting these vendors may fail to influence the final decisions.

- Large industrial end-users often have the accounting mechanisms in place to understand the effects of energy use on their bottom line, they require highly specialized technologies for their application, and they have the in-house expertise to identify and evaluate efficient options for those specialized technologies. In addition, there may be a number of very competent consultants and suppliers who assist the industry with energy efficiency and in a number of other technical support areas. For this kind of company, assistance provided by utility programs must stand out in some particular way to be noticed. The subtleties of that assistance may be lost as time goes on and as staff change, making it harder to identify the effects of that assistance when looking back over time.

Factors that decrease free ridership

- The Utility provides an independent third party verification of the predicted savings and this is very valuable in the decision making process in many organizations.

Positive stories, but ones that do not improve the free ridership

- The participants are quite pleased with their involvement with the program, glad to get the Utility’s assistance, and satisfied with the program.

- The Program assistance and incentives help grease the skids, but they do not change the direction or destination of the sled.

- One trade ally reported “The program gives a comfort factor on value of energy efficiency measures. It improves the interaction between the utility and the customer.”

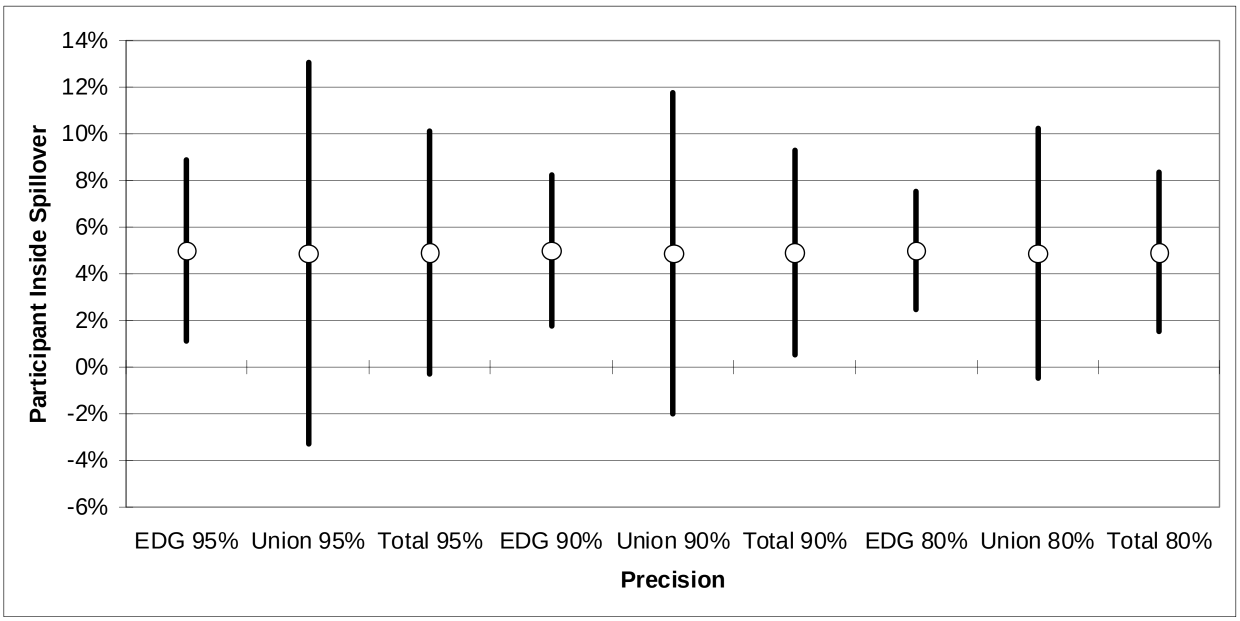
5.2 Spillover Results

Spillover represents energy savings that are due to the program but not counted in program records. Summit Blue estimated **participant inside and outside spillover** through questions in the participant and trade ally surveys and through the Audit-Only Survey. Summit Blue estimated non-participant spillover through the non-participant survey.

5.2.1 Participant Inside Spillover Results

Nine respondents for EGD and five for Union indicated that they had installed additional energy efficiency measures at the same facility without going through the program, those measures count as inside spillover. By extrapolating the m^3 savings from those measures to the population, we calculate that **inside spillover was 5% of gross reported savings for both EGD and Union**. The results for EDG are statistically significant at the 95% level. However, the results for Union are not statistically significant, even at the 80% level. The following figure shows the error bounds around the mean estimate. When the error bounds crosses zero, we cannot say with statistical precision that the results are not zero. The EDG-Union combined total is statistically significant at 90%. Given that the spillover numbers are based on a rather small number of respondents, it is appropriate to calculate spillover across the entire pool of respondents, for Union and EGD combined.

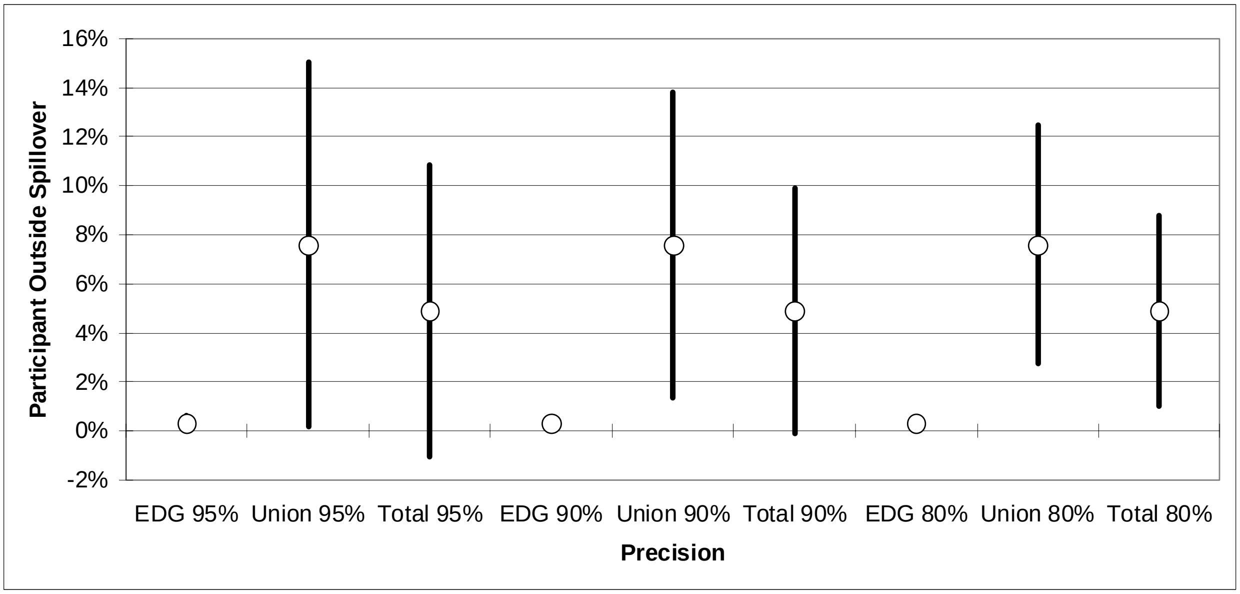
Figure 5-3. Participant Inside Spillover



5.2.2 Participant Outside Spillover Results

Four respondents for EGD and three for Union indicated that they had installed additional energy efficiency measures at *different* facilities without going through the program. Those measures count as outside spillover. By extrapolating the m^3 savings from those measures to the population, we calculate that **outside spillover for Union was 7.6% of gross reported savings, less than 1/2 percent for EGD, and 5% combined across both utilities.** The following figure shows the error bounds around the mean estimate. Given that the spillover numbers are based on a rather small number of respondents, it is appropriate to calculate spillover across the entire pool of respondents, for Union and EGD combined, which is statistically significant at the 80% confidence level.

Figure 5-4. Participant Outside Spillover



5.2.3 Participant Audit-Only Spillover Results

Customers who received an audit, implemented a recommended measure, but did not receive incentives through the program for that measure can be considered audit-only spillover. The audit-only spillover survey and analysis was completed for EGD only as Union Gas was unable to find any companies who had an audit in 2005 and had not implemented one of the recommended measures through the program. As a result, the savings inspired by the Union Gas audits will appear in the program tracking data rather than in spillover. EGD provided a sample of 37 customers who had an audit but did not appear in the tracking data as having implemented a relevant measure. We attempted to complete a survey with each of those customers to estimate spillover and completed 24 surveys (including one who did not recall the audit).

For each respondent, we calculated the share of the recommended measure savings that could be attributed to the influence of the program. 43% of the m^3 savings estimated in the audit were achieved by those who completed a survey. We then applied the 43% savings to parts of the population that can be assumed to follow the same pattern as the respondents (non-respondents and refusals) and assumed zero savings for those who did not recall the audit or whose business was sold or closed (one company was sold, 3 were closed). Summing spillover savings over the whole group then dividing by the sum of the recommended savings gives the final realization rate for spillover savings for the population, which was 35%. **Thus 35% of the gross recommended savings from energy audits are achieved, representing the audit-only spillover.** The total audit-only spillover savings (1,969,700 m^3) will be brought into the final calculation of the program's net-to-gross ratio.

Since the sample was a census of the eligible population there is no need to extrapolate beyond the calculation explained above.

5.2.4 Non-participant Spillover Results

Screening Survey Results. The utilities provided contact information for 1,228 non-participating customers and Global Target Marketing attempted to contact all customers for a screening interview (see Table 5-6). As expected, many respondents (32%) were screened out because they did not implement a measure since 2005. A further 10% were screened out because they were participants and 26% were screened out because they were not aware of the program. Just over one quarter (26%) had implemented a measure since 2005 and were aware of the program but the measure was not influenced by the program. Together, 94.6% of the respondents were screened out for the reasons stated above, leaving a total of 66 customers, or **5.4% of the total population, who were influenced by the program to implement measures** (and did not receive a financial incentive).

These 66 customers were asked to participate in a follow up interview to help quantify savings and 38 agreed (3.1% of the total). Three engineers attempted to contact all 38 customers and conducted interviews with 27 customers (2.2% of the total population and a 71% response rate). Of these, only 5 Union Gas customers (3 commercial and 2 industrial, representing 0.4% of the population) were able to provide enough information to the engineers to enable them to quantify savings. The engineers rated their confidence in the accuracy of their spillover estimates for each project, given the information the respondent was able to provide and the assumptions that they had to make given shortfalls in the data. None of the engineers felt more than modestly confident that the estimates were accurate and several estimates were rated “weak”.

Conclusion. Because of the large size of the sample submitted to the screening effort, the fact that **5.4% of the population had spillover measures** is a meaningful and important result. However, given that we were able to estimate m^3 savings for only 5 respondents, which was less than 10% of those with spillover, and that our engineers were not very confident in the accuracy of the savings calculations, we cannot extrapolate m^3 spillover savings to the population.

Our engineers reported that most respondents could not provide useful information about the equipment installed. As a result, any effort to improve on this effort should include on-site visits by evaluation engineers so that they can directly observe the equipment and collect the data they need to make the savings estimates. This will increase the accuracy of the site-specific savings estimates and will likely increase the number of sites for which estimates can be calculated.

Table 5-6. Non-participant Spillover Screening and Engineering Survey Disposition

	Total		Union Gas				Enbridge Large Volume			
			Commercial		Industrial		Commercial		Industrial	
Screened (Total)	1,228	100.0%	1,078	100.0%	41	100.0%	72	100.0%	37	100.0%
Unaware of Energy Efficiency Program	321	26.1%	297	27.6%	3	7.3%	11	15.3%	10	27.0%
Received Financial Incentives	124	10.1%	88	8.2%	20	48.8%	14	19.4%	2	5.4%
Did Not Install/Modify Equipment Since 2005	398	32.4%	354	32.8%	8	19.5%	26	36.1%	10	27.0%
Installed Measure and Aware Of But Not Influenced By Program	319	26.0%	284	26.3%	6	14.6%	16	22.2%	13	35.1%
Installed Measure and Influenced by Program	66	5.4%	55	5.1%	4	9.8%	5	6.9%	2	5.4%
Agreed To Follow-Up	38	3.1%	33	3.1%	3	7.3%	1	1.4%	1	2.7%
Total Follow-up Interviews	27	2.2%	22	2.0%	3	7.3%	-	0.0%	1	2.7%
Total Providing Savings Estimates	5	0.4%	3	0.3%	2	4.9%	-	0.0%		0.0%

5.2.5 Recommended Spillover Rates

Summit Blue recommends the utilities use following spillover rates:

Table 5-7. Spillover Results

Spillover Type	EGD	Union	Base
Participant Inside Spillover	5%	5%	Of gross reported savings
Participant Outside Spillover	5%	5%	Of gross reported savings
Audit-Only Spillover	35%	0%	Of gross audit-recommended savings
Nonparticipant Spillover	0%	0%	

5.3 Net-to-Gross Ratio

The net-to-gross ratio is defined as 1 - free ridership ratio + spillover ratio. As discussed above, spillover is in several parts: participant inside and outside spillover, audit-only spillover, and non-participant spillover. We know that 5.4% of the non-participants have spillover but cannot calculate its quantity so the calculation of net-to-gross presented below excludes it. Together participant inside and outside spillover amount to 10%. The audit-only savings were 1,969,700 m^3 for EGD, which represents 11% of EGD total gross savings (see Table 5-8). With zero Union audit-only savings, the total audit-only savings equals the EGD savings and the combined audit-only spillover rate is 5%. Subtracting free ridership and adding spillover produces a final **net-to-gross ratio of 79% for EGD, 56% for Union, and 67% across both utilities.** Summit Blue recommends that the utilities use the utility-specific total net-to-gross ratios, as they are based on larger sample sizes than the sector-specific results.

Table 5-8. Net-To-Gross Ratio

Utility	Sector	Gross m^3 Savings	Free Ridership	Participant Inside + Outside Spillover	Audit-Only m^3 Savings	Audit-Only Spillover %	Net-to-Gross Ratio
EGD	Agriculture	1,111,398	40%				
EGD	Commercial Retrofit	3,052,840	12%				
EGD	Industrial	10,028,771	50%				
EGD	Multifamily	1,575,482	20%				
EGD	New Construction	798,310	26%				
EGD	Total	18,588,008	41%	10%	1,969,700	11%	79%
Union	Agriculture	1,387,850	0%				
Union	Commercial Retrofit	1,406,897	59%				
Union	Industrial	14,874,847	56%				
Union	Multifamily	520,974	42%				
Union	New Construction	304,991	33%				
Union	Total	23,209,837	54%	10%	0	0%	56%
Total	Agriculture	2,499,248	18%				
Total	Commercial Retrofit	4,459,738	27%				
Total	Industrial	24,903,618	53%				
Total	Multifamily	2,096,456	26%				
Total	New Construction	1,103,302	28%				
Total	Total	41,797,844	48%	10%	1,969,700	5%	67%

Free Ridership Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

6 SUPPLEMENTARY RESULTS

The participant surveys included several questions that illuminate the customer's decision-making process, but do not necessarily feed directly into the free ridership calculation. This section will present some of those results, first for end users, next for trade allies, and then at the sector level. Following that will be a brief summary of free ridership, spillover, and net-to-gross results from other jurisdictions.

6.1 End Users

Most (35 out of 40 or 88%) EGD end user respondents have a policy that specifies energy efficiency requirements. 18 target specific energy efficiency levels.

For Union 12 out of 24 (50%) have a policy that specifies energy efficiency requirements (4 target energy efficiency levels).

Table 6-1. Company Has an Energy efficiency Policy

	Missing	Yes	No	Total
EGD	1	35	3	39
Union	0	12	12	24
Total	1	47	15	63

Those who had a policy were asked about the efficiency level stated in the policy. The results are shown in the following table.

Table 6-2. Efficiency Level Stated in the Policy

Efficiency Level Stated in the Policy	EGD	Union	Total
Missing	22	8	30
1	0	1	1
20	1	0	1
35	0	1	1
5 % reduction in energy cost per vehicle	2	0	2
8	1	0	1
80+	0	1	1
84 % efficiency on boilers	4	0	4
86 % for boilers	1	0	1
86 % for boilers; new school perspective specifies nature of any equipment	1	0	1
Better than code but no specific amount set.	2	0	2
Exceed National Building code by 25 % on new buildings	1	0	1
reduce fossil fuels by 15% per year, starting in 2002	0	1	1
Total	35	12	47

Virtually all respondents had criteria for energy efficient equipment.

Table 6-3. Do You Have Criteria For Energy Efficient Equipment?

	Yes	No	Total
EGD	39	0	39
Union	23	1	24
Total	62	1	63

The criteria for approving energy efficiency equipment is predominantly simple payback period (multiple respondents mentioned this). 95% of EGD respondents mentioned payback, 17% life cycle cost analysis, 14% internal rate of return (IRR).

78% of Union respondents mentioned payback, 22% mentioned IRR, 9% mentioned life cycle cost analysis.

Only 7 respondents (3 EGD, 4 Union) changed their energy efficiency policy since the project. The table below shows the changes they made.

Table 6-4. How has your energy efficiency policy changed since the project?

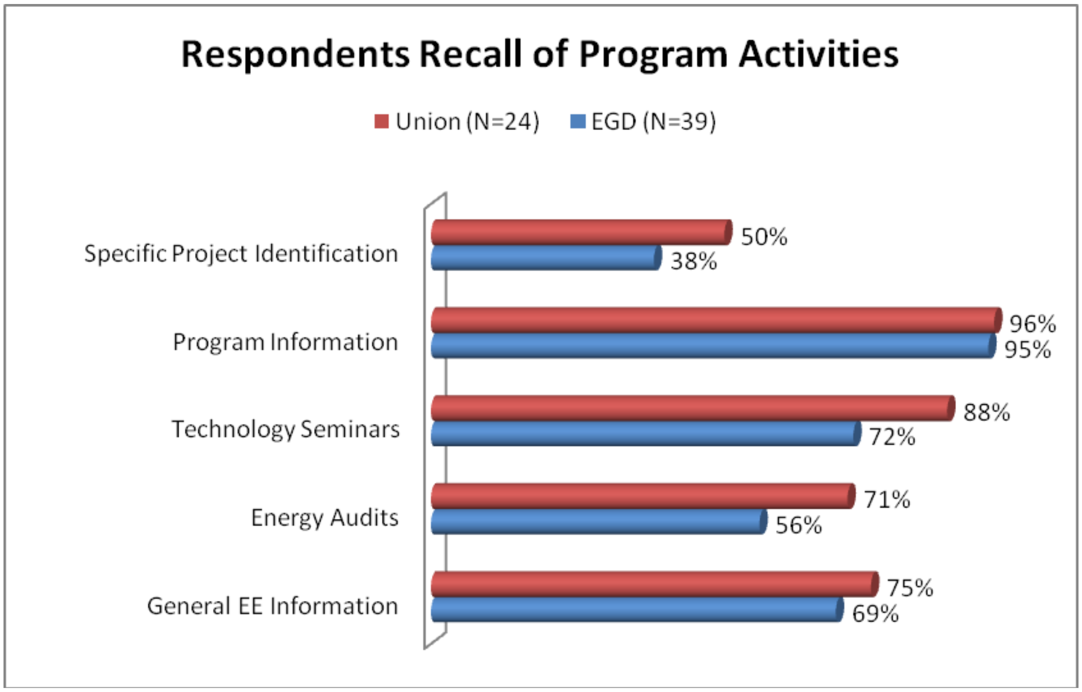
	EGD	Union	Total
EE is now part of their business plan, with a target reduction of 5% annually	0	1	1
Energy wise program has raised awareness of energy efficiency	0	1	1
Greater awareness of need to maintain energy efficiency	0	1	1
Payback has been extended to 5 years	1	0	1
Since the project, the end user has developed a corporate energy policy with a target of a 20% reduction by 2020	0	1	1
Total energy reduction of 6 %	2	0	2
Total	3	4	7

Table 6-5. Percent of respondents recalling program initiative by utility

	General energy efficiency Information	Energy Audits	Technology Seminars	Program Information	Specific Project Identification
EGD (N=39)	69%	56%	72%	95%	38%
Union (N=24)	75%	71%	88%	96%	50%
Total (N=63)	71%	62%	78%	95%	43%

Respondents were asked whether they recalled participating in various program activities. Almost all recalled getting program information (Figure 6-1). Approximately three-fourths remembered going to technology seminars and getting general energy efficiency information.

Figure 6-1. Respondents' Recall of Program Activities



Respondents were asked what the payback was for their project after figuring in the utility incentive. For EGD, 18 of 39 did not respond and 6 had paybacks under a year after incentive (Table 6-6 and Figure 6-2). For Union Gas, 19 of 24 did not respond. Of the 5 who responded, 1 had a payback period under a year.

Table 6-6. What was the project's payback after figuring in the utility incentive?

	EGD	Union	Total
Missing	18	19	37
LT 1 YR	6	1	1
1 to 3 Years	6	3	1
4 to 11 years	9	1	1
Total	39	24	63

6.2 Trade Allies

Consulting Engineers were the most common type of trade ally among the respondents followed by installation contractors (Table 6-7, Figure 6-2, and Figure 6-3). Among our respondents, Enbridge had no manufacturer or distributor/sales as business partners and Union had no property managers as allies.

Table 6-7. Primary Line of Business

	EGD	Union	Total
Consulting Engineer	17	21	38
Installation Contractor	8	6	14
ESCO	5	7	12
Manufacturer	0	8	8
Distributor or Equipment Sales	0	5	5
Property Manager	3	0	3
Other	2	0	2
Total	35	47	82

Figure 6-2. Types of Trade Allies

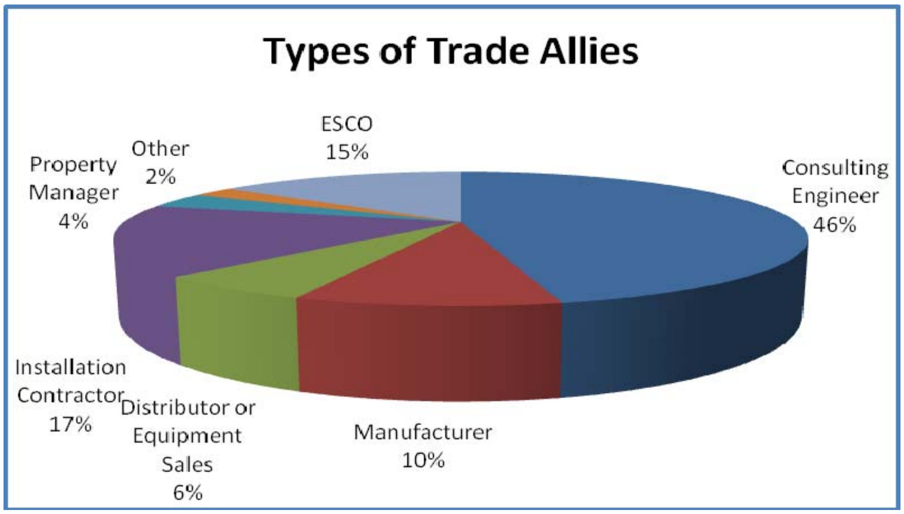
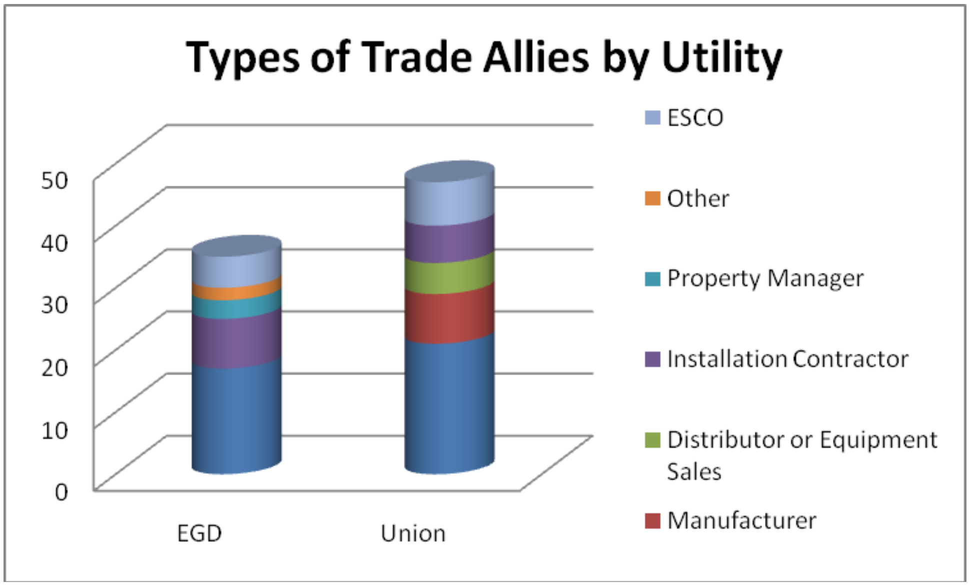
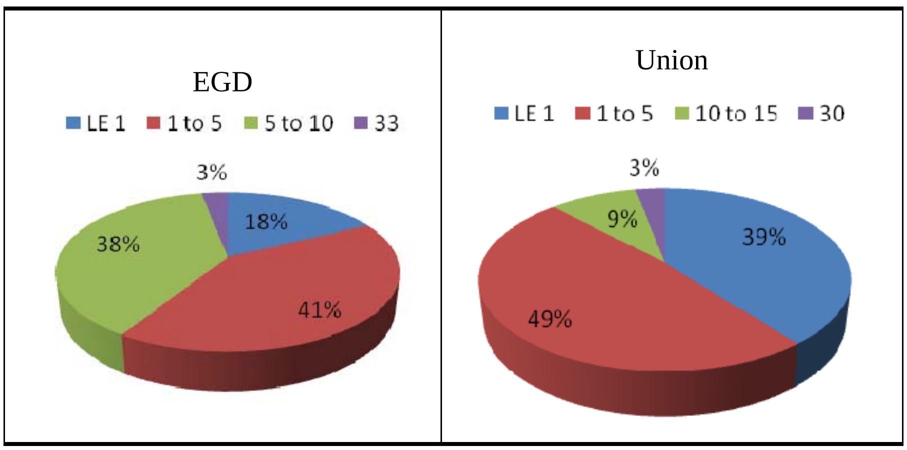


Figure 6-3. Types of Trade Allies by Utility



Respondents were asked to quantify the program incentives as a percent of total project costs. The most common answer was 1-5%, named by just under half of the respondents (Figure 6-4). Over one third of trade allies associated with Union Gas projects thought the incentives were less than or equal to 1%, compared to 18% of the EGD respondents.

Figure 6-4. Incentives as a % of Project Costs



According to the trade allies, all of Enbridge customers were aware of the utility role in the project but only 2/3 of the Union customers were aware.

Table 6-8. Customer Aware Of Utility Role

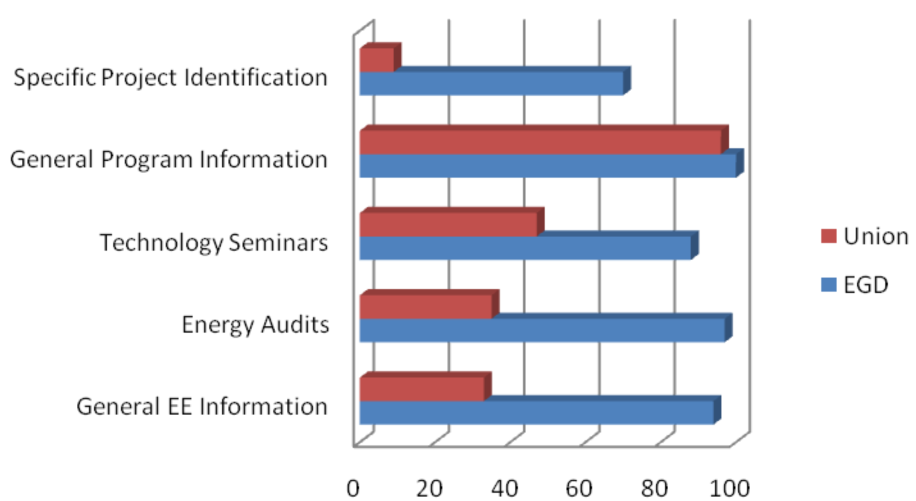
	Yes	Total	%
EGD	34	34	100
Union	27	40	68

Trade allies were asked “Do you recall receiving energy efficiency information and/or training in any of the following areas that was sponsored or delivered by Union Gas/Enbridge Gas Distribution?” Almost all remembered getting general program information (Table 6-9 and Figure 6-5). Among the EGD trade allies, almost all remembered getting information or training in energy audits and general energy efficiency information, compared to around one third for Union trade allies. Over two thirds of EGD respondents recalled getting “specific project identification” compared to nine percent for Union.

Table 6-9 % of Mentions by Utility

	EGD	Union
General Program Information	100	96
Energy Audits	97	35
General EE Information	94	33
Technology Seminars	88	47
Specific Project Identification	70	9
Software	0.38	0.20
Lunch N Learns	0.26	0.22

Figure 6-5. Percent Recall Information Etc. by Utility



6.3 Sector-Specific Answers to Key Questions

This section will present answers to the questions that carry the most weight in the free ridership calculations broken out by utility and sector. The results are presented as percentages after sector weights have been applied. This corresponds to the weighting used when the sector-specific free ridership results were calculated. The key questions that will be presented in this section are shown in the following table.

Table 6-10. Key Questions Influencing Free Ridership Calculation

Label in Text	Marker in Figure 5-1	Description and Survey Question
Direct Measure Level		
Likelihood and/or Share	[4] and [7]	Free Rider percentage based on likelihood (question E2a) and/or share (question E2b)
Months of Early Replacement	[6]	Number of months program caused the project to be moved forward, used to calculate the early replacement adjustment multiplier (question E1a)
Direct Project Level		
Best Estimate of Savings	[14]	Interviewee best estimate of the extra savings that would have been achieved without the program (question E3).
Program Influence Project Level		
Planning	[H]	Project planning interviewer score (question D3b)
Influence	[G]	Interviewer-assigned influence score (question D2b)
Importance	[F]	Program importance participant score (question D1)

The sector level free ridership results are shown in Tables E-1 and 5-1, which can be summarized as follows:

EGD: Industrial and Agriculture are relatively higher than Commercial Retrofit, Multifamily, and New Construction with Commercial Retrofit being particularly low.

Union: Commercial Retrofit and Industrial are relatively higher than Multifamily and New Construction with Agriculture being particularly low (zero).

The discussion of the question-specific results will address those sector differences. Those sectors that saw relatively high free ridership rates are shaded in the tables that follow.

6.3.1 Direct Measure Level

Likelihood and/or Share. Respondents were asked to estimate the *likelihood* that they would have incorporated measures “of the same high level of efficiency” if not for the financial and technical assistance of the program (Figure 5-1 [4]). In cases where respondents indicate that they may have incorporated some, but not all, of the measures, they are asked to estimate the *share of measures* that would have been incorporated anyway at the same level of high-efficiency. The answers they gave were converted into a free ridership percentage, which is shown in the following table.

EGD Notes: In the industrial sector, 67% of the respondents had free ridership scores of 70% or more based on this measure, which was significantly higher than the other sectors, and 89% of the agriculture respondents had free ridership scores at 50% or higher.

Union Gas Notes: Fully 84% of the commercial retrofit respondents had free ridership scores of 100% based on this measure. The industrial scores were somewhat better than multifamily and new construction on this measure. Most of the very largest industrial companies had very high free ridership rates in this area, which is the primary driver of the final free ridership score.

Table 6-11. Likelihood and / or Share – EGD

Free Ridership Percent	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	0%	29%	42%	25%	39%
10	0%	0%	0%	0%	0%
20	11%	0%	2%	0%	0%
25	0%	0%	5%	0%	3%
30	0%	0%	0%	8%	0%
40	0%	0%	0%	0%	0%
45	0%	0%	0%	0%	6%
50	44%	5%	14%	25%	0%
60	11%	0%	0%	0%	0%
65	0%	0%	0%	0%	3%
70	0%	10%	7%	0%	0%
75	11%	19%	2%	0%	0%
80	0%	14%	9%	0%	3%
85	11%	0%	0%	21%	0%
90	0%	0%	5%	4%	0%
100	11%	24%	14%	17%	47%
Total	100%	100%	100%	100%	100%
N	9	22	56	24	44

Table 6-12. Likelihood and / or Share – Union Gas

Free Ridership Percent	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	67%	6%	0%	0%	5%
30	0%	17%	0%	0%	0%
40	0%	0%	6%	0%	0%
50	0%	17%	13%	8%	0%
60	11%	0%	0%	0%	0%
70	0%	6%	0%	0%	0%
75	0%	0%	6%	0%	0%
80	22%	6%	6%	25%	5%
85	0%	6%	0%	0%	0%
90	0%	6%	13%	8%	5%
100	0%	39%	56%	58%	84%
Total	100%	100%	100%	100%	100%
N	8	19	17	12	20

Early Replacement Adjustment Multiplier. On a measure-by-measure basis, respondents were asked if the program influenced them to install the equipment more than one year earlier than they otherwise would have otherwise. If it had, they were asked when they would have installed the equipment without the program (Figure 5-1 [6]). That answer was converted to months and then converted to a percentage multiplier to discount the measure-specific free ridership rate. The answers given are shown below.

EGD Notes: Few projects were moved forward in time in most sectors except for the multifamily sector.

Union Gas Notes: Very few projects in any sector were moved forward by more than 12 months, with the exception of commercial retrofit.

Table 6-13. Months the Program Moved the Project Forward in Time – EGD

Months	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	67%	86%	14%	100%	82%
2	0%	7%	7%	0%	0%
6	0%	7%	7%	0%	0%
9	0%	0%	11%	0%	0%
12	17%	0%	29%	0%	0%
18	0%	0%	14%	0%	0%
24	17%	0%	4%	0%	6%
36	0%	0%	11%	0%	0%
240	0%	0%	4%	0%	12%
Total	100%	100%	100%	100%	100%
N	6	15	32	9	20

Table 6-14. Months the Program Moved the Project Forward in Time – Union Gas

Months	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	0%	92%	0%		50%
6	0%	8%	0%		0%
9	0%	0%	100%		0%
12	100%	0%	0%		0%
24	0%	0%	0%		50%
Total	100%	100%	100%		100%
N	1	13	6	0	3

6.3.2 Direct Project Level

Best Estimate of Savings. Respondents are asked to give an upper, lower and their best estimate [10] of the overall energy savings attributable to the program across all measure categories. If a “best estimate” is not provided, the midpoint between the lower and upper bound is used (Figure 5-1 [14]). Their answers are presented in the following two tables.

EGD Notes: Only two agriculture respondents answered this question, which minimized its effect on this sector, although both said 100% of the savings were attributable to the program. Industrial respondents attributed relatively more of the savings to the program, which would tend to *reduce* their free ridership score.

Union Gas Notes: Industrial and commercial retrofit respondents attributed relatively more of the savings to the program, which would tend to *reduce* their free ridership score.

Table 6-15. Respondent Estimate of Savings Attributable to the Program – EGD

Savings Attributable to the Program (%)	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	0%	6%	19%	8%	0%
10	0%	0%	0%	0%	0%
20	0%	0%	12%	17%	36%
25	0%	6%	0%	0%	0%
35	0%	0%	7%	0%	0%
50	0%	0%	17%	0%	8%
65	0%	0%	5%	0%	0%
70	0%	6%	10%	0%	0%
75	0%	11%	0%	0%	8%
80	0%	17%	14%	25%	6%
85	0%	11%	5%	21%	0%
90	0%	0%	2%	0%	0%
100	100%	44%	10%	29%	42%
Total	100%	100%	100%	100%	100%
N	2	20	56	24	44

Table 6-16. Respondent Estimate of Savings Attributable to the Program – Union Gas

Savings Attributable to the Program (%)	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	75%	6%	0%	0%	5%
20	0%	0%	0%	0%	0%
40	0%	0%	0%	8%	0%
50	0%	19%	14%	0%	0%
70	0%	0%	14%	0%	0%
80	0%	6%	7%	25%	0%
90	0%	0%	0%	17%	0%
100	25%	69%	64%	50%	95%
Total	100%	100%	100%	100%	100%
N	7	15	16	12	20

6.3.3 Program Influence Project Level

Planning. Point [H] in Figure 5-1 is an interviewer score of the amount of planning that went on for the measure before the program got involved, based on open-ended questions to the respondent and probing questions as appropriate. The planning score shown in the following tables is on a scale where 5 indicates that respondent had no plans at all and 1 indicates that respondent had documented plans and had budgeted for all of the efficient equipment.

EGD Notes: Compared to the other sectors, only commercial retrofit stands out as having respondents who had relatively far advanced plans prior to program involvement so this question does not contribute meaningfully to explaining the high free ridership scores for agriculture and industrial.

Union Gas Notes: Three quarters of the commercial retrofit respondents had planning scores of 2 or 1, significantly more than the other sectors. The 42% of industrial respondents having a planning score of 1 is significantly higher than agriculture and multifamily, but less than new construction. Most of the very largest industrial companies had planning scores of 1 or 2.

Table 6-17. Project Planning Score – EGD

Planning Score	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	11%	13%	18%	17%	22%
2	11%	9%	7%	0%	14%
3	0%	0%	4%	0%	8%
4	11%	48%	31%	25%	44%
5	67%	30%	40%	58%	11%
Total	100%	100%	100%	100%	100%
N	9	23	56	24	41

Table 6-18. Project Planning Score – Union

Planning Score	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	22%	42%	7%	50%	58%
2	0%	0%	27%	0%	16%
3	0%	16%	53%	0%	16%
4	0%	26%	0%	25%	0%
5	78%	16%	13%	25%	11%
Total	100%	100%	100%	100%	100%
N	8	19	16	12	19

Influence. Point [G] Figure 5-1 is an interviewer score of the program's influence on the type, efficiency and quantity of the equipment installed. The driving question at [G] was as follows: "Did the assistance you received from [Enbridge/Union] in any way influence your capital funding acquisition process, the type or efficiency level of the equipment or the amount of high efficiency equipment you installed or process changes implemented?" After asking probing questions to understand the answer, the interviewer assigns a 1-5 score where "1" indicates that the program had no influence and "5" indicates that the program was the primary reason that energy efficient equipment was installed. The results are in the following tables.

EGD Notes: Agriculture and industrial respondents are somewhat more likely to score low on this question than multifamily and commercial retrofit (33% agriculture and 29% industrial at 3 or lower compared to 16% multifamily and 25% commercial retrofit) with a low score being correlated with a higher free ridership score.

Union Gas Notes: All commercial retrofit respondents got a program influence score of 3 or lower, which was significantly lower than the other sectors. The industrial respondents had lower program influence scores than the agriculture respondents but higher than the other sectors.

Table 6-19. Program Influence – EGD

Program Influence	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	0%	0%	0%	0%	4%
2	0%	6%	0%	25%	7%
3	33%	24%	16%	42%	14%
4	67%	35%	35%	0%	4%
5	0%	35%	48%	33%	71%
Total	100%	100%	100%	100%	100%
N	3	17	35	24	35

Table 6-20. Program Influence – Union Gas

Program Influence	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	0%	0%	0%	0%	50%
2	0%	10%	0%	20%	25%
3	0%	30%	67%	60%	25%
4	0%	50%	0%	20%	0%
5	100%	10%	33%	0%	0%
Total	100%	100%	100%	100%	100%
N	6	11	3	5	5

Importance. Point [F] in Figure 5-1 represents several questions on the importance of several program components or types of assistance in the participant's decision to install energy efficiency equipment. The maximum score among those questions is carried forward in the calculation where 1 is "not at all important" and 5 is "very important". The maximum score by sector is shown in the following tables.

EGD Notes: Over half of the Agriculture respondents had an importance score of 3 or less, with lower numbers correlated with higher free ridership. This was significantly lower than the other sectors. The industrial scores were lower than multifamily and new construction.

Union Gas Notes: Commercial retrofit importance scores were significantly lower than the other sectors. Industrial importance scores were higher than the other sectors.

Table 6-21. Program Importance – EGD

Importance	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	11%	0%	0%	0%	3%
2	11%	0%	0%	0%	3%
3	33%	22%	0%	4%	16%
4	22%	26%	14%	38%	3%
5	22%	52%	86%	58%	76%
Total	100%	100%	100%	100%	100%
N	9	23	56	24	44

Table 6-22. Program Importance – Union Gas

Importance	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	0%	0%	7%	0%	37%
2	22%	0%	7%	8%	21%
3	0%	6%	13%	17%	5%
4	0%	50%	13%	75%	16%
5	78%	44%	60%	0%	21%
Total	100%	100%	100%	100%	100%
N	8	19	17	12	20

6.3.4 Summary

The following table summarizes the top-level information from the previous tables. It indicates which questions are driving the results for each of the sectors with relatively high free ridership rates.

Table 6-23. Summary of Sector-Specific Questions on High Free Ridership Sectors

Label in Text	EGD Industrial	EGD Agriculture	Union Gas Industrial	Union Gas Commercial Retrofit
Direct Measure Level				
Likelihood and/or Share	High	High	High*	High
Months of Early Replacement				
Direct Project Level				
Best Estimate of Savings	Low	Low	Low	Low
Program Influence Project Level				
Planning			Medium High*	High
Influence	Medium	Medium	Low	High
Importance	Medium	High	Low	High

High = Answers strongly supported the relatively high free ridership scores for these sectors.
High = High for the very largest industrial participants.*
Medium = Answers somewhat supported the relatively high free ridership scores for these sectors.
Low = Answers tended to bring down the free ridership scores for these sectors compared to other sectors.
Blank = Answers neither support nor contradict the free ridership scores.

EGD Summary. The high EGD industrial free ridership results are driven by high scores in the Likelihood and/or Share questions with support from the Influence and Importance questions. The high EGD agriculture free ridership results are driven by high scores in the Likelihood and/or Share and Importance questions with support from the Influence questions.

The EGD commercial retrofit has a relatively low free ridership rate at 12%. This sector had scores corresponding to low free ridership rates on four of the six main questions examined:

- Likelihood and/or Share: One of the lowest free ridership scores.
- Best estimate of savings: One of the highest estimates with 42% saying 100%
- Influence: The highest score (corresponding to a low free ridership rate), with 71% with a score of 5
- Importance: The second to the highest score (corresponding to a low free ridership rate), with 76% with a score of 5.

Union Gas Summary. The Union Gas commercial retrofit respondents show answers correlated with high free ridership results across most questions examined, except the Best Estimate of Savings.

The Union Gas industrial free ridership results are driven by the responses of a small number of very large industrial participants, who are significantly larger than the other Union Gas industrial participants (based on gross m^3 savings). The scores of these large participants on the Likelihood and/or Share and Project Planning questions were the primary drivers in their high free ridership scores.

6.4 Free Ridership, Spillover, and Net-to-Gross from Other Jurisdictions

Free ridership, spillover, and net-to-gross ratios from other jurisdictions can put the Union and EGD results in context.

The Database for Energy Efficiency Resources (DEER) is one commonly-cited source for free ridership numbers. DEER developed by the California Public Utilities Commission and the California Energy Commission, with support and input from the Investor-Owned Utilities and other interested stakeholders. The net-to-gross ratios in DEER take only free ridership into account and not spillover. As of late 2006 the DEER net-to-gross rates were as follows:[40]

0.83	Commercial and agricultural information, tools, or design assistance services
0.80	Default
0.96	Express Efficiency (rebates)
0.83	Energy Management Services, including audits (for small and medium customers)
0.74	Industrial Information and Services
0.70	Large Standard Performance Contract
0.80	All other nonresidential programs

[40] DEER is currently being updated and is off-line as of this writing. The original source of these numbers was : http://eega.cpuc.ca.gov/deer/Ntg.asp.

In 2006, Summit Blue researched the free ridership and spillover rates that have been found in studies in recent years. The results of that benchmarking exercise are presented in the following pages (with some slight updates from studies we are aware of that occurred since 2006). The 79% net-to-gross ratio for EGD is in the same range as several of the programs examined. The 56% ratio for Union Gas is lower than those found in this research.

Table 6-24. Results from Other Jurisdictions

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
California	PG&E	Advanced Performance Options (All Measures)	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: HVAC Technologies PG&E Study ID number: 333B	1999		Commercial	Adjustable Speed Drives, Water Chillers, Customized EMS, Convert to VAV, Other Custom Equipment, Other HVAC Technologies	0.46	0.21	0.75
California	PG&E	Commercial Energy Efficiency Incentives Program: Lighting Technologies	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: Lighting Technologies PG&E Study ID number: 333A	1999	This evaluation covers indoor lighting technology retrofits that were rebated during 1997. These retrofits were performed under three different PG&E programs: the Retrofit Express (RE), Customized Efficiency Options (CEO) and Advanced Performance Options (APO) Programs.	Commercial	Lighting	0.24	0.05	0.82
California	Southern California Edison	Non-Residential Financial Incentives Program	Evaluation of the Southern California Gas Company 2004-05 Non-Residential Financial Incentives Program June 7, 2006	2006	The program focuses on small to medium nonresidential gas customers served under core rate schedules. The program incorporates technical support, education, training, outreach, contractor referral, prescriptive rebates and equitable financial incentives through three program elements.	Small and Medium Commercial, Agricultural, and Industrial		0.3	10% (not evaluated, just an estimate)	0.8
California	PG&E	Retrofit Efficiency Options Program	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: HVAC Technologies PG&E Study ID number: 333B	1999	The REO program targeted commercial, industrial, agricultural, and multi-family market segments. Customers were required to submit calculations for the projected first-year energy savings along with their application prior to installation of the high efficiency equipment. PG&E	Commercial, Industrial, Agricultural, and Multifamily	Adjustable Speed Drives, Water Chillers, Cooling Towers	0.46	0.21	0.75

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
					representatives worked with customers to identify cost-effective improvements, with special emphasis on operational and maintenance measures at the customers' facilities. Marketing efforts were coordinated amongst PG&E's divisions, emphasizing local planning areas with high marginal electric costs to maximum the program's benefits.					
California	PG&E	Retrofit Express Program	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: HVAC Technologies PG&E Study ID number: 333B	1999	The RE program offered fixed rebates to customers who installed specific electric energy efficient equipment. It covered covers lighting, air conditioning, refrigeration, motors, and food service. Customers were required to submit proof of purchase with their applications in order to receive rebates. The program was marketed to small- and medium-sized commercial, industrial, and agricultural (CIA) customers.	Small and Medium Commercial, Industrial, and Agricultural Customers	Central A/C, Adjustable Speed Drives, Package Terminal A/C, Set-Back Thermostat, Reflective Window Film, Water Chillers, Other HVAC Technologies	0.39	0.21	0.82
California		SPC	2003 Statewide Nonresidential Standard Performance Contract (SPC) Program Measurement And Evaluation Study	2005	The program offered fixed-price incentives to project sponsors for kWh energy savings achieved by the installation of energy-efficiency measures. The fixed price per kWh, performance measurement protocols, payment terms, and other operating rules of the program were specified in a standard contract. PG&E and SDG&E also offer incentives for energy efficient gas measures.	Nonresidential	Lighting, lighting controls, VSDs, HVAC	49% / 59% / 35% / 55% / 41% (1999-2003)	5% (not evaluated, just an estimate)	63% (for 2002-2003)
Colorado	Xcel	Bid 2001 Program	Impact and Process Evaluation of the Bid 2001 Program	2003	Demand-side bidding program that acquires demand reductions by	Commercial and Industrial		0.36	0.06	0.7

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
					soliciting proposals for demand reduction projects from customers, and third-party bidders contractors. This program has subsequently been succeeded by the Custom Efficiency program.					
Colorado	Xcel	Custom Efficiency	Colorado Demand-Side Management Programs Impact, Cost-Effectiveness, Process, and Customer satisfaction Evaluations	2005	Launched on December 1, 2001, this program is a C&I DSM bidding program and successor to Bid 2001. The program's goal is to obtain reliable and verifiable electric demand reduction in Company's Front Range service territory. To participate, eligible customers and qualified providers of energy related services respond to RFPs seeking electric demand reduction projects within eligible facilities.	Commercial and Industrial		0.398	0.139	0.741
Massachusetts/ New Hampshire	National Grid	Accelerated Application Process	National Grid 2001 Commercial and Industrial Free-ridership and Spillover Study	2002				0.121	0.146	1.025
Massachusetts/ New Hampshire	National Grid	Comprehensive Project	National Grid 2001 Commercial and Industrial Free-ridership and Spillover Study	2002				0.154	0.109	0.955
Massachusetts/ New Hampshire	National Grid	Design 2000plus	National Grid 2001 Commercial and Industrial Free-ridership and Spillover Study	2002	The program offers technical assistance and financial incentives to large commercial and industrial customers who are building new facilities, adding capacity for manufacturing, replacing failed equipment or undergoing major renovations.	Large Commercial and Industrial	Motors, VFD, HVAC, Lighting, Custom	0.307	0.188	0.881
Massachusetts/ New Hampshire	National Grid	Energy Initiative Program	National Grid 2001 Commercial and Industrial Free-	2002	The program offers technical assistance and incentives to help large C&I customers	Large Commercial and Industrial	Motors, VFD, HVAC, Lighting,	0.096	0.111	1.015

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
			ridership and Spillover Study		purchase energy-efficient measures for their existing facilities.		Custom			
Massachusetts	NSTAR	Business Solutions	PY2002 Business Solutions Impact Evaluation for NSTAR Electric	2004	The program provides technical and financial assistance to NSTAR Electric's commercial, industrial, and institutional customers (except in Cape Light Compact territory) to facilitate the installation of energy saving equipment in existing buildings.	Commercial, Industrial, Institutional	Lighting, lighting controls, VSDs, HVAC, EMS, Refrigeration, Compressed Air, Motors	0.277	0.103	0.854
Massachusetts	NSTAR	Construction Solutions	Construction Solutions Program Year 2002 Impact Evaluation Final Report	2004	The program (previously the C&I New Construction Program) offers technical and financial assistance to design professionals and developers to promote the use of efficient design measures and electrical equipment in the construction, remodeling, or renovation of commercial and industrial buildings. The program also offers incentives to encourage the installation of energy efficient replacement equipment when existing systems fail during operation or at the time of purchasing new equipment.	Commercial and Industrial	Chillers, VSDs, Refrigeration, Lighting, Lighting Controls, Controls, Compressed Air	0.173	0.003	0.848
New York	NYSERDA	CIPP	Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation	2006	CIPP began in June 1998. It provides financial incentives to energy service companies (ESCos) and other contractors to promote energy efficiency capital improvement projects. Program objectives are to: 1) foster the growth of the ESCO industry in New York State and 2) encourage end-use customers to invest in energy-efficient equipment based on the potential	Commercial and Industrial	Lighting, EMS, motors and VSDs, unitary HVAC and chiller replacements, heat pump water heaters, Energy Star vending machines, custom measures with paybacks of greater than one year, including	0.35	0.58	1.04

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
					energy cost savings. Eligible energy efficiency measures must reduce electric energy consumption at the project site and this reduction must be measurable and verifiable. In addition, cost effective renewable energy measures and measures that reduce summer peak demand are eligible for funding consideration as custom measures whether or not electric energy consumption is reduced.		renewable measures and measures that reduce peak summer demand.			
New York	NYSERDA	New Construction Program (NCP)	New Construction Program (NCP) Market Characterization, Market Assessment, and Causality (MCAC)	2006	This comprehensive evaluation covered the period from program inception through year-end 2005. In late 2006, the MCAC Team was tasked with updating certain aspects of the earlier comprehensive evaluation effort. This report discusses the results of the update work.	Commercial and Industrial		0.40	0.85	1.22
New York	NYSERDA	Technical Assistance Program	Technical Assistance Program Market Characterization, Market Assessment And Causality Evaluation	2007	The Program provides customers with objective, customized information by funding detailed energy studies capable of facilitating better energy efficiency, energy procurement, and financing decisions.	Commercial and Industrial		0.27	0.44	1.17

7 CONCLUSIONS

The total free ridership rate across both utilities and all sectors is 48% as shown in Table 7-1. The free ridership rate for EGD is 41% and it is 54% for Union Gas. Summit Blue recommends that the utilities use the utility-specific total free ridership values of 41% and 54% as the best estimate of free ridership. Those results are based on larger sample sizes than the sector-specific results and proved more stable in the sensitivity analysis. The sector-specific results are based on smaller sample sizes and should only be used to support program management, for example to support targeting and marketing decisions.

Table 7-1. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

Summit Blue recommends the utilities use following spillover rates:

Table 7-2. Spillover Results

Spillover Type	EGD	Union	Base
Participant Inside Spillover	5%	5%	Of gross reported savings
Participant Outside Spillover	5%	5%	Of gross reported savings
Audit-Only Spillover	35%	0%	Of gross audit-recommended savings
Nonparticipant Spillover	0%	0%	

Summit Blue recommends the utilities use the following net-to-gross ratios, reflecting both free ridership and spillover:

Table 7-3. Net-to-gross Results

	EGD	Union
Net-to-gross ratio	79%	56%

Appendix A. Revised Analysis Plan

Appendix B: Survey Instruments

APPENDIX A

CUSTOM PROJECT FREE RIDERSHIP AND SPILLOVER STUDY ANALYSIS PLAN

FINAL

Submitted To:

Union Gas Ltd.

Enbridge Gas Distribution Inc.

January 15, 2008
Annotated July 28, 2008 to reflect decisions made for the final calculations.

SUMMIT BLUE
CONSULTING, LLC

Submitted to:

Christine Zivanov	Judith Ramsay
Union Gas Ltd.	Enbridge Gas Distribution Inc.
777 Bay St., Suite 2801	500 Consumers Road
P.O. Box 153	P.O. Box 650
Toronto, ON M5G 2C8	North York, ON M2J 1P8

Submitted by:

Summit Blue Consulting, LLC	Summit Blue Canada, Inc.
1772 14th Street, Suite 230	P.O. Box 25057
Boulder, Colorado 80302	Toronto, Ontario M6S 4M4

Contacts:

Jeff Erickson	Gay Cook
608-245-2585	416.604.9393
jerickson@summitblue.com	gcook@summitblue.com

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Note: The analysis plan presented here has changed from the original approved plan in two ways:
1. Assumptions left undefined in the original plan were finalized.
2. Some details of the free ridership calculation had to be changed to appropriately adjust to realities in the actual data.

INTRODUCTION

This document presents the detailed analysis plan that will govern the free ridership and spillover study for the Custom Projects programs implemented by Enbridge Gas Distribution and Union Gas. This document will present the planned survey and analysis approach and sample design for three surveys:

1. Participant and Trade Ally survey covering free ridership and spillover

2. Participant Audit-Only survey covering spillover

3. Nonparticipant Survey covering spillover.

Finally, this document will outline the final report.

Approach Overview

Free ridership and spillover will be estimated using data from surveys with participants, nonparticipants, trade allies, and utility staff. This approach is based primarily on participant self-reported information along with other perspectives to triangulate the net-to-gross estimates. It is the most common and generally accepted approach to measuring free ridership and spillover in a commercial and industrial energy efficiency program.

Experienced utility industry consultants will personally conduct the interviews and most will be done on-site. This is standard practice for our firm where estimating attribution[1] is a primary objective of the research. Typically the internal champion in an industrial firm will have the most complete information on influences, and this information can best be extracted in an in-person interview which encourages the free flow of significant information.

To address the possibility of respondent bias, the interviews will approach each topic from a variety of directions. The interviewer has the discretion to probe for supporting information and the analysis process checks for consistency across answers. Interviewees will be promised confidentiality and assured that their answers will not affect the incentives or support they have received from the program. To address the possibility of interviewer bias, each interviewer will be trained in the purpose of the research and the importance of objectively probing and recording responses. Three different interviewers will perform the interviews and the data from their interviews will be compared to look for uneven application of the methodology. The interviewers chosen for this effort each have a long history of tackling evaluation projects from an objective point of view.

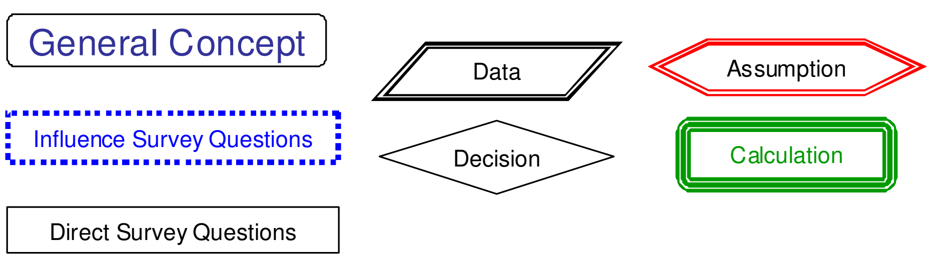
[1] In this study and Analysis Plan, "attribution" is defined as the combined program market influence of free ridership and spillover.

Introduction to the Flow Diagrams

The description below contains references to diagrams of the flow of survey questions and analysis logic shown after page 7. The first diagram (Figure 3) shows a high-level overview of the analysis and survey logic. The revised version of Figure 3 shows revisions to the general approach and the weights given to various parts of the analysis in the calculations used to produce the final, recommended results. Figures 4 through 6 show the direct question sequence with Figure 4 showing the measure-level approach, Figure 5 the project-level approach, and Figure 6 the combined approach. Figure 7 shows the program influence sequence, and Figure 8 shows the combination of the direct and program influence sequences to produce the final results.

Key points in the diagrams are labeled with bold, large numbers and letters. Those labels are referred to in the text in brackets, e.g., [1] [2] [A] [B]. Key assumptions in the logic are noted in the text with bold, italics set off by < > symbols (e.g., ***<Average>***). Key assumptions in the diagrams are noted with the figure labeled "Assumption" shown in the key in Figure 1.

Figure 1. Key to Symbols in the Analysis Diagrams



PARTICIPANT SURVEY – FREE RIDERSHIP

This section will first outline the survey and analysis approach for the participant and trade ally survey, covering the free ridership aspect, and then discuss the sample design.

Participant and Trade Ally Survey and Free Ridership Analysis Approach

We will design and implement surveys with participating end users and trade allies (Channel Partners for Union Gas and Business Partners for Enbridge) to measure free ridership and spillover. The discussion that follows is largely written with the participants in mind. The survey for the trade allies follows the same general logic and they will be asked for their opinion on the impact of the program on specific participants. (The spillover approach will be discussed in the following section.)

Figure 3 presents an overview of the survey and analysis approach. Free ridership will be discussed with each respondent in both **direct questions** aimed at obtaining respondent estimates of the appropriate (full or partial) free ridership rate to apply to them, and in **supporting or influencing questions** used to verify whether direct responses are consistent with participants' views of the program's influence on their equipment investment decisions. The direct questions will be asked at the measure level and at the whole project level. They will then be combined into a single, project-level direct free ridership score. Direct and program influence scores are combined into the final project-level free ridership score. That project-level score is weighted by program-reported savings to calculate the final savings-weighted free ridership percentage. Each of these steps is explained in more detail below, corresponding to the diagrams following Figure 3.

Direct Free Ridership Questions

The direct free ridership questions are posed first for each major category of measures that were reported to the program (*e.g.,* HVAC, building controls, process technologies) (Figure 4), and then for the project as a whole (Figure 5). The measure-level and project-level results are combined in the analysis (Figure 6). For the measure-specific questions, respondents are first asked when, if at all in the foreseeable future, they would have replaced existing equipment or installed new equipment if not for the technical and financial assistance of the program (Figure 4 [1]).

Respondents are then asked to estimate the *likelihood* that they would have incorporated measures "of the same high level of efficiency" if not for the financial and technical assistance of the program (Figure 4 [4]). In cases where respondents indicate that they may have incorporated some, but not all, of the measures, they are asked to estimate the *share of measures* that would have been incorporated anyway at the same level of high-efficiency. This flexibility in how respondents could conceptualize and convey their views on free ridership allows respondents to give their most informed answer, thus improving the accuracy of the free ridership estimates.

Additional direct project-level free ridership questions are then asked to obtain a lower bound, an upper bound, and a best estimate of overall energy savings attributable to the program across all measure categories (Figure 5 [10, 11, 12]). These questions focus on incremental savings from incorporating high-efficiency equipment or controls instead of standard-efficiency equipment and controls. The questions are asked after measure-specific questions so respondents have the decisions they made on individual measures fresh in their minds. Asking respondents about a lower and an upper bound has been successfully used by Summit Blue in several past net-to-gross studies to help respondents narrow down the possible range of free ridership values before making a best estimate.

Program Influence Questions

The **"program influence"** questions (Figure 7) are designed to clarify the role that program interventions (*e.g.*, technical assistance and financing) played in decision-making, and to provide supporting information on free ridership. Questions address the following topics:

- Figure 7 [A] – The importance of features of the program in the decision to incorporate high-efficiency measures in the project. The dimensions include the following:
  - program technical assistance
  - program financial assistance
  - ongoing relationship with the utility (providing impartial advice and facilitating unbiased contacts, e.g., business partners)
  - utility education activities
    - providing best practice information through case studies, as well as specific industry adoption, proven track records, operating experience to help instill confidence etc.
    - training, workshops, and seminars to improve the general or specific knowledge and competencies of customers
    - on-going advertisements re: energy efficiency to heighten customer awareness and concerns

  - promotion of energy efficiency at conferences, trade shows and other industry events

- Figure 7 [B] – The influence of the program on the type or efficiency level of the measures, or the amount of high-efficiency measures, incorporated into the project.
  - Figure 7 [B1] – Each respondent indicating some degree of program influence was asked to describe how the program influenced the decision to install high-efficiency equipment in the project.

- Figure 7 [C] – The customer's plans (or lack thereof) to incorporate the energy efficiency measures included in the project prior to participating in the program.
  - Figure 7 [C1] – Each respondent indicating any degree of planning for high efficiency prior to participating in the programs is asked to describe these plans in detail and is asked for the equipment type, timing, quantity, and efficiency, as well as for any prior budgeting for the high efficiency equipment.

Program influence questions are both closed-ended and open-ended and may require probing by experienced interviewers to elicit complete responses that accurately reflect the level of program influence. If the responses are inconsistent across the three types of questions, the interviewer will probe to attempt to resolve the inconsistency (Figure 7 [J]). Some responses to open-ended questions are quantitatively scored by interviewers using a pre-prepared scoring guide (Figure 7 [G][H]), while other questions ask respondents directly to quantify program influence (Figure 7 [F]).

Using the Participant and Trade Ally Survey Responses to Estimate Free Ridership

Direct Free Ridership Estimate

The direct free ridership estimate is based on both the measure-specific questions and the "whole project" questions. For each measure category for which the respondent had installed equipment through the program, the survey collects information on when, if ever, the equipment would likely have been installed (Figure 4 [2]) and the *likelihood* that the same high efficiency equipment would have been used, or the *share of high-efficiency measures* that would have been installed (Figure 4 [4]). The response to the likelihood/share-of-measures questions are used as the initial free ridership value for the measure category (Figure 4 [7]). This value is then discounted if the respondent indicated that the program influenced them to install the equipment more than one year earlier than they otherwise would have (Figure 4 [6]). The specific discount values (*i.e.,* adjustment multipliers), when defined, will likely follow the outline presented in Table 1.

Options for the specific discount values (*i.e.,* adjustment multipliers) have not yet been determined. The history and critique task will look for precedents in the field in this area and specific values will then be developed.

Enbridge Gas Distribution designates some projects as "advancement". For "advancement" projects, the TRC calculation already discounts the TRC benefits to account for the period which the program has moved projects forward in time. However, there is no need to modify the survey and analysis to take this into account and Enbridge and Union customers will be asked the same questions, including the timing questions.

Table 1. Early Replacement Adjustment Multipliers

Early Replacement ***Within ____ years of program participation***	Adjustment Multiplier <Assumption>	Early Replacement ***Within __ months of program participation***	Adjustment Multiplier <Final>
Within ___ Months	100%	Within 12 Months	100%
__ Months to __ years	__%	13 to 24 months	75%
__ to __ years	__%	25 to 36 Months	50%
__ to __ years	__%	37 to 48 Months	25%
More than __ years	0%	More than 48 Months	0%

Each measure category is also assigned an energy savings value (in cubic metres (m^3)) from the gas savings recorded for that respondent in the program database (Figure 6 [16]). The direct free ridership estimate for each measure category (after any adjustment for early replacement) is weighted according to the relative savings from the category to determine a weighted average free ridership estimate across all measures (Figure 6 [17]). As it turned out, measure-specific gas savings values were not available for the sample period under examination so this adjustment could not be made and the measure adjusted free ridership value [9] fed straight through to the weighting calculation in [18].

A second direct free ridership estimate is determined based on answers to the direct free ridership questions regarding the lower bound (Figure 5 [12]), upper bound [11], and best estimate [10] of the overall energy savings attributable to the program across all measure categories. If a "best estimate" is provided, this value is used as a second direct free ridership estimate (Figure 5 [14]) in addition to the measure-based estimate discussed above. If a "best estimate" is not provided, the midpoint between the lower and upper bound is used (Figure 5 [13]).[2] The final direct free ridership estimate (Figure 6 [21]) is the ***<weighted average>*** (Figure 6 [20]) of the measure-based estimate [17] and the "best estimate" [14]. If sufficient information is available for only one of these values, then this value is used as the final direct free ridership estimate. ***<Equal weight>*** will be given to the measure-specific and best estimate values to calculate the final direct free ridership estimate (Figure 6 [18][19]). In the final approach, the best estimate values were given three times the weight of the measure-specific estimates.

Program Influence Free Ridership Estimate

As previously discussed, additional questions are included in the surveys to support an analysis of the consistency of responses. Responses to these "program influence" questions are used to adjust the direct free ridership estimates using objective criteria described below. Adjustments are made to individual respondents' free ridership estimates—not to the aggregate free ridership value across respondents. **Adjustments are only made if the respondent's direct free ridership score is beyond the bounds that could reasonably be expected based on responses to the influence questions.** Specifically, the process for whether and by how much to adjust a respondent's direct free ridership estimate is as follows:

Step 1. Calculate an *<average>* program influence score (Figure 7 [L]) (on a 5-point scale) from the scores assigned to the three sets of program influence questions regarding program's importance (Figure 7 [A]), influence of the program [B], and project planning [C]. In the final approach, the importance score [F] was given three times the weight of the Influence [G] and Planning [H] scores (as shown in the revised Figure 3). The ***<maximum score>*** [E] for the program influence dimensions is carried forward in the calculation [F]. A higher score for program influence and importance suggests greater program

[2] Previous research showed that the average "best estimate" was within 3 percentage points of the midpoint.

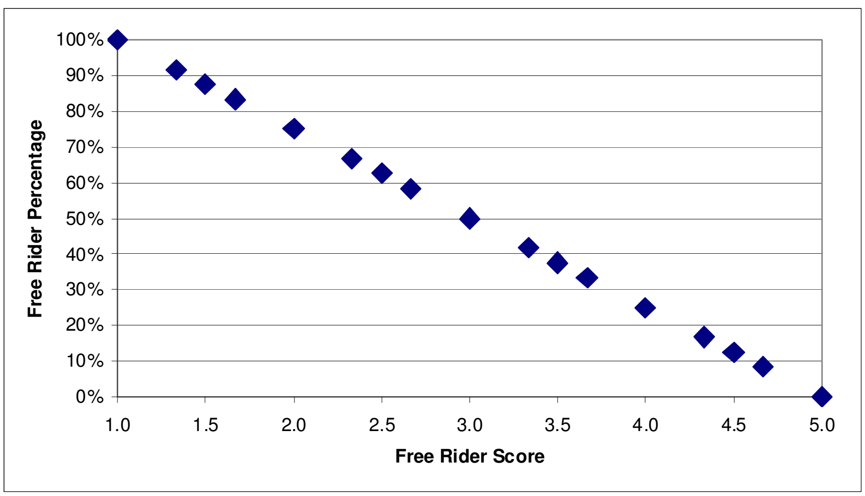
impact, but a higher score for planning indicates lower impact. Therefore, prior to calculating an average score across the three sets of questions, the planning score is inverted so that 1=5, 2=4, etc. In this way, a higher average score across these questions unequivocally represents greater program impact. If the participant's contractor was the most significant influence [D], ***<the results of the trade ally survey will determine the free ridership score>*** [I].

Step 2. Translate the program influence score into a free ridership rate. The influence score has to be converted into a free ridership rate (Figure 7 [M] to [N]) to be used in subsequent calculations. The assumption governing the conversion is that ***<the relationship should be linear>*** with an influence score of 5 converting to 0% free ridership and an influence score of 1 converting to 100% free ridership (see Table 2 and Figure 2).

Table 2. Translate Influence Score to Free Ridership Percentage *<Assumptions>*

Average Influence Score	1.00	1.33	1.50	1.67	2.00	2.33	2.50	2.67	3.00	3.33	3.50	3.67	4.00	4.33	4.50	4.67	5.00
Free ridership	100%	92%	88%	83%	75%	67%	63%	58%	50%	42%	38%	33%	25%	17%	13%	8%	0%

Figure 2. Translate Influence Score to Free Ridership Percentage



<u>Step 3.</u> Define reasonable bounds for the program influence score (Figure 7 [P][Q]). These bounds are intended to reflect the range of free ridership values that could reasonably characterize a project based on a respondent's answers to the program influence questions. For example, if a respondent's program influence score is the maximum possible value of 5.0 (implying that the program was very influential), then a reasonable free ridership value would be as low as 0% and ought to be no higher than 50% to be logically consistent. The width of the range that defines the reasonable bounds (50% in this example) will be identified in the data analysis phase. A reasonable bounds width ought to cause a reasonable number of scores to be adjusted by this step, which probably means less than a third of the scores but more than 5%. Exactly what that "reasonable number" should be can only be determined by examining the results.

Adjusting Direct Estimate with the Influence Estimate

The upper and lower bound estimates derived from the program influence questions are used to adjust the direct free ridership estimate. ***<If the direct free ridership value falls outside of the bounds, then it is***

adjusted to a final free ridership estimate equal to the closest lower or upper bound value> (Figure 8 [AA]). Thus, if the direct free ridership value is higher than the program influence upper bound, then the upper bound is used as the final free ridership value. Conversely, if the direct free ridership value is lower than the program influence lower bound, then the lower bound is used as the final free ridership value.[3] This creates the influence-adjusted, customer-specific final free ridership estimate (Figure 8 [BB]). In the final analysis, because the final direct project level free ridership rate [21] was almost always significantly different from the program influence score [N], the influence upper [Q] and lower bounds [P] had to be very wide or the vast majority of scores were adjusted to the influence bounds. As this gave too much weight to [N], it was decided that a more appropriate approach was to average [21] and [N]. In the final results, [N] and [21] were given equal weights (also shown in Figure 3).

Scaling Customer-Specific Results to the Population

The customer-specific free ridership results are scaled up to the population using project-level energy savings to create a savings-weighted free ridership result (Figure 8). The customer-level free ridership score is multiplied by the customer-level gross energy savings [CC] to calculate customer-level net free rider savings [EE]. The gross and net savings are summed up across all customers and then net savings divided by gross savings produces the final savings-weighted, program-wide free ridership result (Figure 8 [GG]). (Segment-level strata weights, if any, are applied during this step [FF] to calculate the final results.)

[3] The actual calculation shown in the diagram is: Maximum(Lower bound, Minimum(Upper bound, direct free ridership result)).

Figure 3. Free Ridership Analysis – Overview – Original

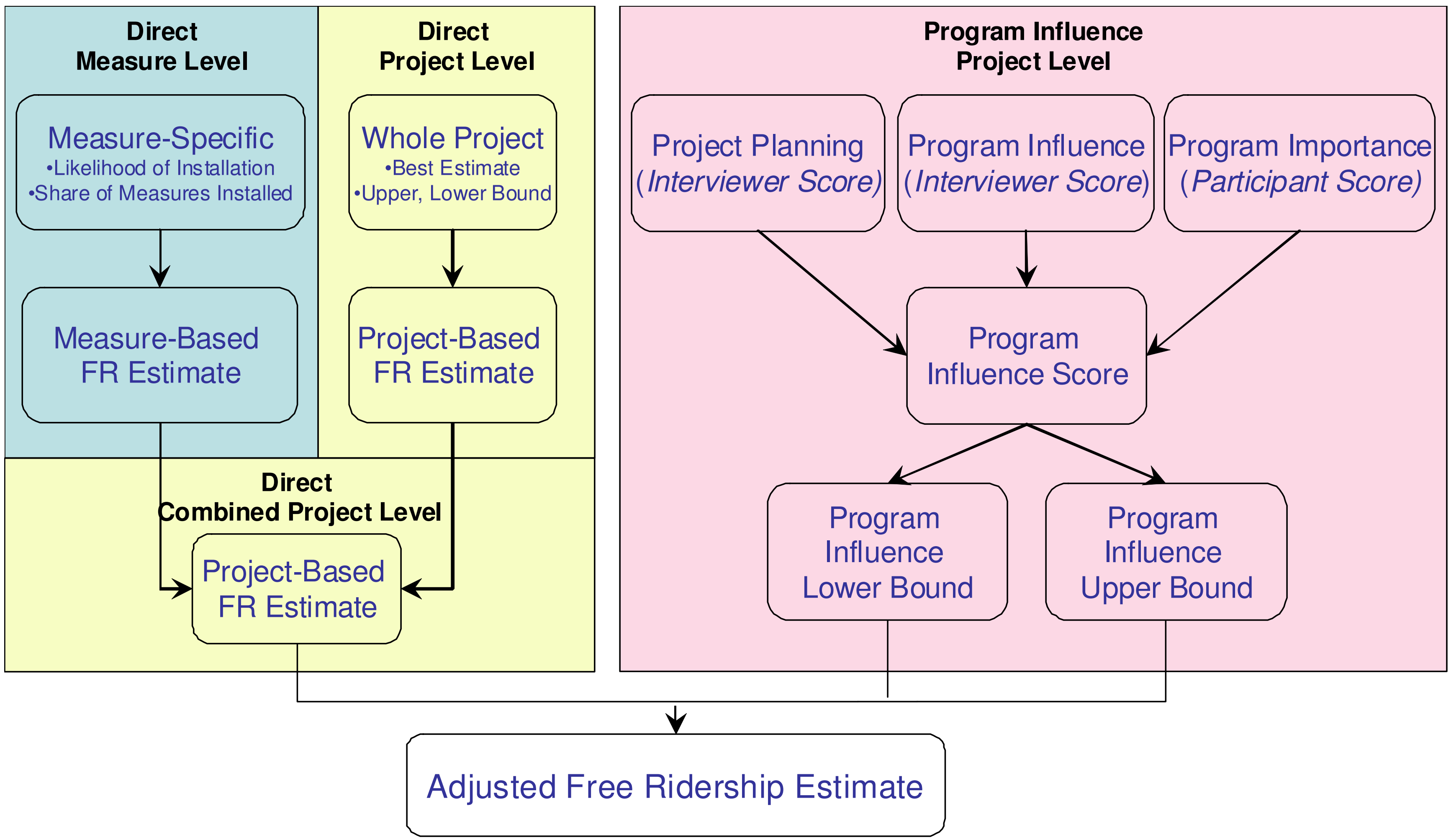


Figure 3. Free Ridership Analysis – Overview – Final Approach

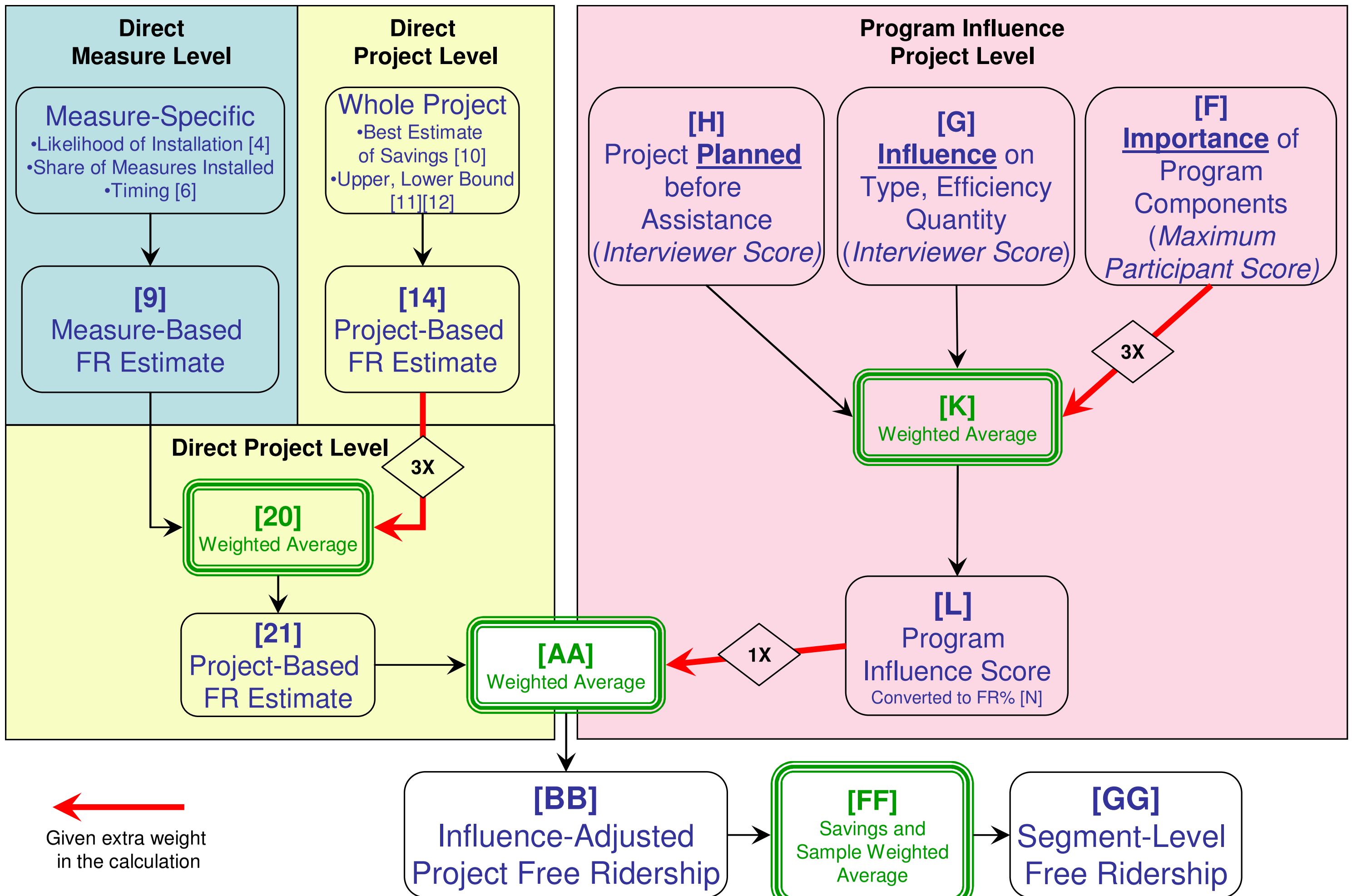


Figure 4. Free Ridership Analysis – Direct, Measure Level

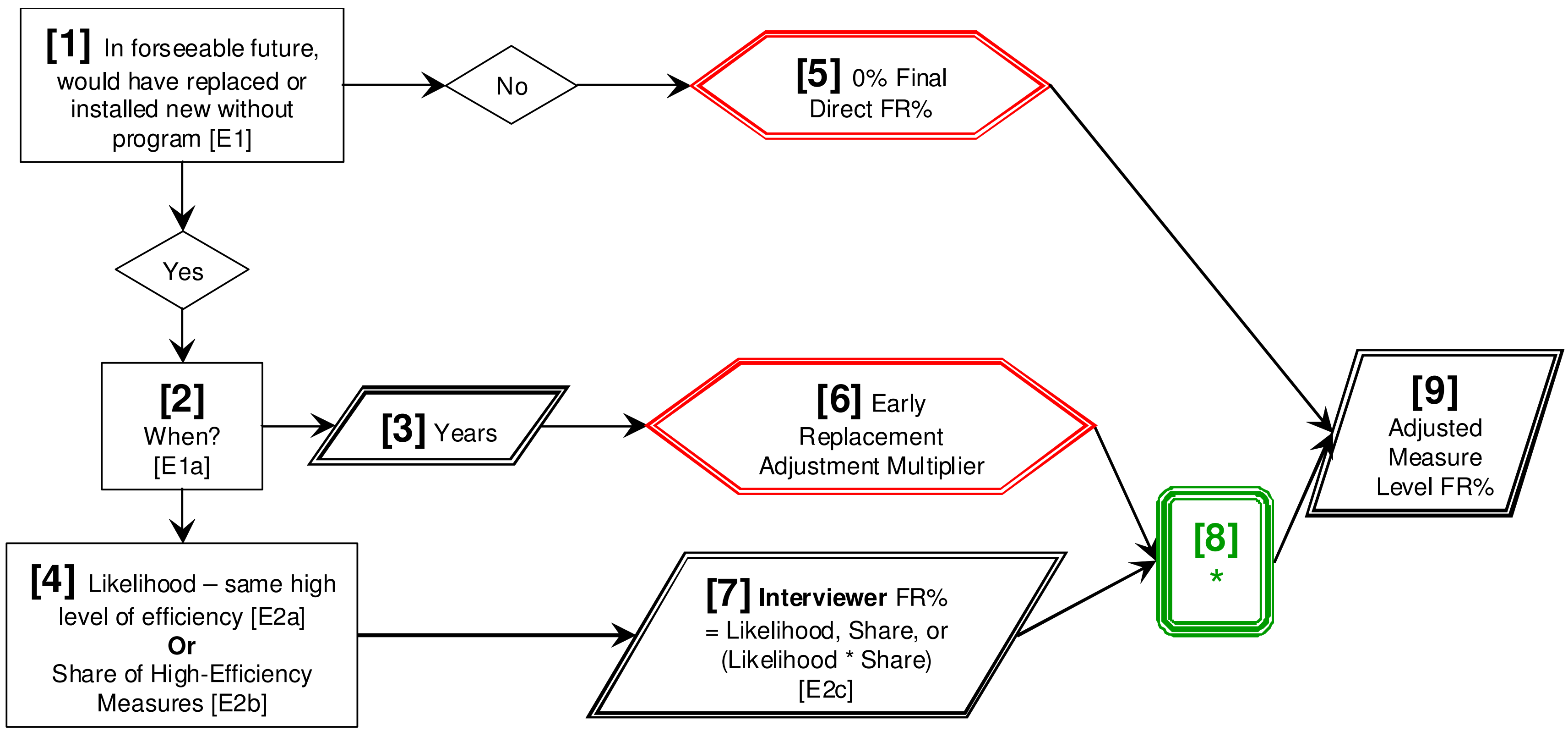


Figure 5. Free Ridership Analysis – Direct, Project Level

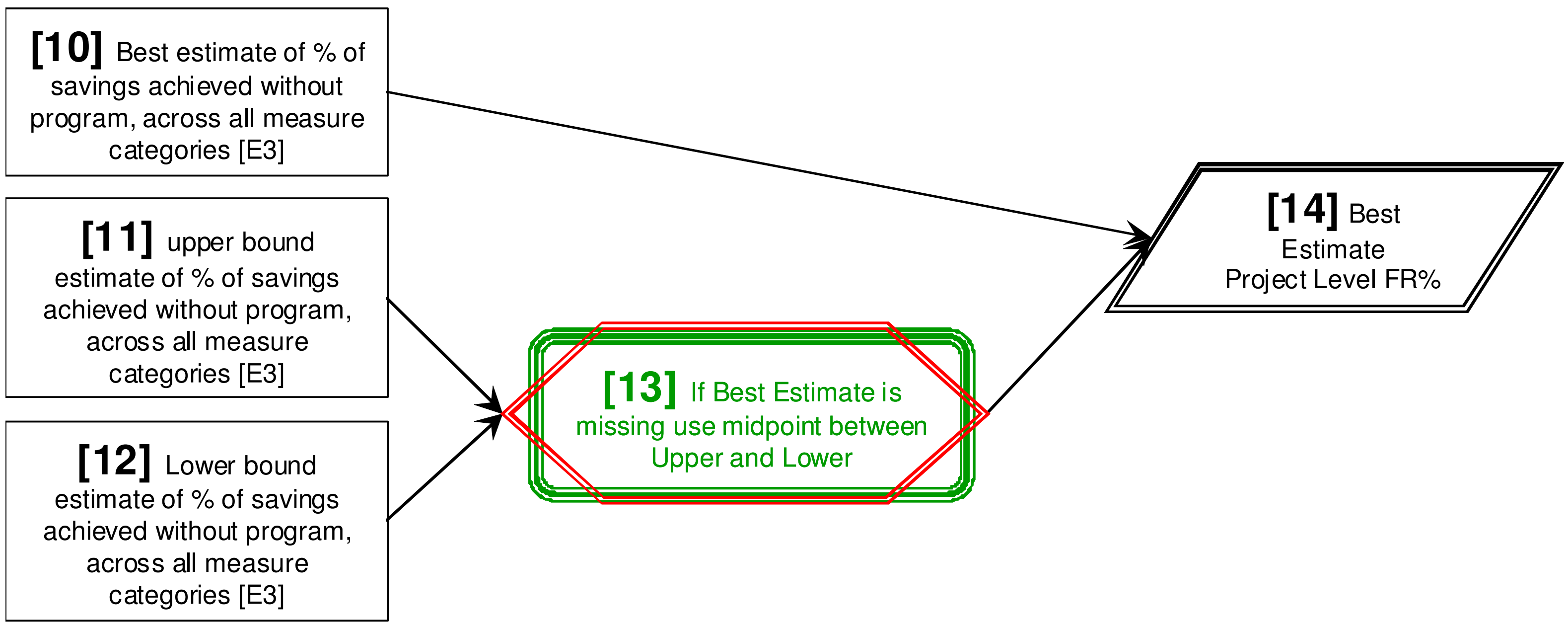


Figure 6. Free Ridership Analysis – Direct, Combined Project Level - Original

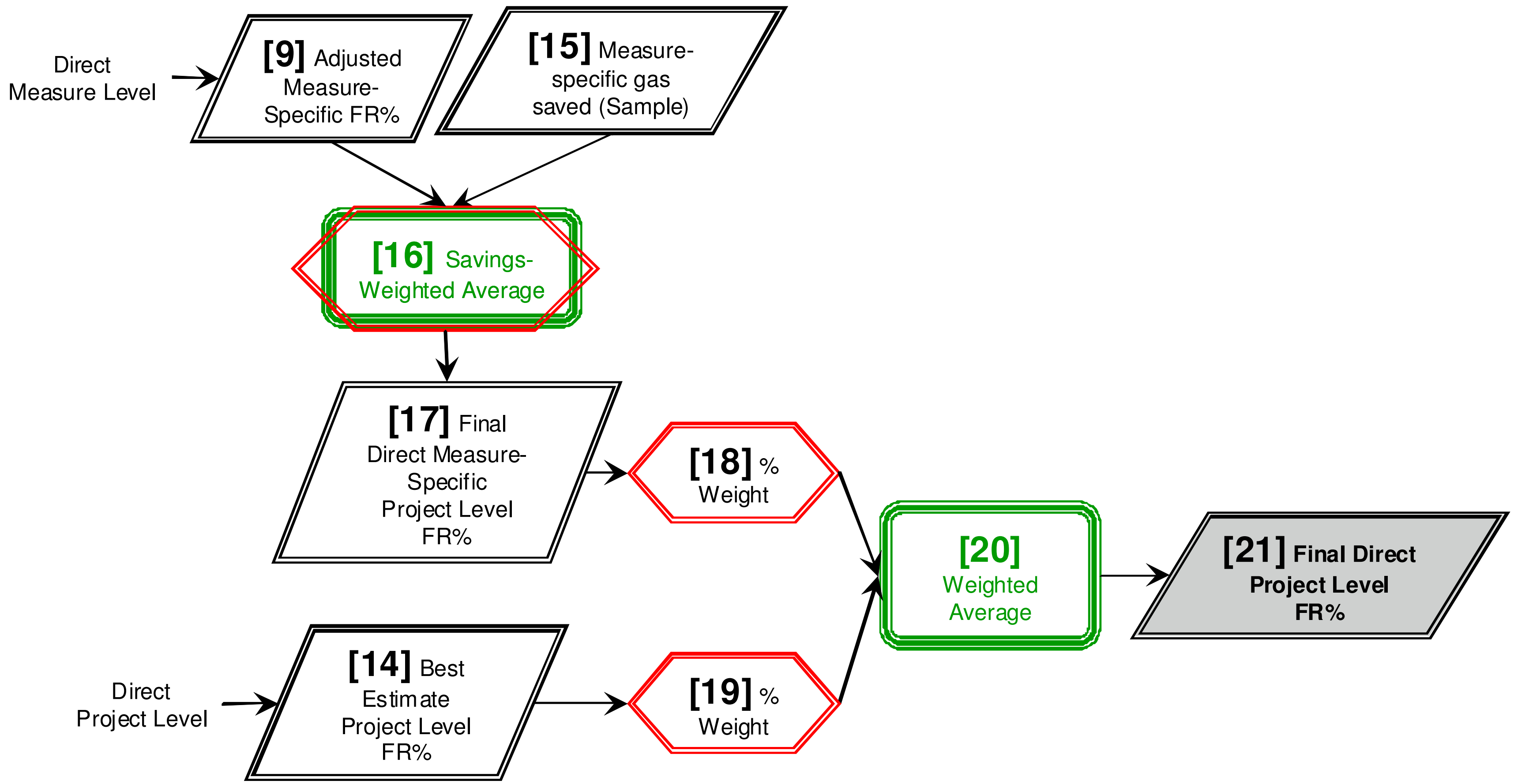
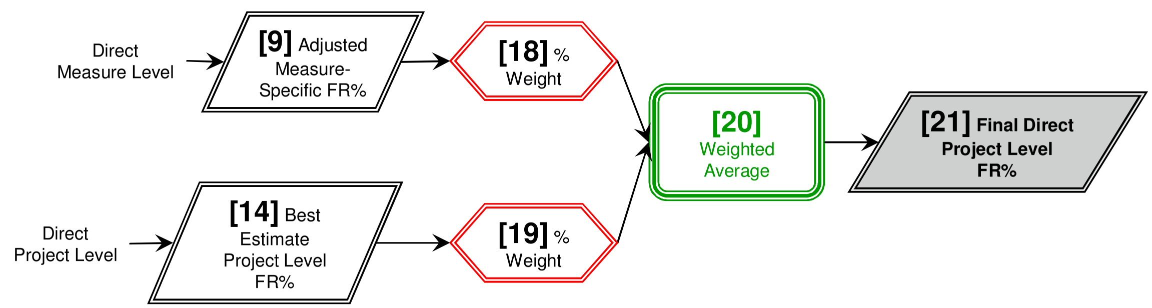
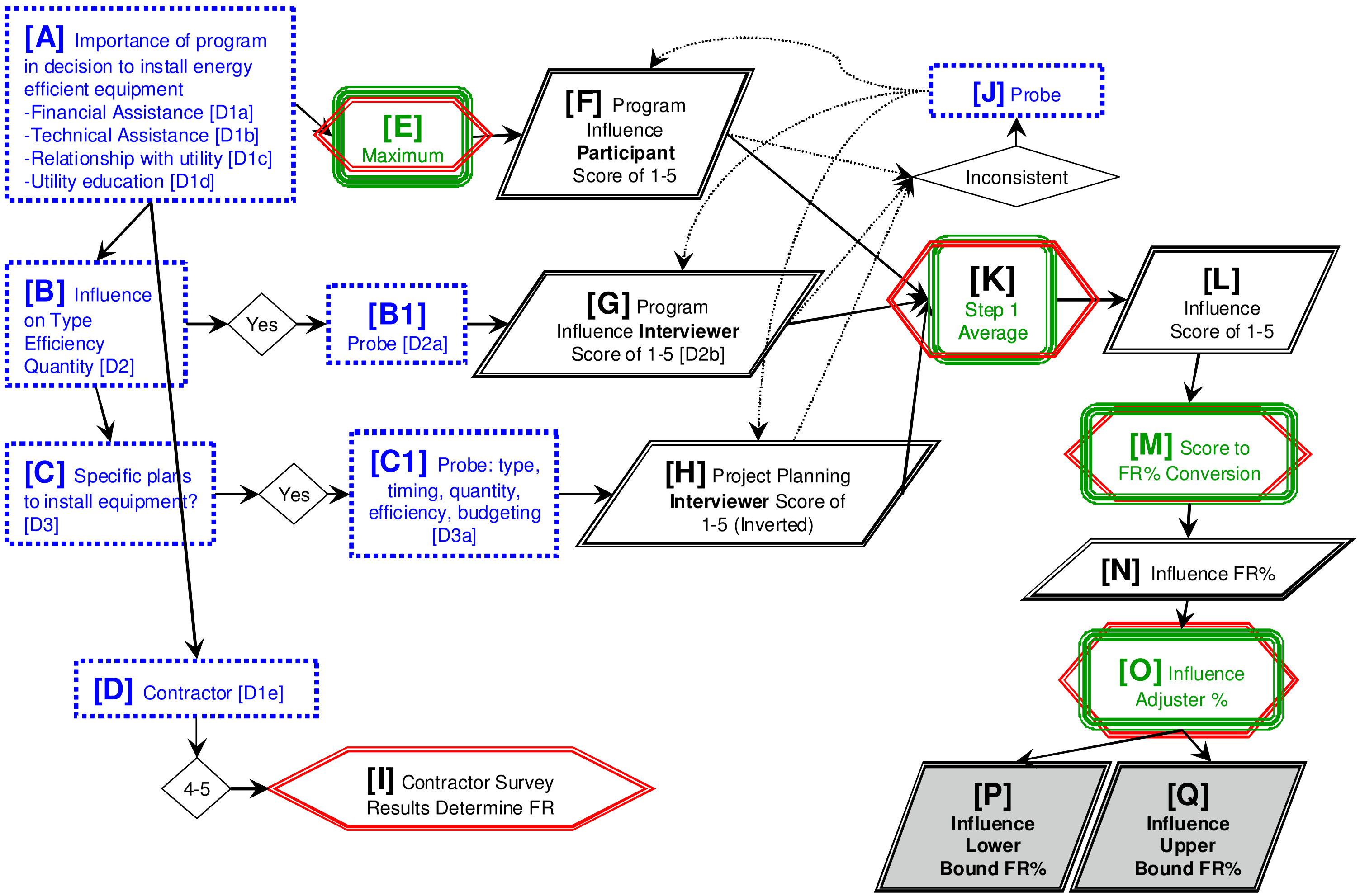


Figure 6. Free Ridership Analysis – Direct, Combined Project Level – Revised



Changes: Measure-specific gas savings values were not available so [9] fed straight through to [18].

Figure 7. Free Ridership Analysis – Program Influence, Project Level



Changes: Boxes [O], [P], and [Q] were deleted. See discussion on the following pages.

Figure 8. Free Ridership Analysis – Combined Direct and Program Influence Results - Original

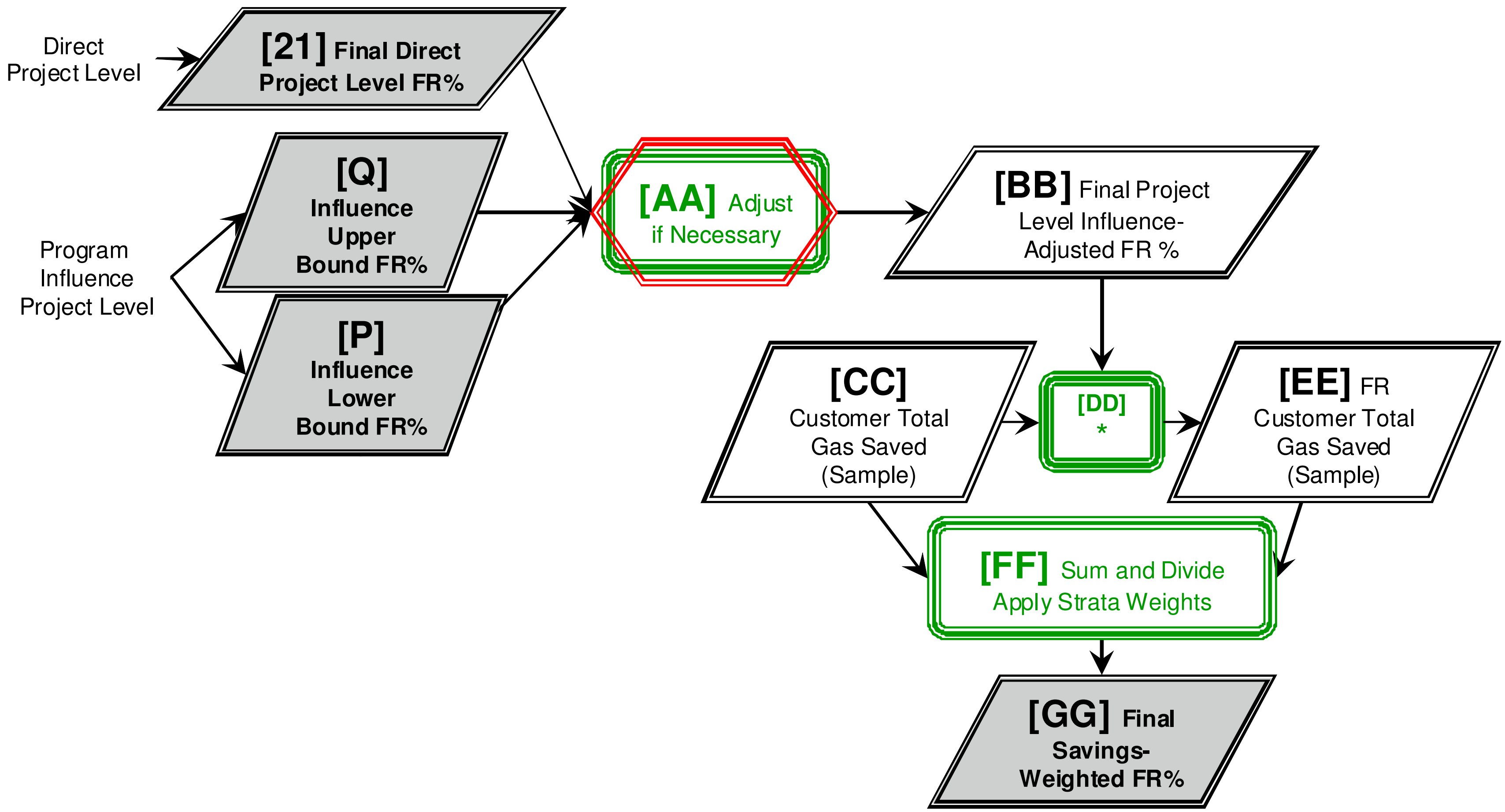
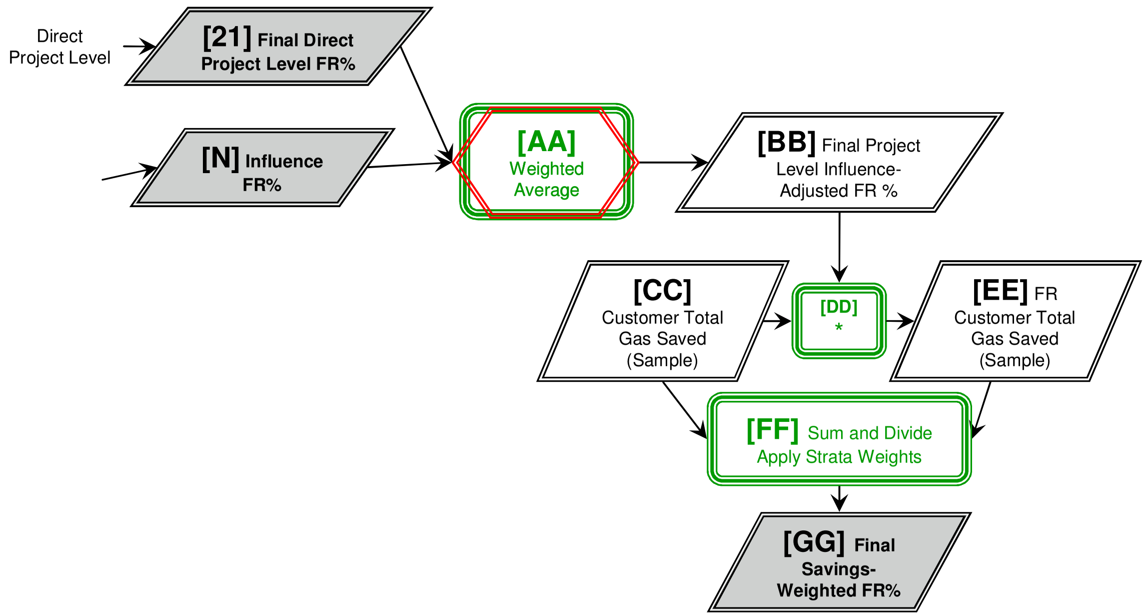


Figure 8. Free Ridership Analysis – Combined Direct and Program Influence Results - Revised



Changes: Because [21] was almost always significantly different from [N], the influence upper [Q] and lower bounds [P] had to be very wide to incorporate [21], which gave too much weight to [N]. It was decided that a more appropriate approach was to average [21] and [N].

Participant and Trade Ally Survey Sample Design

The budget for this study is designed to produce results at 90% confidence level at +/- 20% precision at the segment level with five segments per utility and 90% confidence level at +/- 10% precision at the utility level. The budget is based on the assumption that we will complete 17 surveys per segment per utility, covering a total of 170 projects. Since the total number of surveys that would be completed at 90/20 precision with 5 segments is more than that needed to produce 90/10 precision at the utility level, the budget should be sufficient to produce both 90/20 precision at the segment level and 90/10 precision at the utility level. Some extra surveys may be needed in certain segments to improve the fit of the sample to the utility-level population to produce 90/10 results.

We will on occasion complete more than one survey per project if we need to talk to both the end user and the contractor. The survey costs assume we will complete an average of 1.3 surveys per project.

Segments

Enbridge and Union agreed to the following definitions of the segments that should be included in the sample:

- Industrial
- Agriculture
- New Construction
- Commercial
- Multifamily (Multifamily is also referred to as "multi-residential".)

Enbridge provides design assistance and a holistic approach to all new construction projects in commercial and multifamily buildings. As a result, it includes new construction projects in those sectors in a "New Construction" category. For all other sectors, energy savings claimed typically refer only to mechanical upgrades related to the new facility and so are grouped with retrofit projects in their sector.[4]

Sample Size within Segments

It may be that the optimal sample distribution is not simply to do a random distribution from among the participants in each segment. There are two issues to consider. First the available population, second the size of individual projects relative to the population.

Sample compared to population size. It appears that there are enough participants in each segment to complete 17 surveys per segment with the exception of the Agriculture and New Construction segments for Union (Table 3). There are 18 individual agriculture customers and only five new construction customers. We will attempt to interview all Union participants in those segments (and will stop if we get 17 in agriculture). We can distribute the 12 completes that cannot be obtained in the Union new construction segment to other segments.

[4] Source: Judith Ramsay email 10/23/2007.

Table 3. Sample Size as Percent of Population

	Individual customers/ decision makers		17 Completes as % of Population	
	Union	Enbridge	Union	Enbridge
Industrial	67	76	25%	22%
Agriculture	18	32	**94%**	53%
Multi-family	29	187	59%	9%
New Construction	5	52	**340%**	33%
Building Retrofit	94	105	18%	16%

Source: Derived from spreadsheet sent by Christine Zivanov October 10, 2007.

If the population is not large, a small population correction factor is typically used to reduce the needed sample size,[5] e.g., if the population in a targeted group is 100, the sample size to achieve 90/10 precision is reduced to 40. For 90/20 precision, the small population correction factor comes into effect for populations of 170 or smaller, which covers all but one segment, Enbridge multifamily projects. The required sample size to reach 90/20 by segment, after applying the small population correction factor is shown in Table 4, which shows a total of 124 surveys. Given a budget based on 170 completes we could potentially distribute 46 surveys (170-124=46) to address other issues (we will return to this below).

Table 4. Sample Sizes Adjusted for Small Population

Segment	Utility	Population Size	Adjusted Sample Size
New Building	Union	5	4
Agriculture	Union	18	9
Multi-family	Union	29	11
Agriculture	Enbridge	32	12
New Building	Enbridge	52	13
Large Industrial	Union	67	14
Large Industrial	Enbridge	76	14
Building Retrofit	Union	94	15
Building Retrofit	Enbridge	105	15
Multi-family	Enbridge	187	17
Total			*124*

Source: Population size from spreadsheet sent by Christine Zivanov October 10, 2007.

Size of individual projects relative to the population. One common approach to sampling for DSM program evaluations is to stratify the sample to ensure that many of the participants with the highest energy savings are included. This reduces the variance among respondents within each stratum and results in a greater overall precision in estimating the share of energy savings that could be considered free

5 When the sample size exceeds 1/10th of the population size, then the sample size is calculated as (Sample Size)/((Sample Size)/(Population Size)+1).

riders. This is the approach that will be taken for this analysis, basing the segmentation only on gas savings, without regard to water or electricity savings or the TRC.

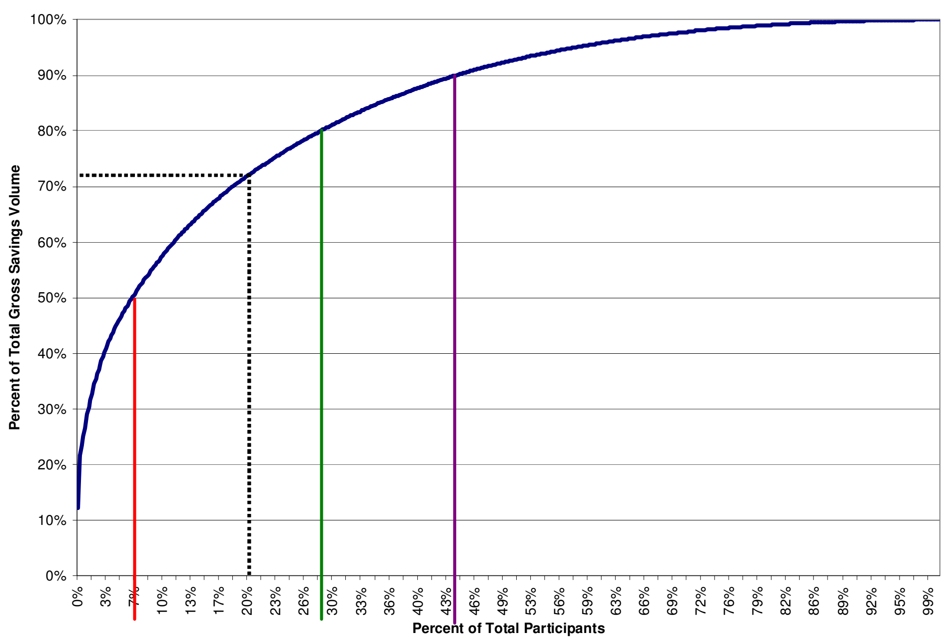
One half of the savings reported by Enbridge from the last quarter of 2006 and the first three quarters of 2007 was achieved by 6.4% of the participants, the largest 20% of projects represent 72% of the program savings, and the top 44% of participants represent 90% of the savings (Table 5 and Figure 9). Given this distribution, it seems appropriate to segment the sample by savings.

Table 5. Participants' Share of Savings – Enbridge

Percent of Participants	Percent of Gross m^3
6.4%	50%
20.0%	72%
22.8%	75%
28.2%	80%
44.0%	90%

Interpretation: 6.4 Percent of the participants account for 50% of the gross savings volume.
Source: Derived from spreadsheet sent by Judith Ramsay October 09, 2007.

Figure 9. Participants' Share of Savings – Enbridge



Source: Derived from spreadsheet sent by Judith Ramsay October 09, 2007.

One approach to segmenting the sample by savings would be to sample with certainty the customers responsible for the most savings within each segment. Table 6 shows the percent of segment savings for Enbridge projects of the five projects with the largest savings within each segment. In three of the segments, the top five projects represent over 40% of the savings. Since this represents a fairly large percent of the savings, this supports the decision to sample the top five projects in each segment for each utility with certainty and the remaining sample should be picked at random from the remainder.

Table 6. Percent of Savings from Top 5 Projects

	Total Gross m^3			Percent of Segment Total		
Segment	Top 5 Projects	Remainder	Total	Top 5 Projects	Remainder	Total
Industrial	24,066,050	26,646,410	50,712,460	47%	53%	100%
Agriculture	1,900,331	2,588,866	4,489,197	42%	58%	100%
Multifamily	1,917,380	21,570,252	23,487,632	8%	92%	100%
New Construction	1,023,733	3,061,981	4,085,714	25%	75%	100%
Commercial	5,771,444	8,124,495	13,895,939	42%	58%	100%
Total	34,678,938	61,992,004	96,670,942	36%	64%	100%

Source: Derived from spreadsheet sent by Judith Ramsay October 09, 2007.

PARTICIPANT AND TRADE ALLY SURVEY – SPILLOVER

This section will outline the survey and analysis approach for the participant survey, covering the spillover aspect. The spillover questions will be incorporated in the participants and trade ally surveys described above and the spillover analysis will be implemented in concert with the free ridership analysis.

Survey Overview

Spillover represents energy savings that are due to the program but not counted in program records. Spillover can be broken out in three ways:

- **Participant inside spillover** represents energy savings from other measures taken by participants at participating sites not included in the program but directly attributable to the influence of the program.
- **Participant outside spillover** represents energy savings from measures taken by participants at non-participating sites not included in the program but directly attributable to the influence of the program.
- **Non-participant spillover** represents energy savings from measures that were taken by non-participating customers but are directly attributable to the influence of the program. Non-participant spillover is sometimes called the "Free-Driver effect."[6]

Summit Blue will estimate **participant inside and outside spillover** through questions in the participant and trade ally surveys and through the Audit-Only Survey. Summit Blue will estimate nonparticipant spillover through the nonparticipant survey.

[6] See for example California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals. TecMarket Works. Prepared for the California Public Utilities Commission. April 2006. Page 226.

Participant Inside Spillover

Respondents are asked whether their experience with the programs caused them to install additional energy efficient equipment at the site that did not go through the program. This establishes whether inside spillover exists. For those respondents reporting that additional measures were installed, they are asked to identify in which year(s) the measures were installed, and to describe how the program influenced their decisions to install additional energy efficient equipment at their facility. An additional question is asked to determine the ratio of the savings from these additional measures compared to the savings from the measures installed under the program. That is, they are asked the percent of savings as a multiple of the savings achieved under the program (**savings multiplier**). Finally, respondents are asked to estimate the share of the savings from these additional measures that can “reasonably be attributed to the influence” of the program **(net-to-gross percentage)**. The process of breaking the questions into incremental steps helps the respondent think through each part, and it allows the respondent to provide his or her expert judgment as a participant in the target market.

Participant Outside Spillover

Similar to inside spillover, respondents are asked first whether the influence of the program caused them to install any additional energy efficiency equipment, outside of the program, at other sites beyond what they would have done without their experience with the program. If they respond yes, they are asked several follow-up questions designed to provide an estimate of the level of savings from these actions that could be attributed to the program. These questions address the following:

- The number of non-program-funded facilities at which these extra installations occurred.
- How the program has influenced their decisions to install the high efficiency equipment at other facilities.
- The savings—per site—from the additional measures relative to the savings from the participating project being discussed in the interview.
- The share of the savings that can reasonably be attributed to the program’s influence.

Using the Participant and Trade Ally Survey Responses to Estimate Spillover

Participant Inside Spillover

Inside spillover is zero for those without additional measures (or those who failed to answer all of the questions), and it is the product of the savings multiplier and the net-to-gross percentage for those with inside spillover. Similar to the free ridership analysis, individual spillover estimates are weighted both by relative energy savings for each respondent, as well as by sample stratification to determine an inside spillover value for the group as a whole.

Participant Outside Spillover

The savings as a percent of the in-project measure is multiplied by the share of savings attributed to the program to calculate the outside spillover value.[7] Similar to the free ridership analysis, individual spillover estimates are weighted both by relative energy savings for each respondent, as well as by sample stratification to determine an outside spillover value for the group as a whole.

AUDIT-ONLY SURVEY

This section will outline the survey, analysis approach, and sample design for the Audit-Only Participant survey.

Survey Overview

Participants who received an audit, implemented a recommended measure, but did not receive incentives through the program for that measure can be considered spillover. These kinds of participants would not be included in either the participant or nonparticipant surveys discussed above and below. We will implement a survey specifically with this population and focusing solely on spillover measures to provide an important additional estimate of program spillover.

The interviewer will begin by asking the respondent if they recall receiving the audit. If they do not, the interviewer will attempt to speak to someone else who might recall the audit.

The interviewer will ask the participant about each measure recommended in the audit. (Although we will limit this to the measures with the largest savings if there are more than 5 measures recommended.) The interviewer will examine whether the respondent remembers the recommendation and whether it has been installed and when. If the participant installed a measure, the interviewer will ask the following:

1. On a scale of 1 to 5 where 1 is “no influence” and 5 is “a great deal of influence”, how much influence did the audit have in your decision to implement this measure?

2. What share of the savings from this measure can reasonably be attributed to the influence of the program?

During the survey, the interviewer will fill in a matrix approximately like the following.

[7] A cap of five outside spillover projects per respondent is used to prevent outliers from skewing the results.

Table 7. Audit Survey Question Matrix

Recommended Measure Description	Recall recom-mended?	Measure installed?	% of Measures	% of Savings	When was it installed?	Influence of Program	Share of Savings
1. [Data]	Y/N	Y/N/DK	%	%	Month, Year	1 2 3 4 5	%
2. [Data]	Y/N	Y/N/DK	%	%	Month, Year	1 2 3 4 5	%
3. [Date]	Y/N	Y/N/DK	%	%	Month, Year	1 2 3 4 5	%
4. [Date]	Y/N	Y/N/DK	%	%	Month, Year	1 2 3 4 5	%
5. [Date]	Y/N	Y/N/DK	%	%	Month, Year	1 2 3 4 5	%

Using the Audit-Only Survey Responses to Estimate Spillover

The analysis of audit-related spillover savings will be fairly straightforward. The program tracking data will have measure-specific savings estimates from the audit. In general form, the participant-level spillover calculation will be:

Spillover Multiplier = (Influence of Program {converted to percentage} + Share of Savings)/2

Participant-level spillover = (Savings Estimate *{from sample}*) * (Spillover Multiplier) * (Percent of Items that were recommended that were installed)

This amounts to ***<averaging>*** the converted influence score with the answers to the share of savings question. Converting the influence of the program score to a percentage will be done using the scale shown in Table 8 below.

Table 8. Translate Influence Score to Free Ridership Percentage *<Assumptions>*

Average Influence Score	1.00	2.00	3.00	4.00	5.00
Influence Percentage	0%	25%	50%	75%	100%

Calculating program level savings will require weighting respondents and scaling up to the population.

Audit-Only Survey Sample Design

The sample will be taken from customers who had audits in 2005. This provides the optimal balance between providing enough time for the customers to have acted on the recommendations in the audit and ensuring that the audit is not so far in the past that respondents have trouble recalling details of the recommendations. Because the sample will be based on a single year, the result of the analysis can be expressed in spillover per year. Given that there have not been any significant changes in the program strategy, spillover calculated from a prior year ought to reasonably represent the probable spillover from the current year.

The costs of implementing the Audit-Only survey are based on these assumptions:

1. The survey would be done over the phone
2. Enbridge and Union provide the sample

3. Program tracking records provide estimates of savings for measures that get counted as spillover.
4. Completing 67 surveys for each utility to provide 90/10 precision at the utility level

Enbridge and Union will provide customer-level data from their program tracking systems that describes customers who have had audits in 2005 but have not implemented measures that appear in their program tracking systems. However, Union Gas was unable to find any companies who had an audit in 2005 and had not implemented one of the recommended measures through the program. As a result, no audit-only surveys were attempted with Union Gas customers. Based on the relatively limited sample available, Summit Blue will survey all available sample.

NONPARTICIPANT SPILLOVER SURVEY

This section will outline the survey, analysis approach, and sample design for the nonparticipant spillover survey.

Survey Overview

Summit Blue will estimate nonparticipant spillover using a survey targeted at nonparticipants only. The approach will be similar to participant spillover as follows:

- Whether spillover may exist. Using yes/no questions ask whether the respondent installed energy efficiency equipment.
- The amount of savings per spillover project. Asking respondents to estimate the energy savings associated with the implemented measures.
- The share of those savings that could be attributed to the influence of the program.

The approach to determine program influence will parallel that taken to determine free ridership – determining how much influence the program had on the decision to implement the measure.

The largest challenge in a nonparticipant spillover survey is identifying an appropriate sample and reaching a person within each company who can and will address the relevant issues. Using Enbridge and Union customer data we will identify a sample that would be reasonably close to the participant population then implement a phone survey in the following sequence:

1. Find someone knowledgeable about the replaced or modified equipment.

2. Aware of the program? If no, terminate.

3. Did the company participate in the program in the past 3 years? If yes, terminate.

4. Has the company modified or installed equipment that might fall under the program’s incentives? (List target equipment.) If no, terminate. If yes, when?

5. Determine what effect, if any, the program had on their decision. (Same questions as in the Audit-Only survey.)

5A. On a scale of 1 to 5 where 1 is “no influence” and 5 is “a great deal of influence”, how much influence did the program have in your decision to install or modify your equipment?

5B. What share of the savings from this change can reasonably be attributed to the influence of the program?

5C. On a scale of 1 to 5 where 1 is “no influence” and 5 is “a great deal of influence”, how much influence did **your suppliers or contractors** have in your decision to install or modify your equipment?

5D. If ***<5A > 2 or 5B > 30%>*** then: “We want to have one of our engineers follow up with you to ask some technical questions. Will that be OK?

6. If 5D=Yes. Quantify the magnitude of savings. Summit Blue engineer calls to ask enough questions about the equipment to make an engineering estimate of the energy savings it produces.

Because a large number of companies may be screened out in the first four steps, it is most cost-effective to implement this kind of survey over the phone. The costs are driven more by locating a company and person able to get to step 5 than by the asking the questions that come in step 5. However, costs can also be significant in step 6, if detailed questions and engineering calculations are needed to calculate savings for each measure that was influenced by the program.

Using the Nonparticipant Survey Responses to Estimate Spillover

As described above, if the company indicates that it implemented measures that were influenced by the program, then a Summit Blue engineer will call to ask enough questions to estimate the measure’s energy savings. With that done, the calculation of spillover parallels that for the Audit-Only survey, as follows.

Nonparticipant spillover = (Engineering-based Savings Estimate) * (Spillover Multiplier *{calculated from survey}*)

The Multiplier is calculated in the same way as the Audit-Only multiplier.

Nonparticipant Sample Design

The project budget assumes that we will implement a minimum of 670 screening surveys across both utilities but cannot guarantee a specific number of respondents getting through to step 6. In theory, completing 67 screening surveys with companies who have made appropriate equipment purchases or changes that could have been influenced by the program would provide 90/10 precision for an estimate of whether spillover happened (again across both utilities). If the incidence of spillover is small, it would not provide a very robust estimate of the therm value of that spillover. We based the budget on an assumption that 10 screening calls are needed to complete 1 call through step 5, thus requiring 670 screening calls. If the 1/10 ratio is low, then we will spend relatively more money on engineering calls and reviews. If it is high, then we will complete relatively more screening surveys. We will complete as many screening calls and engineering reviews as the budget will allow.

The sample will be done at random after eliminating customers in the small commercial rate class. This will target the sample at the segment most likely to have been influenced by the program and allow a simple extrapolation to the population. Summit Blue staff will advise utility staff on the best approaches to drawing a random sample from their data.

OUTLINE OF FINAL REPORT

The following is a preliminary outline of the final report presented to start a dialog about how the report should be structured.

1. Executive Summary
    a) Top-Level Results
    b) Program-Wide Free Ridership
    c) Segment-Level Free Ridership
    d) Role of Prior Program Experience
    e) Spillover
    f) Net-to-Gross Ratio
2. Introduction
    a) Definitions
    b) Report Contents
3. History and Critique of Free Ridership Methodologies
4. Summary of Analysis Methodology
    a) Estimating Free Ridership
    b) Estimating Spillover
5. Sampling and Data Collection
6. Findings
    a) Free Ridership Results
        i) Direct Free Ridership Estimates
        ii) Program Influence Questions
        iii) Adjusted Free Ridership Estimates
        iv) Role of Prior Program Experience
    b) Spillover Results
    c) Net-to-Gross Ratio
7. Conclusions

Appendix A: Methodology Detail—Estimating Free Ridership and Spillover
Appendix B: Survey Instruments

Appendix B. Surveys

Contents

1. Custom Projects Participant Survey

1.1 Conventions

- Bold text is spoken.
- Italics text is instructions for the interviewer.
- *{VIP}* indicates questions that are particularly important and represent specific boxes in the analysis flow chart.

1.2 Sample Data

(NOTE: Projects are the survey unit, so each project to be interviewed separately. Thus, use separate form for each Project, even if the same interviewee is associated with multiple projects)

Name___________________________________ Interviewer Initials _________________________

Firm Name ______________________________ Survey Date ______________________________

Address ________________________________ Sample ID # _____________________________

Phone Number ___________________________ Project ID #______________________________

Project Completion Date____________________

Equipment installed: ____

Channel Partner involved: ____

Program activity: ____

2.2. Project Briefing Information – Union Gas sales/marketing staff input:

2.2.1. Month/year of initial Union Gas involvement with the project or its precursors

2.2.1a Month_______

2.2.1b Year_______

2.2.2. General context of Union Gas relationship with customer:

a. Historical education effort with customer on efficiency opportunities & Union Gas programs (high, medium, low level of effort):

____

____

b. Facility energy audits performed (steam traps, boilers, etc)

____

____

c. Distribution and merchant services support provided (general credibility & relationship building)

____

____

d. Other (describe) ____________________

____

____

2.2.3. Services provided to customer in project-related contacts:

a. Gas bill histories (usage, cost) ____________________

b. Approximate number of project-related contacts with customer ____________________

c. General information on program ____________________

____

____

d. Project-specific technical information or analysis: technical/engineering, financial, vendor/technology alternatives, etc.

____

____

e. Project/technology recommendations ____________________

____

____

f. Other (describe) ____________________

____

____

ga. Low/medium/high intensity of support to customer generally

____

____

gb. Low/medium/high intensity of support to project specifically

____

____

h. Low/medium/high effect of on project's efficiency level

____

____

1.3 IDENTIFY CORRECT RESPONDENT

[Note: These questions may be covered on the phone while setting up an appointment.]

A1. Are you the most appropriate person to talk to about the decision to install that equipment and about the selection of the specific energy efficiency equipment?

1. YES Continue to Question A3

2. NO ➔ "May I ask who would be the best person to talk to?"
   [obtain names and phone numbers] ________________________________
   ____
   ____
   [Ask to speak with this person. Start again at the beginning.]
3. DO NOT REMEMBER PROJECT ➔ Ask Question A2

A2. Do you recall participating in <u>any</u> programs through Union Gas/Enbridge Gas Distribution in the past few years regarding this location?

1. YES
   A2A. Did the program involve assistance from Union Gas/Enbridge Gas Distribution in identifying energy efficient equipment or process changes and financing toward the initial capital costs?
   1. YES *Continue to Question A3*
   2. NO➔ "Can you provide me…" *[See text for "NO" above]*
2. NO ➔ "Can you provide me with a contact name and phone number for a person who might be familiar with the work that was done?" *[Get contact information and call this person; Start again at the beginning.]*

[If they express hesitation, use an appropriate combination of the following.]
Confidentiality. We are an independent research firm and will not report your individual responses in any way that would reveal your identity, as your response only will be presented in aggregate along with responses from other survey participants.
Security. Your responses will not affect your ability to participate in the program in the future.
Sales concern. I am not selling anything. I simply want to understand what factors were important to your company when deciding to install energy efficient equipment with assistance from this program.
Contact. If you would like to talk with someone about this effort from
–Union Gas, you can call your account manager.
–Enbridge Gas Distribution, the Enbridge Industrial contact is Peter Goldman at 416-495-6348, the Enbridge Commercial contact is Stefan Surdu at 416-495-5917, or you may contact your Energy Solutions Consultant.

1.4 Confirmation Of Equipment Installed

B1. Prior to calling, review program records for the project. In Table 1 below under "Program Records," check off each measure category for which energy efficient equipment was installed.

B2. Just to make sure that we're talking about the same project, I show that you installed *[list major equipment or equipment categories]***. To your recollection, was all this equipment installed?**
[Check off each category for which respondent recalls installing equipment. If information is not available from program records, ask the respondent to recall what measures were undertaken.]

B3. Did Union Gas/Enbridge Gas Distribution provide financial assistance for installing this equipment?
[Ask of only those checked in B2. Check off each category for which respondent recalls that Union Gas/Enbridge Gas Distribution provided financial assistance.]

B3b. Approximately how much was the incentive as a percent of the total project cost?
[Ask of only those checked in B3.]

B4. Did you receive any technical assistance from Union Gas/Enbridge Gas Distribution staff with any of this equipment?
[Ask of only those checked in B2. Check off each category for which respondent recalls that Union Gas/Enbridge Gas Distribution provided technical assistance for the measure.]

Table 1. Equipment in program records and recalled by respondent

[Check if Yes]

Measure Category	B1. Program Records	B2. Respondent Recollection	B3. Union Gas/Enbridge Gas Financial Assistance	B3b. Incentive as % of Project Cost	B4. Union Gas/Enbridge Gas Distribution Technical Assistance	Notes/Caveats
a. Machine/Process	❒	❒	❒	%	❒	
b. HVAC (incl. furnaces, all boilers, A/Cs, chillers, EMS, etc.)	❒	❒	❒	%	❒	
c. Lighting	❒	❒	❒	%	❒	
d Controls (boiler controls, variable frequency drive controls	❒	❒	❒	%	❒	
e. Building envelope (incl. insulation, windows)	❒	❒	❒	%	❒	
f. Domestic hot water	❒	❒	❒	%	❒	
g. Refrigeration	❒	❒	❒	%	❒	
h. Agriculture	❒	❒	❒	%	❒	
i. Converted equipment from electricity to gas (fuel substitution)	❒	❒	❒	%	❒	
j. Other: _______________	❒	❒	❒	%	❒	

1.5 SET THE CONTEXT

C1. Prior to the project being discussed, did your organization have a general policy regarding the energy efficiency specification of projects involving new construction and equipment retrofits, replacements or building remodeling generally?
1. Yes 2. No -8. Do not know -9. Refused

C2. [If yes] Did your policy target a specific standard of efficiency levels?
1. Yes 2. No -8. Do not know -9. Refused

C2a. [If yes] Can you specify what those efficiency levels are?
-8. Do not know -9. Refused

C3. Since the project, has your energy efficiency policy changed
1. Yes 2. No -8. Do not know -9. Refused

C4. [If Yes] How?
____

C5. Does your organization have specific criteria for selecting energy efficient equipment based on payback periods, life cycle costs, or internal rate of return?
1. Yes 2. No -8. Do not know -9. Refused

C6. [If C5=1 (yes)] Which?
1. Simple payback period
2. Life-cycle cost analysis
3. Internal rate of return
4. Other [Record verbatim] C6B. ____

-8. Don't know
-9. Refused

C7. [If C6=1 (simple payback period)] How many years or less must the project payback be?
-8. Do not know -9. Refused

C8. [If C6=2 (internal rate of return)] What is the minimum percent rate of return required for energy-efficiency related projects? [Record 10% as "10" not "0.10"]
-8. Do not know -9. Refused

C9. What was simple payback period for this project <u>prior</u> to any financial assistance from Enbridge/Union?
-8. Do not know -9. Refused

C10. What was simple payback period for this project <u>after</u> financial assistance from Enbridge/Union? ***{VIP}***
-8. Do not know -9. Refused

C11. [Note other relevant comments about how payback period figured in the decision process.]
____

C12. Do you recall receiving energy efficiency information and training in any of the following areas that was sponsored or delivered by Union Gas/Enbridge Gas Distribution?
1. Yes 2. No -8. Do not know -9. Refused

C12a. General energy efficiency information
C12b. Energy audits
C12c. Technology seminars (including those co-sponsored with trades)
C12d. Program information
C12e. Specific project identification

1.6 FREE RIDERSHIP BATTERY

1.1.1 Program Influences

[Ask Questions in this section for all the equipment installed in aggregate.]

I'm going to ask a few more questions about the influence of Enbridge Gas Distribution/Union Gas on your decisions to install high efficiency equipment.

D1. On a scale of 1 to 5, where 1 = "not at all important" and 5 = "very important"… Please indicate how important each of the following aspects of your experience with [Enbridge/Union] were in your decision to install energy efficient equipment at your facility? {*VIP*}

D1a. Financial assistance	**1 2 3 4 5**	**DK**	**Refused**
D1b. Project technical assistance	**1 2 3 4 5**	**DK**	**Refused**
D1c. Your ongoing relationship with the utility *(Providing impartial advice and facilitating unbiased contacts, e.g., business partners)*	**1 2 3 4 5**	**DK**	**Refused**
D1d. Utility education activities *(e.g., case studies, best practice information, training, seminars, conferences, trade shows)*	**1 2 3 4 5**	**DK**	**Refused**
D1e. Advice and assistance from a contractor	**1 2 3 4 5**	**DK**	**Refused**

D1e1. [If D1e>3] Who was that contractor?

D1e2. [If D1e>3] May I have the name and phone number of your main contact there?

D2. Did the assistance you received from [Enbridge/Union] in any way influence the <u>type</u> or <u>efficiency level</u> of the equipment or the <u>amount</u> of high efficiency equipment you installed or process changes implemented?

1 Yes ➔ *Continue to Question D2a*
2 No (all the same equipment would have been installed at the same high efficiencies) ➔ *Skip to Question D3*
-8 Don't know ➔ *Skip to Question D3*
-9 Refused➔ *Skip to Question D3*

D2a. In what ways did the assistance you received from [Enbridge/Union] change your plans or in any other way influence your decision to install energy efficient equipment. Be sure to identify specific equipment.

____

D2b. ***[Based on response to D2a, fill in a "1 to 5"score indicating the extent to which the program influenced the decision to install energy efficient equipment. DO NOT ASK RESPONDENT DIRECTLY. "1" indicates that the program had no influence; "5" indicates that the program was the primary reason that energy efficient equipment was installed.]***
{VIP}

(No program influence) 1 2 3 4 5 (Program was primary influence)

D3. **Did your company have specific plans to install <u>any</u> of the** *[list <u>all</u> relevant measure categories]* **equipment prior to your first contact with [Enbridge/Union] staff regarding this project?**

1 Yes ➔ *Continue to Question D3a*
2 No ➔ *Skip to Next Section*
-8 Don't know ➔ *Skip to Next Section*
-9 Refused➔ *Skip to Next Section*

D3a. Please describe any plans that you had to install the equipment prior to receiving assistance you received from [Enbridge/Union].
[Interviewer note: the goal here is to understand the plans that were in place before being influenced by program. Probe for equipment type, timing, quantity, and efficiency, as well as prior budgeting. Attempt to elicit responses that will provide answers for the "likelihood" or "share of savings" questions (E2a and E2b).]

D3b. *[Based on responses to D3a, fill in a "1 to 5"score indicating the extent to which respondent was already planning to install the energy efficient equipment. DO NOT ASK RESPONDENT DIRECTLY. "1" indicates that respondent had no plans at all; "5" indicates that respondent had documented plans and had budgeted for all of the efficient equipment.]* *{VIP}*

(No plans) 1 2 3 4 5 (Documented plans/budget)

1.1.2 Direct Decision Making Questions

[Ask the following questions <u>for each measure category</u> checked under Question B2 in Table 1 above. If previous open-ended questions have provided the necessary information, interviewer may skip the question/measure category. By the end of the interview, interviewer should be able to <u>populate Table 2</u> below with EITHER a "likelihood" OR a "share of equipment" OR both, for each relevant measure category.]

Now I'd like to try to quantify the impact of the [Enbridge/Union] assistance. I'd like you to think about the energy savings you achieved with the equipment you replaced. Some of the savings may have come from just replacing old equipment with <u>any</u> new equipment *[as appropriate: or replacing your existing process with a new process]***. And some of the savings may have come from the fact that the equipment you installed was more efficient than standard new equipment. I'd like you to think about the utility's influence on this last type of savings.**

First, let me ask about the ____________*[MEASURE CATEGORY]***.**

E1. If you had not received assistance you received from [Enbridge/Union] , would you have replaced your existing ___________*[MEASURE CATEGORY]* or installed new equipment in the foreseeable future? *{VIP}*

[Note that these do not have to be "energy efficient" equipment.]

1 Yes ➔ *Continue to Question E1a*

2 No ➔ *ENTER 0% for the category in the Free Ridership Value column in Table 2 below (E2c) and move on to the next measure category.*

-8 Don't know ➔ Probe, perhaps using *Question E1a*

-9 Refused➔ *Skip to next measure category*

E1a. When would you likely have made these investments if you had not received assistance from [Enbridge/Union]? *[If clarification needed:]* (Within how many months or years of when you participated in the program?) *{VIP}*

E1aM. _____ Months

E1aY. _____ Years

-8 Don't know ➔ Probe, perhaps using *Question E1a*

-9 Refused➔ *Skip to next measure category*

- *Fill in only for categories for which equipment has been installed.*
- *Enter "0" years if equipment would have been installed in the same timeframe regardless of program participation.*
- *If respondent says, "…in a year or two," enter "1.5" years.*
- *Based on earlier responses, ask either the "likelihood" question below or the "share of equipment" question, whichever is more appropriate.*
- *For example, if respondent installed a single chiller, then the "likelihood" question may be most appropriate; if they installed multiple measures of various types/sizes, then the "share of equipment" may be more appropriate. Some respondents may be able to offer valid responses to both questions.*
- *If you are uncertain, ask both questions. If respondent can provide a response to each, then record both responses.*

E2a. *[Likelihood]* What is the likelihood that you would have installed the same or similar ___________ *[MEASURE CATEGORY]* of the same level of energy efficiency if it had not been for the assistance you received from [Enbridge/Union]? *{VIP}*

1 Definitely would NOT have installed equipment of the same level of energy efficiency

2 Definitely WOULD have installed equipment of the same level of energy efficiency anyway

3 MAY HAVE installed equipment of the same level of energy efficiency, even without the program

E2a2.About what percent likelihood? _____%

-8 Don't know

-9 Refused

E2b. *[Share of equipment]* (Or, if you might have installed some but not all of the ___________ *[MEASURE CATEGORY]* even without the assistance you received from [Enbridge/Union] , then…) what share of the ___________ *[MEASURE CATEGORY]* would you have installed anyway at the same level of energy efficiency? *{VIP}*

[If necessary, or if the flow of the interview dictates, you may derive this value by asking 1) the share of equipment that would have been installed (at any efficiency) and 2) the share of installed equipment that would have been high efficiency. The value in the table below for Question E2b would be the product of these two values.]

Table 2. Equipment

[Fill in EITHER the "likelihood" value OR the "share of equipment" value OR both values for each relevant measure category.
If respondents ask for the timeframe, use the timeframe specified above in Question E1a.
Then enter the appropriate free ridership value (E2c), which will be one of the following, depending on the nature of the project and the responses:

1) *The single value for "likelihood" or "share of equipment" if only one is entered;*
2) *If value provided for both, enter either Likelihood or Share value, whichever best represents the appropriate value*
3) *The product of the two, if appropriate (e.g., if there is a 50% likelihood that 75% of the equipment would have been installed, and respondent definitely wouldn't have done the final 25%)*

Measure Category	**E1. Would have installed in foreseeable future** *[Check no or yes]*		**E1a. Within ____ Years of participation** *[Enter # of years]*		**E2a. Likelihood that energy efficient equipment…**		**E2b. Share of energy efficient equipment that…**	**E2c.** *[Entered by interviewer]*
	2=No *FR=0%*	**1=Yes** (cont.)			**…would have been installed without the program**			**Free Ridership Value**
a.Machine/Process	❒	❒	Months	Yrs	%	and/or	%	%
b. HVAC	❒	❒	Months	Yrs	%	and/or	%	%
c. Controls								
d. Lighting	❒	❒	Months	Yrs	%	and/or	%	%
e. Building envelope	❒	❒	Months	Yrs	%	and/or	%	%
f. Domestic hot water	❒	❒	Months	Yrs	%	and/or	%	%
g. Refrigeration	❒	❒	Months	Yrs	%	and/or	%	%
h. Agriculture	❒	❒	Months	Yrs	%	and/or	%	%
i. Fuel substitution	❒	❒	Months	Yrs	%	and/or	%	%
j. Other:	❒	❒	Months	Yrs	%	and/or	%	%

E2d. *[Additional notes/caveats (e.g., explaining how/why free ridership value was chosen, if necessary)]*

____

E3. **Overall, across all equipment, that is the entire project, how much of these extra energy savings would have been achieved anyway, even if you had not received assistance from [Enbridge/Union]. Please provide a lower and upper bound, and then your best estimate. {VIP}**

[If needed for clarification:] **For example, 50% means that half of the extra savings from the energy efficient equipment would have been achieved anyway. Remember, I'm asking only about the extra savings from installing energy efficient equipment instead of standard equipment.**

E3A.Lower bound ➔ _____ % E3B. Upper bound ➔ _____ % E3C. Best estimate ➔ _____ %

1.7 PARTICIPANT INSIDE SPILLOVER

Now I want to ask about whether the assistance you received from [Enbridge/Union] has influenced you to install any other energy efficient equipment that did not receive financial support from [Enbridge/Union].
[For these questions, I'm talking about all your company's participation in the program, not just since October 2006.]

G1. **Did the assistance you got from [Enbridge/Union] in any way influence you to install additional energy efficient equipment** ***at this site*** **that did not get reported to the program** (i.e., *equipment that would not have been installed without the influence of the program)***?**

1 Yes➔ Continue to Question G2
2 No ➔ Skip to next section
-8 Don't know ➔ Skip to next section
-9 Refused➔ Skip to next section

G2. [*If G1 = "yes"]* **What year did you install this equipment?**

G3. *[If G1 = "yes"]* **Please briefly describe how the assistance you received from [Enbridge/Union] has influenced your decisions to install additional energy efficient equipment at your facility.**
[Identify the types of equipment affected.]

G4. **Would you estimate the energy savings from this extra equipment to be less than, similar to, or more than the savings from the energy efficient equipment from the original project?**

1 Less than the original project ➔
G4a. About what percentage of the savings from the original project?
____% *[Enter a number less than 100%]*
2 About the same savings
3 More than the original project ➔
G4b. About what percentage of the savings from the original project?
____% *[Enter a number greater than 100%]*
-8 Don't know
-9 Refused

G5. **What share of the savings from this extra equipment can reasonably be attributed to the influence of the assistance you received from [Enbridge/Union]?**
______% *[100% or less]*
-8 Don't know
-9 Refused
[Interviewer may be able to complete this based on response to G3, or at least use G3 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question.]

1.8 PARTICIPANT OUTSIDE SPILLOVER

H1. **Did the assistance you received from [Enbridge/Union] in any way influence you to install any additional energy efficient equipment** ***at other jobs or facilities in Union Gas/Enbridge Gas Distribution's Service Territory*** **beyond what you would have done otherwise?**
[Don't include projects that participated in another Union/Enbridge program.]

1 Yes ➔

H1a. How many other facilities were influenced (that did not participate in Union Gas/Enbridge Gas Distribution programs)? _________ (-8 Don't know, -9 Refused)

2 No ➔ Skip to next section
-8 Don't know ➔ Skip to next section
-9 Refused ➔ Skip to next section

H2. *[If H1 = "yes"]* **Please briefly <u>describe how</u> the assistance you received has influenced your decisions to install this equipment. (Probe to identify the types of equipment affected.)**

H3. <u>On average</u>, would you estimate the energy savings from these other <u>non-program</u> projects to be <u>less than</u>, <u>similar to</u>, or <u>more than</u> the savings from the energy efficient equipment from the program-supported that we've been discussing?
[E.g., if the same equipment was implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected.]

1. Less than the Custom Projects project
   H3A. About what percentage of the savings from the Custom Projects project? ____% ***[Enter a number <u>less than</u> 100%]***
2. About the same savings
3. More than the Custom Projects project
   H3B. About what percentage of the savings from the Custom Projects project? ____% ***[Enter a number <u>greater than</u> 100%]***

-8 Don't know
-9 Refused

H4. What share of the savings from energy efficient equipment at these facilities can reasonably be attributed to the influence of the assistance you received from [Enbridge/Union]?
[Interviewer may be able to complete this based on response to H2, or at least use H2 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question.]
______% [100% or less]
-8 Don't know
-9 Refused

1.9 FIRMOGRAPHICS

Z1. Does your company own or lease this building? :

1. Owner
2. Lease

-8. Don't know
-9. Refused

Z2. Approximately how large is the facility that received the efficiency improvements we have been talking about? (square meters)

1. Up to 5,000
2. 5,001 to 10,000
3. 10,001 to 15,000
4. 15,001 to 25,000
5. 25,001 to 50,000
6. 50,001 to 100,000
7. 100,001 to 200,000
8. 200,001 to 500,000
9. Over 500,000

-8 Do not know
-9 Refused

Z3. Is your company independent, or part of a larger organization?

1. Independent
2. Part of a larger company
3. Other Z3a. (specify) ______________________________

-8. Don't know
-9. Refused

Z4. How old is your facility?

-8 Don't know
-9 Refused

Z5. Does your building contain any manufacturing processes?

1. Yes   2. No   -8. Do not know   -9. Refused

Z6a. [If yes] What type of energy do they use?

1. Natural Gas
2. Electricity
3. Other

-8 Don't know
-9 Refused

Z6b. [If yes to Z5] Have you reviewed their energy usage?

1. Yes   2. No   -8. Do not know   -9. Refused

Z7. How many locations does your organization have in Ontario?

1. One	5. More than 20
2. 2 to 5	6. Currently Unoccupied
3. 6 to 10	-8. Don't know
4. 11 to 20	-9. Refused

Z8. Approximately how many full time employees or full time equivalents does your organization have at your locations in Ontario?

1. Fewer than 5	5. 50 to 99
2. 5 to 9	6. 100 to 249
3. 10 to 19	7. 250 or More
4. 20 to 49	-8 Do not know
	-9 Refused

Those are all the questions I had.

Z9. Do you have any final comments you would like to make?

____

____

Thank you very much for your time!

Z10. Record all additional or supporting comments here.

____

____

2. Custom Projects Trade Ally Survey

Business Partner (EGD) or Channel Partner (UG)

2.1 Conventions

- Bold text is spoken.
- Italics text is instructions for the interviewer.
- *{VIP}* indicates questions that are particularly important and represent specific boxes in the analysis flow chart.

2.2 Sample Data

(NOTE: Projects are the survey unit, so each project to be interviewed separately. Thus, use separate form for each Project, even if the same interviewee is associated with multiple projects)

Contact Name ____________________________
Firm Name ______________________________
Address ________________________________
Phone Number ___________________________
Project Completion Date___________________

Interviewer Initials ______________________
Survey Date _____________________________
Sample ID # _____________________________
Project ID #______________________________

Equipment installed: ____

Customer involved: ____

2.3 Information From Utility Staff and Records

3.1. Project Briefing Information – Union/EGD sales/marketing staff input:

3.1.1. Month/year of initial EGD/Union Gas involvement with the project or its precursors

3.1.1a Month_______
3.1.1b Year_______

3.1.2. General context of EGD/Union Gas relationship with Channel/Business Partner:

a. Historical education effort with customer on efficiency opportunities & Enbridge/Union Gas programs (high, medium, low level of effort):

____

____

b. Facility energy audits performed (steam traps, boilers, etc)

____

____

c. Distribution and merchant services support provided (general credibility & relationship building)

____

____

d. Other (describe)____

____

3.1.3. Services provided to Channel/Business Partner in project-related contacts:

a. Gas bill histories (usage, cost) ________________________________

b. Approximate number of project-related contacts with customer ____________

c. General information on program ________________________________

____

d. Project-specific technical information or analysis: technical/engineering, financial , vendor/technology alternatives, etc.

____

____

e. Project/technology recommendations ______________________________

____

f. Other (describe) ____

____

3.1.4. Channel/Business Partner involvement with customer project:

a. General context of Channel/Business Partner involvement with project or its precursors

____

____

b. Extent of Channel/Business Partner use of Union Gas program & other needed information, Union Gas technical services or other support

____

____

c. Type of service & information support given customer generally and project specifically by Channel/Business Partner (engineering/financial analysis of alternatives, project engineering, project construction, ongoing Maintenance/Repair/Operations support, other/describe)

____

____

d. **Low/medium/high intensity of support by Channel/Business Partner to customer generally and project specifically**

____

e. **Low/medium/high effect of on project's efficiency level**

____

2.4 PRELIMINARY CONCERNS

[If they express hesitation, use an appropriate combination of the following.]
Confidentiality. We are an independent research firm and will not report your individual responses in any way that would reveal your identity. Your response will only be presented in aggregate along with responses from other survey participants.
Security. Your responses will not affect your ability to participate in the program in the future. All responses are your opinion and there are no wrong answers.
Sales concern. I am not selling anything. I simply want to understand what factors were important to your company when deciding to install energy efficient equipment with assistance from this program.
Contact. For Union, the Channel Partners would have been notified by phone call or email from their Account Manager. If they have any questions, it is their Union Gas Account Manager they can call.
The Enbridge Industrial contact is Peter Goldman at 416-495-6348 or Stefan Surdu at 416-495-5917 or your Enbridge Energy Solutions Consultant/Union representative.

2.5 INTRODUCTION

A1. **What is your primary line of business?**

1. Consulting engineer
2. Manufacturer
3. Distributor or equipment sales
4. Installation contractor
5. Property manager
6. Other. A1b. Please specify. ______________________________

2.6 CONFIRMATION OF EQUIPMENT INSTALLED

B1. Prior to the interview, review program records for the project or projects. In Table 1 below under "Program Records," check off each measure category for which energy efficient equipment was installed.

B2. **Just to make sure that we're talking about the same project, I show that your company designed and specified/supplied/installed** *[list major equipment or equipment categories]* at *[end use customer}*. **To your recollection, was all this work completed?**
[Check off each category for which respondent recalls installing equipment. If information is not available from program records, ask the respondent to recall what measures were undertaken.]

B3. **Do you recall if Union Gas/Enbridge provided financial assistance for installing this equipment?**
1. Yes 2. No -8. Do not know -9. Refused

[Ask of only those checked in B2. Check off each category for which respondent recalls that Union Gas/Enbridge provided financial assistance.]

B3a. *[If yes, for Union Only]* **Who received the incentive, your company or the customer?**

1. Your Company
2. The Customer

-8. Do not know
-9. Refused

B3b. Approximately how much was the incentive as a percent of the total project cost?
*[Ask of only those checked in B3.]*______________________________*%*
-8. Do not know
-9. Refused

[Ask of only those checked in B2. Check off each category for which respondent recalls that Union Gas/Enbridge provided technical assistance for the measure.]

B4. Did your company receive any technical or marketing assistance from Union Gas/Enbridge staff?
1. Yes 2. No -8. Do not know -9. Refused

B4a. ***[If Yes]*** **Please describe.**

____

____

B5. Was the customer aware that Union/Enbridge was involved with the project?
1. Yes 2. No -8. Do not know -9. Refused

Table 1. Equipment in program records and recalled by respondent

[Check if Yes]

Measure Category	**B1.** Program Records	**B2.** Respondent Recollection	**B3.** Union /Enbridge Financial Assistance	**B3a.** Trade ally received incentive	**B3b.** Incentive as % of Project Cost	**B4.** Union /Enbridge Technical or Marketing Assistance	**Notes/Caveats**
a. Machine/Process	❐	❐	❐	❐	%	❐	
b. HVAC (incl. furnaces, all boilers, A/Cs, chillers, EMS, etc.)	❐	❐	❐	❐	%	❐	
c. Lighting	❐	❐	❐	❐	%	❐	
d Controls (boiler controls, variable frequency drive controls	❐	❐	❐	❐	%	❐	
e. Building envelope (incl. insulation, windows)	❐	❐	❐	❐	%	❐	
f. Domestic hot water	❐	❐	❐	❐	%	❐	
g. Refrigeration	❐	❐	❐	❐	%	❐	
h. Agriculture	❐	❐	❐	❐	%	❐	
i. Converted equipment from electricity to gas (fuel substitution)	❐	❐	❐	❐	%	❐	
j. Other: _____________	❐	❐	❐	❐	%	❐	

2.7 Set the Context

C1. Do you recall receiving energy efficiency information and/or training in any of the following areas that was sponsored or delivered by Union Gas/Enbridge?
1. Yes 2. No -8. Do not know -9. Refused

		Yes	No	Do not know	Refused
C1a.	General energy efficiency information	❐	❐	❐	❐
C1b.	Energy audits	❐	❐	❐	❐
C1c.	Technology seminars	❐	❐	❐	❐
C1d.	Program information	❐	❐	❐	❐
C1e.	Specific project identification	❐	❐	❐	❐
C1f.	Training or workshops	❐	❐	❐	❐
C1g.	Software e.g., Cumulative Sum of Differences (CUSUM)	❐	❐	❐	❐
C1h.	Lunch & Learns	❐	❐	❐	❐

2.8 Free Ridership Battery

2.8.1 Program Influences

[Ask Questions in this section for all the equipment installed in aggregate.]

I'm going to ask a few more questions about the influence of Enbridge/Union Gas on your customer's decisions to install high efficiency equipment.

D1. On a scale of 1 to 5, where 1 = "not at all important" and 5 = "very important"… Please indicate how important each of the following aspects of your experience with [Enbridge/Union] were in the decision to install energy efficient equipment for your customer at this facility? *{VIP}*

D1a. Financial assistance 1 2 3 4 5 -8 DK -9 Refused
D1b. Project technical assistance 1 2 3 4 5 -8 DK -9 Refused
D1c. Your ongoing relationship with the utility 1 2 3 4 5 -8 DK -9 Refused
(Providing impartial advice and facilitating unbiased contacts, e.g., business partners)
D1d. Utility education activities 1 2 3 4 5 -8 DK -9 Refused
(e.g., case studies, best practice information, training, seminars, conferences, trade shows)
D1e. Marketing assistance 1 2 3 4 5 -8 DK -9 Refused
(e.g., lead generation, printed material)

D2. Did the assistance you received from [Enbridge/Union] in any way influence the type or efficiency level of the equipment, the amount of high efficiency equipment that was installed or efficient features that were added or process changes that were implemented?
1 Yes ➔ *Continue to Question D2a*
2 No (all the same equipment would have been installed at the same high efficiencies) ➔ *Skip to Question D3*
-8 Don't know ➔ *Skip to Question D3*
-9 Refused➔ *Skip to Question D3*

D2a. In what ways did the [Enbridge/Union] assistance change the plans or in any other way influence the decision to install energy efficient equipment? Be sure to identify specific equipment.
[Probe for whether the contractor added efficient features to make a more efficient system.]

____

____

____

D2b. ***[Based on response to D2a, fill in a "1 to 5"score indicating the extent to which the program influenced the decision to install energy efficient equipment. DO NOT ASK RESPONDENT DIRECTLY. "1" indicates that the program had no influence; "5" indicates that the program was the primary reason that energy efficient equipment was installed.]***
{VIP}

(No program influence) 1 2 3 4 5 (Program was primary influence)
-8 Don't know -9 Refused

D3. Did this customer have specific plans in place to install **<u>any</u>** **of the** *[list <u>all</u> relevant measure categories]* **equipment prior to contacting your company regarding this project?**

1 Yes ➔ *Continue to Question D3a*
2 No ➔ *Skip to Next Section*
-8 Don't know ➔ *Skip to Next Section*
-9 Refused➔ *Skip to Next Section*

D3a. Please describe the plans to install the equipment prior to contacting you.
[Interviewer note: the goal here is to understand the plans that were in place before being influenced by the trade ally. Had they already planned to install all the measures and at the same level of efficiency and with all the energy saving features? Probe for equipment type, timing, quantity, and efficiency, as well as prior budgeting. Attempt to elicit responses that will provide answers for the "likelihood" or "share of savings" questions (E2a and E2b).]

____

____

____

D3b. *[Based on responses to D3a, fill in a "1 to 5"score indicating the extent to which end user was already planning to install the energy efficient equipment prior to contact with the trade ally. DO NOT ASK RESPONDENT DIRECTLY. "1" indicates that respondent had no plans at all; "5" indicates that respondent had documented plans and had budgeted for all of the efficient equipment.]* ***{VIP}***

(No plans) 1 2 3 4 5 (Documented plans/budget)
-8 Don't know -9 Refused

D4. *[Enbridge only]* **Enbridge offers a higher incentive if three or more measures are implemented. Did this higher incentive figure in the decision process?**

1 Yes ➔ *Continue to Question D4a*
2 No ➔ *Skip to Next Section*
-8 Don't know ➔ *Skip to Next Section*
-9 Refused➔ *Skip to Next Section*

D4a. How?

____

____

____

D4b. *[Based on responses to D4a, fill in a "1 to 5"score indicating how much influence the higher incentive had on the decision. DO NOT ASK RESPONDENT DIRECTLY.] {VIP}*

(No influence) 1 2 3 4 5 (Critical Influence)
-8 Don't know -9 Refused

2.8.2 Direct Decision Making Questions

[Fill in Table 2 for most of these questions.]
[Ask the following questions for each measure category checked under Question B2 in Table 1 above. If previous open-ended questions have provided the necessary information, interviewer may skip the question/measure category. By the end of the interview, interviewer should be able to populate Table 2 below with EITHER a "likelihood" OR a "share of equipment" OR both, for each relevant measure category.]

Let me ask about the ____________*[MEASURE CATEGORY]*.

E1. Did the *[Enbridge/Union]* assistance in any way change the timing of the installation?
1. Yes 2. No -8. Do not know -9. Refused

E1a. *[If Yes]* **Was the equipment installed earlier or later than first planned?**
1. Earlier
2. Later

E1b. ***[If Yes to E1]* When would it have been installed without the program assistance?** *{VIP}*

E1bM. ___ Month
E1bY. ___ Year
-7 Never -8. Do not know -9. Refused

Based on earlier responses, ask either the "likelihood" question below or the "share of equipment" question, whichever is more appropriate. For example, if respondent installed a single chiller, then the "likelihood" question may be most appropriate; if they installed multiple measures of various types/sizes, then the "share of equipment" may be more appropriate. Some respondents may be able to offer valid responses to both questions If you are uncertain, ask both questions. If respondent can provide a response to each, then record both responses.

E2a. ***[Likelihood]*** **What is the likelihood that you would have installed the same or similar ___________ *[MEASURE CATEGORY]* of the <u>same level of energy efficiency</u> or with the same features that affect the overall system efficiency if it had not been for the assistance from [Enbridge/Union]?**
{VIP}

1 Definitely would NOT have installed equipment of the same level of energy efficiency
2 Definitely WOULD have installed equipment of the same level of energy efficiency anyway
3 MAY HAVE installed equipment of the same level of energy efficiency, even without the program
E2a2.About what percent likelihood? _____%
-8 Don't know
-9 Refused

E2b. ***[Share of equipment]*** **What share of the ___________ *[MEASURE CATEGORY]* would you have installed anyway at the <u>same level of energy efficiency</u> if it had not been for the assistance from [Enbridge/Union]?** *{VIP}*

[If necessary, or if the flow of the interview dictates, you may derive this value by asking 1) the share of equipment that would have been installed (at any efficiency) and 2) the share of installed equipment that would have been high efficiency. The value in the table below for Question E2b would be the product of these two values.]
-8 Don't know
-9 Refused

Table 2. Equipment

[Fill in EITHER the "likelihood" value OR the "share of equipment" value OR both values for each relevant measure category.
If respondents ask for the timeframe, use the timeframe specified above in Question E1a.
Then enter the appropriate free ridership value (E2c), which will be one of the following, depending on the nature of the project and the responses:

1) *The single value for "likelihood" or "share of equipment" if only one is entered;*
2) *If value provided for both, enter either Likelihood or Share value, whichever best represents the appropriate value*
3) *The product of the two, if appropriate (e.g., if there is a 50% likelihood that 75% of the equipment would have been installed, and respondent definitely wouldn't have done the final 25%)*

Measure Category	E1. Change when the equipment was installed?	E1a. Forward or Slow	E1b. When would it have been installed?	E2a. Likelihood that energy efficient equipment… …would have been installed without the program		E2b. Share of energy efficient equipment that…	E2c. *[Entered by interviewer]* Free Ridership Value
a. Machine/Process	Y N DK R	F S	Months Yrs	%	and/or	%	%
b. HVAC (incl. furnaces, all boilers, A/Cs, chillers, EMS, etc.)	Y N DK R	F S	Months Yrs	%	and/or	%	%
c. Lighting	Y N DK R	F S					
d Controls (boiler controls, variable frequency drive controls	Y N DK R	F S	Months Yrs	%	and/or	%	%
e. Building envelope (incl. insulation, windows)	Y N DK R	F S	Months Yrs	%	and/or	%	%
f. Domestic hot water	Y N DK R	F S	Months Yrs	%	and/or	%	%
g. Refrigeration	Y N DK R	F S	Months Yrs	%	and/or	%	%
h. Agriculture	Y N DK R	F S	Months Yrs	%	and/or	%	%
i. Converted equipment from electricity to gas (fuel substitution)	Y N DK R	F S	Months Yrs	%	and/or	%	%
j. Other: ________________	Y N DK R	F S	Months Yrs	%	and/or	%	%

E2d. *[Additional notes/caveats (e.g., explaining how/why free ridership value was chosen, if necessary)]*

____

E3. Overall, across all equipment, that is the entire project, how much of these extra energy savings would have been achieved anyway, even without the assistance from [Enbridge/Union]. Please provide a lower and upper bound, and then your best estimate. {VIP}

[If needed for clarification:] **For example, 50% means that half of the extra savings from the energy efficient equipment would have been achieved anyway. Remember, I'm asking only about the extra savings from installing energy efficient equipment instead of standard equipment.**

E3A. Lower bound ➔ _____ % E3B. Upper bound ➔ _____ % E3C. Best estimate ➔ _____ %

2.9 Participant Inside Spillover

G1. Did the assistance from [Enbridge/Union] in any way influence you to help the customer install additional energy efficient equipment *at the same site* that did not get reported to the program (i.e., *equipment that would not have been installed without the influence of the program)***?**

1 Yes➔ Continue to Question G2
2 No ➔ Skip to next section
-8 Don't know ➔ Skip to next section
-9 Refused➔ Skip to next section

G2. [*If G1 = "yes"]* **What year did this equipment get installed?**
-8 Don't know
-9 Refused

G3. *[If G1 = "yes"]* **Please briefly describe how the program assistance from [Enbridge/Union] influenced the decisions to install additional energy efficient equipment at the same site.**
[Identify the types of equipment affected.]

G4. Would you estimate the energy savings from this additional equipment to be less than, similar to, or more than the savings from the energy efficient equipment from the original project?
1 Less than the original project ➔
G4a. About what percentage of the savings from the original project?
____*%* *[Enter a number less than 100%]*
2 About the same savings
3 More than the original project ➔
G4b. About what percentage of the savings from the original project?
____*%* *[Enter a number greater than 100%]*
-8 Don't know
-9 Refused

G5. What share of the savings from this additional equipment can reasonably be attributed to the influence of the assistance from [Enbridge/Union]?
______*% [100% or less]*
-8 Don't know
-9 Refused

[Interviewer may be able to complete this based on response to G3, or at least use G3 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question.]

2.10 Participant Outside Spillover

H1. Did the assistance from [Enbridge/Union] in any way influence you to help the company to install any additional energy efficient equipment *at other jobs or facilities in Union Gas/Enbridge's Service Territory* beyond what they would have done otherwise?
[Don't include projects that participated in another Union/Enbridge program.]

1 Yes ➔
H1a. How many other facilities were influenced (that did not participate in Union Gas/Enbridge programs)? ___________________________ (-8 Don't know, -9 Refused)
2 No ➔ Skip to next section
-8 Don't know ➔ Skip to next section
-9 Refused ➔ Skip to next section

H2. *[If H1 = "yes"]* **Please briefly describe how the assistance has influenced the decisions to install this equipment. (Probe to identify the types of equipment affected.)**

____

____

H3. On average, would you estimate the energy savings from these other non-program projects to be less than, similar to, or more than the savings from the energy efficient equipment from the program-supported project that we've been discussing?
[E.g., if the same equipment was implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected.]

1. Less than the Custom Projects project
   H3A. About what percentage of the savings from the Custom Projects project? ____% *[Enter a number less than 100%]*
2. About the same savings
3. More than the Custom Projects project
   H3B. About what percentage of the savings from the Custom Projects project? ____% *[Enter a number greater than 100%]*

-8 Don't know
-9 Refused

H4. What share of the savings from energy efficient equipment at these facilities can reasonably be attributed to the influence of the assistance from [Enbridge/Union]?
[Interviewer may be able to complete this based on response to H2, or at least use H2 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question.]
______% [100% or less]
-8 Don't know
-9 Refused

2.11 Closing

Those are all the questions I had.

Z9. Do you have any final comments you would like to make?

Thank you very much for your time!

Z10. Record all additional or supporting comments here.

2. CUSTOM PROJECTS AUDIT-ONLY SURVEY

2.1 CONVENTIONS

- Blue text is spoken.
- *Italics text is instructions for the interviewer.*
- Arial, bold font in brackets is skip instructions **[skip instructions]**
- Underlined in brackets are data from the sample: [sample data]

2.2 INTERVIEWER DATA

Interviewer ID
Survey Date
Survey Duration

2.3 SAMPLE DATA

Sample ID #
Contact Name
Contact Title
Contact Phone Number
Firm Name
Address
Company Phone Number
Audit Date
Recommended measure description (up to 5 per customer)
Recommended measure estimated gas savings (up to 5 per customer)

2.4 Recall Audit, Identify Respondent

[Enbridge] **According to our records, you had an energy or HVAC audit conducted by a third party professional that was co-funded by Enbridge Gas Distribution on [date].**

[Union] **According to our records, you had a boiler audit or feasibility study conducted with financial assistance provided by Union Gas on [date].**

1. Do you recall receiving that audit?

1. Yes .... 2. No -8. Do not know
.... -9. Refused

2. [If not Yes] **Can you suggest someone else at your company who might be familiar with the audit?**

1. Yes .... 2. No -8. Do not know
.... -9. Refused

If yes, get name and phone. Ask to speak with this person. Start again at the beginning.

2.5 Measure-Specific Questions

[The interviewer will repeat these questions for each audit recommendations (limit of 5 recommendations).]

3. The audit recommended that you implement [recommendation]. Do you recall that recommendation?

1. Yes .... 2. No -8. Do not know
.... -9. Refused

4. Has it been installed or implemented?

1. Yes .... 2. No 3. Partial
.... 4. Caveat
-8. Do not know .... -9. Refused

Partial = Some of the recommended equipment was installed but not all.
Caveat = Installed something related to the recommendation but not the exact thing recommended

[If Q4=3]

5. What percent of the items recommended or equipment did you install?

Enter percents as whole numbers, thus 90% would be entered as "90" NOT "0.9".

-8 Don't know .... -9 Refused

[If Q4=4]

6. The audit estimated that this item [or the actual equipment] would save [savings] cubic meters of gas. What percent of that estimated savings do you think you achieved?

Enter percents as whole numbers, thus 90% would be entered as "90" NOT "0.9".

-8 Don't know .... -9 Refused

[If not installed (Q4=2, -8, -9)]

6A. Why have you not implemented this recommendation yet?

1. We plan to but have not yet
2. Do not have the money
3. We do not have that equipment any more
4. Other
   6AOther. **[Capture verbatim]**

-8 Don't know
-9 Refused

[If not installed (Q4=2, -8, -9), skip to the next recommendation. If last recommendation, skip to the next section.]

7. When was it installed?

Record month and year installed

-8 Don't know.. -9 Refused

8. On a scale of 1 to 5 where 1 is "no influence" and 5 is "a great deal of influence", how much influence did the audit have in your decision to implement this item?

1 2 3 4 5 .... -8 Don't know -9 Refused

9. What share of the savings from this item can reasonably be attributed to the influence of the audit?

Enter percents as whole numbers, thus 90% would be entered as "90" NOT "0.9".

-8 Don't know.. -9 Refused

2.6 Firmographics

Now I have just a few questions about your company.

Z1. Approximately how large is the facility that received the audit? (square feet)?

1. Up to 5,000
2. 5,001 to 10,000
3. 10,001 to 15,000
4. 15,001 to 25,000
5. 25,001 to 50,000
6. 50,001 to 100,000
7. 100,001 to 200,000
8. 200,001 to 500,000
9. Over 500,000

-8 Do not know
-9 Refused

Z2. Is the facility you work in independent, or part of a larger organization?

1. Independent
2. Part of a larger company
3. Other

Z3Other. [Capture verbatim]

-8. Don't know
-9. Refused

Z3. Approximately how many full time employees or full time equivalents does your organization have at your locations in Ontario?

1. Fewer than 5
2. 5 to 9
3. 10 to 19
4. 20 to 49
5. 50 to 99
6. 100 to 249
7. 250 or More

-8 Do not know
-9 Refused

Those are all the questions I had. Thank you very much for your time!

3. CUSTOM PROJECTS NONPARTICIPANT SPILLOVER SURVEY

3.1 CONVENTIONS

- Blue text is spoken.
- *Italics text is instructions for the interviewer.*
- Arial, bold font in brackets is skip instructions: **[skip instructions]**
- Underlined in brackets are data from the sample: [sample data]

3.2 INTERVIEWER DATA

Interviewer ID
Survey Date
Survey Duration

3.3 SAMPLE DATA

Sample ID # (Per Sample File)
Contact Name
Contact Title
Contact Phone Number
Firm Name
Address
Company Phone Number
Dwtp Code Desc (Per Sample File)
Utility (Enbridge / Union Gas – Per Sample File)

3.4 Qualify Respondent, Explain Purpose

Find someone knowledgeable about the company's buildings and equipment.

Q1. May I speak with the plant engineer or facilities manager?

1 Yes **[CONTINUE WITH INTRODUCTION]**
-8 Do Not Know **[PROMPT WITH DESCRIPTION OF APPROPRIATE CONTACT]**
-9 Refused **[THANK AND TERMINATE]**

DESCRIPTION OF APPROPRIATE CONTACT (If necessary):

I would like to speak with someone who is accountable for energy efficiency or who is responsible for your building's operation and is knowledgeable about your company's energy-using equipment, like space and water heating, ventilation, and industrial processes.

INTRODUCTION - Once you have the person on the phone (or if needed to find the person) say:

I am calling on behalf of [Enbridge/Union Gas] to ask some questions about your plant or building operation and equipment to help [Enbridge/Union Gas] improve their energy efficiency programs.

If necessary:

Confidentiality: **We will not report your individual answers to [Enbridge/Union Gas]. We only report results aggregated across all the respondents.**

Record

Q2. Name

Q3. Phone number

3.5 Participation Screening

P1. Have you heard of [Enbridge/Union Gas'] energy efficiency program?

1 Yes **[SKIP TO P3]**
2 No
-8 Don't Know
-9 Refused

P2. The energy efficiency program is designed to provide incentives and technical assistance for implementing projects that save energy. Does that sound familiar?

1 Yes
2 No **[THANK AND TERMINATE]**
-8 Don't Know **[THANK AND TERMINATE]**
-9 Refused **[THANK AND TERMINATE]**

P3. Have you received financial incentives through the program to make energy efficiency improvements or conduct an energy audit?

1 Yes **[THANK AND TERMINATE]**
2 No
-8 Don't Know
-9 Refused

P4. Have you had contact with [Enbridge/Union Gas'] energy efficiency program through a trade show, attending a workshop or receiving a publication?

1 Yes
2 No
-8 Don't Know
-9 Refused

3.6 Equipment Screening

S1. Have you modified or installed any of the following types of equipment since the beginning of 2005?

Read each option.

Equipment	Yes	No	Don't Know	Refused
a. Space Heating	1	2	-8	-9
b. Water Heating	1	2	-8	-9
c. Steam generation	1	2	-8	-9
d. Other kind of heating	1	2	-8	-9
e. Ventilation	1	2	-8	-9
f. Industrial process improvements	1	2	-8	-9
g. Building controls	1	2	-8	-9

[IF 'NO, DK or RF' TO ALL IN S1, THANK AND TERMINATE]

[FOR EACH 'YES' IN S1 ASK]

S2. When did you make that change?

Record month and year.

Equipment	Month	Year	Don't Know	Refused
a. Space Heating	-- --	-- -- -- --	-8	-9
b. Water Heating	-- --	-- -- -- --	-8	-9
c. Steam generation	-- --	-- -- -- --	-8	-9
d. Other kind of heating	-- --	-- -- -- --	-8	-9
e. Ventilation	-- --	-- -- -- --	-8	-9
f. Industrial process improvements	-- --	-- -- -- --	-8	-9
g. Building controls	-- --	-- -- -- --	-8	-9

3.7 Program Influence

[FOR EACH 'YES' IN S1 ASK]

G1. On a scale of 1 to 5 where 1 is "no influence" and 5 is "a great deal of influence", how much influence did the [Enbridge/Union Gas] energy efficiency program have in your decision to install or modify your [Equipment]?

Equipment	No Influence				Great Deal of Influence	Don't Know	Refused
a. Space Heating	1	2	3	4	5	-8	-9
b. Water Heating	1	2	3	4	5	-8	-9
c. Steam generation	1	2	3	4	5	-8	-9
d. Other kind of heating	1	2	3	4	5	-8	-9
e. Ventilation	1	2	3	4	5	-8	-9
f. Industrial process improvements	1	2	3	4	5	-8	-9
g. Building controls	1	2	3	4	5	-8	-9

[FOR EACH 'YES' IN S1 ASK]

G2. What share of the savings from this change can reasonably be attributed to the influence of the [Enbridge/Union Gas] energy efficiency program?

Enter percents as whole numbers, thus 90% would be entered as "90" NOT "0.9".

Equipment	**%**	**Don't Know**	**Refused**
a. Space Heating	-- -- --	-8	-9
b. Water Heating	-- -- --	-8	-9
c. Steam generation	-- -- --	-8	-9
d. Other kind of heating	-- -- --	-8	-9
e. Ventilation	-- -- --	-8	-9
f. Industrial process improvements	-- -- --	-8	-9
g. Building controls	-- -- --	-8	-9

[FOR EACH 'YES' IN S1 ASK]

G3. On a scale of 1 to 5 where 1 is "no influence" and 5 is "a great deal of influence", how much influence did your suppliers or contractors have in your decision to install or modify your [Equipment]?

Equipment	**No Influence**				**Great Deal of Influence**	**Don't Know**	**Refused**
a. Space Heating	1	2	3	4	5	-8	-9
b. Water Heating	1	2	3	4	5	-8	-9
c. Steam generation	1	2	3	4	5	-8	-9
d. Other kind of heating	1	2	3	4	5	-8	-9
e. Ventilation	1	2	3	4	5	-8	-9
f. Industrial process improvements	1	2	3	4	5	-8	-9
g. Building controls	1	2	3	4	5	-8	-9

3.8 FOLLOW-UP CALL OK?

[IF P4 > 2 OR P5 > 30% FOR ANY MEASURE FROM S1 THEN CONTINUE. ELSE, TERMINATE]

F1. We want to have one of our engineers ask you some technical questions about the equipment changes you made. Will that be OK?

1 Yes **[VERIFY/COLLECT CONTACT INFORMATION]**
2 No **[THANK AND TERMINATE]**
-8 Don't Know **[THANK AND TERMINATE]**
-9 Refused **[THANK AND TERMINATE]**

May I verify your:

F2. Name ________________________________ [PRE-FILL WITH INFO FROM Q2]
F3. Phone number ________________________________ [PRE-FILL WITH INFO FROM Q3]
F4. Email Address ________________________________

Those are all the questions I had. Thank you very much for your time!

SEC INTERROGATORY #53

INTERROGATORY

[B/6/5, p. 7] Please advise whether, as far as the expert is aware, self-report surveys are still used in all jurisdictions that do not have deemed NTG values. If that is no longer the case, please provide details of the changes.

RESPONSE

Self-report surveys are widely used, specifically for the C&I sector, but the Navigant team can't state with certainty that the method is used in all states that don't have deemed savings.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #54

INTERROGATORY

[B/6/5, p. 22] Please provide an update to Table 3, if such an update is available.

RESPONSE

Developing the information in Table 3 was not in the scope of the work. In addition, it would be difficult as a number of the secondary references used to provide input to this table (See Appendix A) have not themselves been updated. It would be a significant effort to provide an accurate, updated version of this Table.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #55

INTERROGATORY

[B/6/5, p. 47] Please confirm that the DNV GL NTG study for 2015 would be characterized by the expert as an Option 4 study. Please confirm that the expert continues to be of the view that "The enhanced self-report approach would likely be the most appropriate approach given Union and Enbridge's programs are custom C&I and that identifying the magnitude of individual NTG components is desired." If that view has changed, please explain both how it has changed, and why.

RESPONSE

Yes. The DNV study would be characterized as an Option 4 study as defined on p. 47.

The following quote is still viewed as accurate:

> The enhanced self-report approach would likely be the most appropriate approach given that Union's and Enbridge's programs are custom C&I and that identifying the magnitude of individual NTG components is desired.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #56

INTERROGATORY

[B/6/5, p. 53] Please confirm that this program is most similar to the Union and Enbridge prescriptive C&I programs, and is not similar to custom C&I.

RESPONSE

The Navigant team has not gone back to review this 2004/2005 California Investor Owned Utility ("IOU") program as part of recent work; however, as the target of the cited program is small and medium-sized commercial customers, it is likely that this program is more similar to the Union and Enbridge prescriptive C&I programs. Customer C&I programs usually target large customers.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #57

INTERROGATORY

[B/6/5, p. 59] Please provide a summary of similarities and differences between the NTG approach for this program, and the DNV GL NTG study for 2015 Enbridge and Union custom C&I.

RESPONSE

This question refers to a study Navigant conducted for the Ontario Technical Evaluation Committee ("TEC") in 2013. The evaluation effort for the Massachusetts study cited on page 59 of Exhibit B, Tab 6, Schedule 5, was a statewide study that addressed all customer and prescriptive gas programs implemented by utilities. These programs included:

- National Grid programs: New Construction (custom and prescriptive), Retrofit (custom and prescriptive), Direct Install (prescriptive);
- NSTAR programs: Business Solutions (custom), Construction Solutions (custom), Small Business Solutions (custom and prescriptive);
- Columbia Gas programs: Large Custom, Small Custom, Prescriptive;
- Unitil programs: Large Retrofit (custom and prescriptive), Gas Networks (prescriptive), Small Direct Install (prescriptive);
- New England Gas programs: Retrofit (custom), Lost Opportunity (prescriptive), Direct Install (prescriptive); and,
- Berkshire Gas programs: Custom, Prescriptive.

The Navigant team has not gone back to review this specific study in detail for recent work. In terms of high-level comments, both the DNV study and the Massachusetts multi-utility study cited used self-report surveys as the primary approach for estimating NTG. However, there are likely differences in the question banks used in the two studies and the approaches taken with respect to using information from trade allies. These are areas where there often are differences across NTG studies, with some differences being driven by the differences in the program(s) being evaluated.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #58

INTERROGATORY

[B/6/4, p. 22] Please advise how, if at all, randomized controlled trials and similar methods can be used for measuring NTG for custom C&I projects. If they can be used, please provide examples of jurisdictions in which they have been used for that purpose.

RESPONSE

This question cites a report prepared for the Uniform Methods Project ("UMP") sponsored by the U.S. DOE in 2017. There is no question that C&I customer programs pose greater challenges for the application of randomized control trials (and other randomized approaches) than do residential programs that tend to have greater numbers of participants that are more homogeneous. C&I custom programs have project expenditures that can be in the tens of thousands of dollars. Typically, these programs are opt-in, and random assignment within an appropriate eligible participant population is difficult.

It is possible to use randomized approaches for customer C&I programs in large markets where there is a large number of candidate participants and controls, e.g., a state-wide program in California. The Navigant team believes these methods have been considered but does not have a specific example of an evaluation using a randomized approach that has been performed.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #59

INTERROGATORY

[B/6/4, p. 34] Please explain how the pre-post approach measures the extent to which the installed measures were caused by the program, vs. being caused by external factors.

RESPONSE

This question cites a report prepared for the Uniform Methods Project ("UMP") sponsored by the U.S. DOE in 2017. This approach would compare the energy use of C&I program participants after they participated in the program with their energy use prior to participation. This is most commonly done in a statistical modeling framework where variables in addition to program participation can be used to control for other external factors. This often includes weather but can also include economic / facility variables such as production levels, facility operations, and other variables that are known to have varied between the pre- and post-participation time periods. Ideally, the pre/post approach would also include C&I customers that did not participate in the program to compare their pre-/post-participation period energy use.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #60

INTERROGATORY

[B/6/4, p. 40] Please provide a copy of Prahl, et al (2013), or a link to where the article is available.

RESPONSE

This question cites a report prepared for the Uniform Methods Project ("UMP") sponsored by the U.S. DOE in 2017. This paper (Prahl, 3013) can be found at the link below:

https://www.iepec.org/conf-docs/conf-by-year/2013-Chicago/095.pdf#page=1 [Insert link in Browser].

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #61

INTERROGATORY

[B/6/4, p. 45] Please advise whether the expert agrees with the view of the working group that self-report surveys are necessary because “other available methods and research designs are generally not feasible for large nonresidential customer programs”.

RESPONSE

The Navigant team agrees. Self-report surveys may be the best option for nonresidential customer programs; however, they pose challenges in implementation and it is important for these efforts to mitigate biases common to these approaches as discussed in section 2.3 of the cited report and on page 26 of the report. These include issues with recall bias and the following types of response bias:

- provision of socially desirable answers;
- rationalization of past decisions;
- inability of respondents to know what they would have done in hypothetical situations;
- failure of respondents to recognize the influence of other parties, e.g., influence of the program on contractors due to market effects; and,
- arbitrariness in the scoring methods used to translate the responses into free-rider estimates and overall estimates of NTG

Best practice studies need to mitigate these issues and potential biases. Often this is done by pre-testing instruments and through sensitivity analyses to determine how the responses drive the final estimates. The report cited in this question was prepared for the Uniform Methods Project (“UMP”) sponsored by the U.S. DOE in 2017. Page 26 of this report discusses these issues.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #62

INTERROGATORY

[B/6/4, p. 46] Please explain how payback periods with and without the rebate are used in the estimation of free-ridership.

RESPONSE

Payack periods are generally not used directly in the estimation of free-ridership, but as supporting information.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #63

INTERROGATORY

[B/6/4, p. 62] Please advise whether the expert agrees with the Delaware and Indiana views that standard market practice baselines capture all free riders. Please explain why this would not result in utilities focusing on early adopter customers who have already decided to proceed with a measure, and are thus free riders, rather than focusing on more conservative customers who would otherwise be below the standard market practice. Please advise of any self-report NTG studies of which the expert is aware in jurisdictions that use a standard market practice baseline, and the results of any such studies.

RESPONSE

The use of standard market practice baselines is not generally viewed as capturing all free-ridership in specific evaluations when evaluations are focused on estimating savings from a specific program year. The assumptions underlying the view that standard market practice baselines capture appropriate levels of free-ridership are viewed as more appropriate when providing estimates of energy savings over a period of time (e.g., five year program accomplishments) under the assumption that the sustained implementation of program(s) over this period influenced the broader market such that the overall efficiency of the market has been improved.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #64

INTERROGATORY

[B/6/4, p. 68] Please advise of any top-down studies known to the expert that have confirmed the savings results reported by the program administrators.

RESPONSE

This question cites a report prepared for the Uniform Methods Project ("UMP") sponsored by the U.S. DOE in 2017. The applications of top-down methods are discussed in this report (See: Exhibit Filed: 2017-12-19, EB-2017-0324, Exhibit B, Tab 6, Schedule 4, page 68 to 75). In general, top-down methods have been applied at the national level to confirm aggregate energy savings across states or regions. However, top-down methods are still being tested in terms of their ability to estimate savings at a utility service territory level or state/province level that might be associated with a given program administrator. Pilot efforts at using top-down methods to produce state-level estimates of energy savings have been undertaken in Massachusetts, but there is no consensus around the quality of the results of these efforts. The data needed to support top-down modeling is very challenging to collect for smaller geographic areas (such as utility service territories), and this has posed problems for the application of these methods at the state level.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #65

INTERROGATORY

[B/6/4, p. 82] Please explain why "as the program matures (all else equal), observed free-ridership will increase during the study period, but so will spillover and market effects".

RESPONSE

In general, the existence of free ridership and even increasing free ridership over program years does not necessarily indicate that the program is unsuccessful or not cost-effective. As a program matures over time and is in place for a number of years, the measures offered by the program become better known to all market actors (customers and trade allies) and free ridership is likely to increase, but these program influences over time should also increase spillover and market effects.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #66

INTERROGATORY

[B/6/1, p. 4] Please confirm that the "experts" interviewed for the case studies were three utility staff, three staff of regulators, and four energy efficiency consultants. Please advise how many of the regulatory staff and consultants were former utility or program administrator employees. Please advise how many of the consultants were representatives of customers or customer groups.

RESPONSE

The case study interviewees included: two commission staff, three utility staff, and five consultants. For the states which they were interviewed, two consultants work on behalf of commission staff, two consultants conduct NTG evaluation studies, and one consultant is a former commission staffer. Our interviews did not ask interviewees about their former positions or other consulting engagements.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #67

INTERROGATORY

[B/6/1, p. 4, 14, 17] Please confirm that, in California, custom C&I NTG is measured by after-the-fact self-report surveys, which are then applied retrospectively.

RESPONSE

Correct.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #68

INTERROGATORY

[B/6/1, p. 8] Please confirm that all of the utility experts were included in those who complained about application of NTG retrospectively.

RESPONSE

Respondents noted difficulties with applying NTG retrospectively across all interviewee types.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #69

INTERROGATORY

[B/6/1, p. 9] Please discuss the relative value of accuracy vs. predictability in deciding whether to apply NTG results prospectively or retrospectively.

RESPONSE

Page 9 of Exhibit B, Tab 6, Schedule 1 describes tradeoffs reported by experts in Massachusetts regarding prospective versus retrospective application of results. The relative value of these tradeoffs depends on the policy priorities of individual jurisdictions and their stakeholders.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #70

INTERROGATORY

[B/6/1, p. 10] Please discuss the extent to which it is appropriate for an EM&V contractor to withhold from utilities specific information from NTG surveys that could be used to identify individual customers. Please include discussion of the appropriate application of this issue in the context of custom C&I NTG studies.

RESPONSE

Confidentiality is important and, if promised as part of the survey framework, it would be inappropriate to share sensitive information that could be used to identify individual customers. However, it is also important to provide transparency in how different responses drive the NTG estimates. In the experience of the Navigant team, it has always been possible to provide information in a manner that provides adequate transparency while also protecting individual customers.

Multiple (i.e., 3) interviewees stated that confidentiality of customer responses is important and evaluators often cannot or do not share individual responses. Although provision of individual responses was only reported in the Illinois case study (p. 25), in that instance identifying information was redacted. There are other ways to provide transparency into responses and calculations without divulging confidential information. As described on page 10 of the report, one interviewee stated:

> cross-tabulations or frequencies 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.

Another interviewee noted (p. 19) that in California, CPUC staff and consultants will hold a meeting with utility representatives to provide transparency on methods and calculations without providing confidential information.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #71

INTERROGATORY

[B/6/1, p. 15, 20] Please discuss the basis for the California 5% spillover adder, including any studies done and any variation in its application across various program types.

RESPONSE

The California CPUC (Decision 12-11-015 November 8, 2012, pages 55 and 56) provided the following information about the 5% spillover adder:

> Therefore, the Navigant team believes that accepting the program-specific values proposed by the IOUs for the 2013-2014 portfolio would convey a false specificity and accuracy in this important area when the appropriate research and data does not yet exist.
>
> Instead, at this time the Navigant team finds it more 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. This is analogous and parallel to our default NTG ratio prior to completion of specific studies on program free ridership.
>
> A case could be made that the Navigant team could develop a middle-ground approach based on spillover theory and existing data, such as applying sector-level or age-of-program differentials, but absent any comments in the record to support these types of approaches, the Navigant team think the portfolio-wide adjustment better represents the state of recent research in this area in California and does not convey false precision.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #72

INTERROGATORY

[B/6/1, p. 17] Please provide a summary of best practices for program administrators in pre-review and screening of custom C&I projects to "assess NTG and baselines prior to project approval".

RESPONSE

As part of the report, the Navigant team did not conduct research or find existing research of best practices for pre-review and screening of custom C&I projects.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #73

INTERROGATORY

[B/6/1, p. 18] Please provide a critical comparison of the California process outlined in Table 3 to the current process used in Ontario.

RESPONSE

As part of the report, the Navigant team did not conduct a critical comparison of the California process and the Ontario process.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #74

INTERROGATORY

[B/6/1, p. 21] Please confirm that the Illinois SAG is a large group, is dominated by utility participants, and has only limited participation by customer groups.

RESPONSE

Our research did not conduct an analysis of parties that dominate or have limited participation in the Statewide Advisory Group ("SAG"). Four utilities participated in the SAG including ComEd, Ameren Illinois, Nicor Gas and Peoples Gas - North Shore Gas.

In addition to the four utilities, there were 61 non-utility participants. The full list of participants can be found on the SAG website: http://www.ilsag.info/meeting-participants.html

The SAG policy manual states: "Attendance and participation in SAG is open to all interested stakeholders. Program Administrators offering Programs pursuant to Sections 8-103B and 8-104 of the Act shall participate in the EE SAG, as directed by the Commission." (p 1 of Illinois Energy Efficiency Policy Manual Version 1.1 - A Manual Guiding the Operation of Illinois Energy Efficiency Programs).

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #75

INTERROGATORY

[B/6/1, p. 22] Please explain why Illinois applies realization rates retrospectively, but NTG only prospectively.

RESPONSE

As noted on Table 4 (p. 22), Illinois uses prospective application of realization rates for TRM-based measures. For custom measures (i.e., measures that fall outside of the TRM), Illinois applies realization rates retrospectively. The reason for this is explained in the Illinois TRM:

> In exceptional cases where the participant, program administrator, and independent evaluator all agree that the TRM algorithm for a particular energy efficiency measure does not accurately characterize the energy efficiency measure within a project due to the complexity in the design and configuration of the particular energy efficiency project, a more comprehensive custom engineering and financial analysis may be used that more accurately incorporates the attributes of the measure in the complex energy efficiency project. In such cases and consistent with Commission policy adopted in ICC Docket No. 13-0077, Program Administrators are subject to retrospective evaluation risk (retroactive adjustments to savings based on ex-post evaluation findings) for such projects utilizing customized savings calculations.
>
> Page 25, Volume 6.0.

As a general comment, the observed changes in ex-post realization rates compared to ex-ante values have been smaller program-wide than is typically found for net savings ex-post and ex-ante estimates. This realization rate adjustment is usually much smaller and does not have the same negative effects on program planning and delivery incentives that are generally found when NTG is applied retroactively.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #76

INTERROGATORY

[B/6/1, p. 23] Please advise whether the expert agrees with the statement “utilities have a decent amount of influence in terms of how they influence programs to push higher NTG or lower”. Please explain why.

RESPONSE

Utilities can influence the NTG levels through their control of program elements, such as program design, marketing, technical assistance and eligibility requirements.

The term “decent” was used by the interviewee contacted as part of the reseach effort on page 23 (Exhibit B, Tab 6, Schedule 1). The Navigant team cannot comment on this adjective in the quote.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #77

INTERROGATORY

[B/6/1, p. 23] Please advise whether the expert agrees with the statement "assessing net savings is particularly important for custom programs because it is common to pay for projects that would have happened otherwise". Please explain why.

RESPONSE

The Navigant team agrees that assessing net savings is important for all measure and program types, including custom programs. The Navigant team do not necessarily agree that paying for custom projects that would happen otherwise is "common", as the frequency of occurrence depends on multiple factors, such as program design and eligibility requirements.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #78

INTERROGATORY

[B/6/1, p. 24] Please discuss the extent, if any, to which applying NTG results prospectively as opposed to retrospectively reduces the incentive on program administrators to design and implement programs with a view to improving NTG.

RESPONSE

The extent to which the timing of NTG results application influences program administrators' behavior is influenced by multiple factors, including savings goals, incentive calculations, and frequency of updates.

As noted on page 24, in Illinois there were early concerns that utilities would have less incentive to monitor NTG under a prospective framework, but interviewees noted that the annual update of the NTG values provides incentive to utilities to try to reduce free ridership.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #79

INTERROGATORY

[B/6/1, p. 38] Please confirm that 24 of the states studied use net savings, 11 of those states apply the adjustment to custom C&I programs retrospectively, and 3 of the remaining 13 states have a fixed value. Please confirm that 10 states apply their net savings adjustment only prospectively.

RESPONSE

Yes, those numbers are correct. Therefore, 13 of 24 states determine NTG for their custom programs prior to the beginning of a program year.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #80

INTERROGATORY

[B/6/2, p. 6] Please advise whether, in the expert's opinion, the use of the 48 month cutoff was a reasonable judgment by DNV.

RESPONSE

It is not possible to judge whether the 48-month cutoff was reasonable or not without seeing additional data from the DNV study. This would include sensitivity analyses on how free ridership estimates change with alternative reasonable cut-off assumption. These analyses would provide information on the robustness of the estimates under this assumed value. Other jurisdictions use different cut-off values to address the timing factor. Whether the selection of 48 months as the cut-off is appropriate will likely depend upon the characteristics of the market in which the program is being offered and aspects of program delivery. The Navigant team does not believe there is any generally correct answer. As a result, it is important that sensitivity analyses be conducted.

Another issue is whether customers provide accurate responses to this bank of questions, i.e., can a customer that participated in a custom C&I program provide good answers as to whether they would have – in the absence of the program – installed similar energy efficiency equipment 48 months from the date they installed the measures through the EE program. This is a hypothetical question that requires respondents to consider what they might have done four years from the date they participated in the program. Over the course of four years, many things can change. The market can change, available technologies can change, and company/corporate finances can change.

Answers to 48 month timing questions seem to be quite speculative and subject to the socially desirable effect or halo effect (i.e., the respondent has a bias towards answers that reflect well on them). This cognitive bias would lead them to say that of course they would have undertaken appropriate energy efficiency investments at some time in the future and probably within a four-year timeframe, even if they may not know the answer. The responses as they move out beyond a 24 or even a 12 month timeframe for indicating when the actions would likely have been taken becomes more speculative, while the impact on the NTG values still can be quite significant for these longer time frames.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

Testing the robustness of the NTG values to different timeframes and cutoffs for the timing questions is important in having confidence in the results. If the NTG estimates are heavily influenced answers to questions that seem to be the most speculative, then there will be less confidence in the overall results.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #81

INTERROGATORY

[B/6/2, p. 7] Please explain how additional stakeholder review would have helped solve the problem of respondents' difficulty in estimating the counterfactual. Please identify which questions and sequences in the DNV GL study the expert believes should have been changed, and would have been had there been additional stakeholder review.

RESPONSE

As background, prior to the DNV GL study the most recent empirical NTG study on the Enbridge's and Union's Custom C&I programs was conducted in the 2007 to 2008 timeframe. A "Custom Free Ridership and Participant Spillover Jurisdictional Review" was completed for the Ontario Technical Evaluation Committee ("TEC") in May 2013 (See Exhibit B, Tab 6, Schedule 5). However, the empirical work in the recent DNV effort was a major new research effort and was managed through a new process by OEB staff. Given these circumstances, it is important that this recent NTG study have buy-in from the key provincial stakeholders including regulators, program administrators, and stakeholders representing customer groups and other constituencies. These circumstances also are likely to make the stakeholder review process more challenging as there is considerable learning required by the parties undertaking this effort. In addition, there can also be practical constraints. Research budgets and timelines influence the depth and opportunities within a stakeholder process.

There are two important parts to the stakeholder review process: (1) working toward agreement on the methods to be used and (2) working towards a common understanding of study findings and results. The review of findings and results can often result in the specification of different sensitivity analyses around assumptions, judgments, and use of data to determine the key drivers behind the NTG results.

The Navigant Team personnel did not participate in the stakeholder process around this NTG study, so our insights are based on a review of the published study and reading certain commentaries. Given these limitations, it is our belief that the stakeholder review might have changed/influenced the study in four general areas:

1. Scoring of the attribution questions. It was noted in Exhibit B, Tab 6, Schedule 2 to this filing that several jurisdictions use similar attribution questions but score them differently. A stakeholder process that looked at the different scoring

methods with the perspective of which method is more consistent with policies and views in Ontario could have affected the findings of the study.

2. The role of trade allies in the study. Trade allies were only interviewed if the customer indicated that the trade allies were important to the participation decision. In some cases, the customers may not be aware of how the program interacts with the trade allies and how this may flow through to the customer's choices. A viable argument might have been made that it was important to get the trade allies' views on program attribution, even when the customer did not specifically cite trade allies as an influential factor.

3. Interpretation of the responses to the timing questions. As stated above, an important component of the stakeholder process involves working towards agreement on the NTG study findings. The ability of stakeholders to participate in this aspect of the process is dependent on the information provided by the NTG evaluation contractor, consistent with their budget, timeline, and scope of work. In this case, there seem to be areas where sensitivity analyses might have produced information that would have resulted in better understanding of the results and robustness of the findings. The 48-month cut-off used in the timing attribution question is one example of where sensitivity analyses might have been useful. Exhibit B, Tab 6, Schedule 2, page 6 presents some verbatim responses from C&I participants indicating how difficult these questions were for some customers to respond to accurately.

4. Context around the findings. Exhibit B, Tab 6, Schedule 2, page 12 discusses the context around NTG findings. Additional collaborative process interactions may have provided for a different context around the findings, particularly given the importance of the NTG estimates in the calculation of incentives.

A high-quality collaborative process can be challenging, and the situation in Ontario for this recent NTG posed additional challenges given the gap between empirical/in-field NTG studies. However, it seems like a number of contentious issues could have benefitted by additional input as part of a stakeholders' collaborative process.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #82

INTERROGATORY

[B/6/2, p. 7] Please discuss the alternative response bias, where respondents wish to give the answer that they believe the questioner would like, and so affirm the value of the program by minimizing their free-rider attributes.

RESPONSE

Response bias generally refers to a range of potential cognitive biases that can influence respondents in a such a manner that they do not provide accurate answers. This is always an area of concern in structured self-report survey approaches. The particular response bias referred to in the question seems to concern respondents providing answers that they believe are those the sponsor of the study might like to see. For example, if a utility EE program is being evaluated, respondents might believe that the utility would like to hear that they are not free-riders and thereby provide answers that minimize their likelihood of being identified as program free-riders. This type of bias can occur in self-report studies across a range of applications.

One way to address response bias is to structure a question bank where there are confirming and cross-validation studies. As a simple example, the survey can ask a question about whether the customer would have taken the actions even if the program had not been offered. Cross-validation questions might ask about the role of program incentives and information in their decision. If the customer states that these factors were important in their decision making, that answer may be judged as inconsistent with an answer indicating that they would have undertaken the same actions even if the program had not been offered. This approach makes it less likely that respondents can produce this biased result. They would have to consider their response to multiple questions in different parts of the survey.

A number of different types of response biases are of concern in every self-report survey. The survey professionals that design questions for self-report studies are generally aware of which forms of self-response bias are important threats to the overall validity of the study's findings and develop approaches for reducing these biases. This is also an argument for triangulation approaches where the process incorporates several different viewpoints (e.g., customers, trade allies, and implementers) and methods to enhance validity.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #83

INTERROGATORY

[B/6/2, p. 7, 12] Please advise whether, in the expert's opinion, the judgments of DNV GL with respect to survey design and scoring algorithm were reasonable. If any of those judgments were, in the expert's opinion, not reasonable, please provide details. Please advise whether, in the expert's opinion, it is fair to say the following [from EB-2017-0323, Ex. A/3, p. 15]:

> *"There are well documented concerns with the approach to NTG determination taken by the EC [DNV GL]. The NTG study did not in many instances reflect industry best practice."*

RESPONSE

It is important to acknowledge that judgments are just judgments and that other experienced researchers might have used different judgments in arriving at approaches and methods. In addition, there may be no specific criteria to determine which judgements are more appropriate than alternatives in advance of performing the study.

Rather than debating whether specific judgments are appropriate or not, it may be more useful to highlight where judgments were made by researchers and assess the influence of those judgments. If a judgment is determined to be influential in scoring or producing the study's results, then it can be important to examine alternative judgments that also fall into the set of reasonable judgments. In some cases, judgments can be mistakenly viewed as being facts or research driven assumptions.

For example, DNV made judgments in the scoring algorithm, such as the use of a 48 month cut-off. The Navigant team is not criticizing the DNV or any specific judgments. All research requires certain judgments. After the study is fielded, however, there are now data on how customers answered the timing question. Examining this data in the context of the judgmental assumption can be important. How many respondents provided a specific future-month estimate out to 48 months as the date when they would have undertaken the EE investment offered by the program, or whether they provide brackets, i.e., a lower month and an upper month? These data provide information on potentially useful sensitivity analyses that can be conducted to test the importance of this judgment. This judgment can then be compared to other reasonable but different judgments, which provides insight regarding the robustness of the results under differing assumptions. For example, the assumed scoring for timing seems to

Witnesses: S. Dimetrosky
L. Gage
D. Violette

result in lower NTG values than do the same or similar questions applied in Massachusetts (See Exhibit B, Tab 6, Schedule 2, page 11 of 19). It would be useful to understand how the responses and scoring assumptions drive these different results.

These types of analyses can facilitate stakeholder review of the findings and help reach common agreement regarding the context of the findings, as well as suggest research questions for future NTG studies. This type of process can also be facilitated by the forward looking prospective application of NTG values rather than the retrospective application of NTG estimates.

With respect to "industry best practice," the work by Navigant reviewed best practices in other jurisdictions and in general for self-report studies. A best practice review of the DNV GL was not undertaken; however, some of the best practices outlined in the reports (Exhibit B, Tab 6, Schedule 1 and Exhibit B, Tab 6, Schedule 2) did not seem to be applied. A discussion of methods in this context would be useful for stakeholders.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #84

INTERROGATORY

[B/6/2, p. 13] Please compare and contrast the stakeholder processes in California, Massachusetts, and Illinois with the stakeholder process in Ontario.

RESPONSE

Navigant's jurisdictional review report was designed to present information from three leading jurisdictions regarding stakeholder processes. Navigant was not involved with the Ontario stakeholder process. The case studies set out in the Jurisdictional Review report are meant to be reviewed by stakeholders in Ontario to see how the process there compares with the three case studies.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #85

INTERROGATORY

[B/6/2, p. 14] Please confirm that, all other things being equal, collaborative processes tend to embed a pro-utility bias because the utilities usually have superior resources to apply to those processes relative to customer and environmental groups.

RESPONSE

It is not Navigant's experience that there is a pro-utility bias in collaborative processes due to their having superior resources. Stakeholders often bring in experienced professionals from other jurisdiction that have expertise in NTG policies, uses, and estimation. In some jurisdictions, there may be a designated state-wide evaluation consultant that most often reports to the regulators. These state-wide evaluation consultants often have considerable influence on the process. It has been Navigant's experience that the influence of entities and people in these processes is generally based upon how those contributors are viewed by the collaborative participants in terms of relevant experience and whether they have perspectives that fit with objectives, goals, and situations of that jurisdiction.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #86

INTERROGATORY

[B/6/2, p. 15] Please summarize any research known to the expert on biases in vendor/trade ally answers in triangulation surveys.

RESPONSE

Just as there are concerns regarding response bias in customer/participant surveys, there are concerns with trade ally surveys. The same approaches to mitigate biases used in customer surveys are also used in trade ally surveys. One concern that has been raised is that trade allies might more closely align themselves with program implementers (e.g., utilities) and might sway their answers to be more in line with the utilities' point of view; however, this concern is generally mitigated by the fact that trade ally views can help identify biases in customer responses to self-report surveys. In addition, trade allies can be among the most severe critics of utility EE programs. Overall, it is not clear that there are generally one-directional or systematic biases across the responses of a group of trade allies nor that the biases in vendor/trade ally surveys are more significant and difficult to address than customer/participant surveys.

The general view among the evaluation community is that triangulation is beneficial in NTG studies. The different perspectives and experiences with the program and the way it influences EE actions have proven to be valuable. The three state case studies in Exhibit B, Tab 6, Schedule 1 indicated that triangulation was an approach used in all three states as part of NTG evaluation. Best practice approaches for trade ally and market actor surveys are discussed in Exhibit B, Tab 6, Schedule 4, page 41.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #87

INTERROGATORY

[B/6/2, p. 18] Please describe how self-report survey setup questions have to be designed to avoid the effect of suggesting the desired answer to the respondents.

RESPONSE

An issue in survey and question design is the avoidance of leading questions that can bias respondent answers. One variant of this is acquiescence bias. In responding to survey questions, acquiescence bias can be a tendency for respondents to select an "agree" response more often than a "disagree" response or select a positively worded response category more often than a negatively worded response category, regardless of a question's substance. This bias is typically addressed by not asking "agree" or "disagree" questions (i.e., do you agree or disagree with the following statement). Additionally, questions and responses need to avoid wording that makes one answer or rating seem more desirable than others. This is an important but standard approach to question design and wording.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #88

INTERROGATORY

[B/6/2, p. 18] Please describe how, when working with utility account managers and trade allies to develop hypotheses, the evaluation contractor can avoid introducing bias into the survey design.

RESPONSE

Working with informed program and market actors on the development of hypotheses for attribution and program influence research is generally different than the actual fielding of a survey.

It is important for the evaluation researchers to understand the spectrum of paths by which a program can influence customer participation and investment decisions. The development of process and influence diagrams for review by individuals familiar with the program and target markets / customers may be useful as part of a more flexible interview process. In some cases, these interviews can be conducted with several people at one time, making it similar to a focus group.

This interaction with account managers and trade allies focuses on hypothesis development regarding program influence factors, and there is usually not much concern about bias in this research step. An additional step involves assessing the relative importance of these proposed influence factors. This is tested as part of a research design that may use a self-report surveys. It is in this second step that response biases become more important, and considerable care is required in survey design and questionnaire wording.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

SEC INTERROGATORY #89

INTERROGATORY

[General] Please review the recommendations in Section 5.2.1 of the DNV GL report 2015 Annual Verification dated October 12, 2017, and advise in each case whether the expert agrees with the recommendation, and whether the recommendation, in the expert's opinion, represents best practices.

RESPONSE

The agreement or disagreement with the DNV GL report recommendations in section 5.2.1 are shown in the table below and is based on Table 1-5 from the DNV GL report.

#	Energy Savings and Program Performance Recommendation	Agree / Disagree and Comments
ES1	The utilities should continue in their commitment to accuracy.	Agree, with a comment. In addition to accuracy in engineering estimates of savings, there should also be a commitment to improving processes used to estimate NTG over time. One concern with the recent NTG study is recall bias. Asking customers about what actions they might have taken in the absence of the program where there is a time lag of over two years after participation raises concerns over recall bias affecting NTG estimates. Recall bias is one of the most oft-cited concerns with self-report survey methods, and actions should be taken to reduce the lag between participation and when participants respond to the NTG self-report survey. There should be a statement in the recommendations regarding actions that can be taken to help address recall bias. This time lag may have been unavoidable. It may have been the case that, in the recent DNV NTG study, the time lag between survey and time of participation might have been unavoidable, but this shouldn't be true going forward.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

ES2	Evaluate free-ridership for the programs annually and consider coupling the free-ridership evaluation with process evaluation	Disagree. The narrow focus of the recommendation on only evaluating free-ridership should be expanded to include other components of NTG (e.g., spillover and possibly qualitative judgments of market effects). With respect to the recommendation for free-ridership evaluation to be performed “annually,” it is unlikely that free-ridership will vary substantively from year to year, and annual evaluations of free-ridership likely will cost more to conduct than the value of the information produced by the effort. In addition, these studies should address other components of NTG, including spillover. Some jurisdictions will conduct process evaluations in years that NTG is not being evaluated. This timing helps avoid customer fatigue. Having customers answer process evaluation surveys / interviews, combined with responding to NTG surveys in the same year, could result in customer fatigue. There are a number of research designs that could be considered. For example, a fast-feedback free-ridership survey could be used to address free-ridership factors almost continually. The fast-feedback approach contacts almost every participant via e-mail or phone within a couple of months after participation. This streamlined survey approach can be complemented by a more in-depth NTG study every other year. A number of research design alternatives should be considered that would balance out research costs with the information needed to make program decisions and assess net savings.
ES3	Error ratios from this report inform sample design for future evaluation.	Agree, with a comment. The error ratios should be one factor that is used to inform future sample designs, but the ratios should be augmented with other information. For example, if it is determined that changes in the scoring or questionnaire banks are warranted in future efforts, then the ways in which these changes might impact the standard deviation of the estimates should also be considered.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

ES4	Align the program design with cumulative net goals	Agree.
ES5	Do not pay incentives until after installation is complete.	No Opinion. We do not have the information to express an opinion on the report findings and the resulting recommendation.
ES6	Develop policies to collaborate across electric and gas projects to avoid double-counting fuel savings and increases from energy efficiency measures.	Agree, but potentially complex. Policies should be developed at two levels. At the province level, energy savings from electric and gas projects should avoid double counting. This should be straightforward. At the utility or program implementer level, there are questions about whether the savings from electric and gas projects should be broken out by those attributable to the gas utility and those savings attributable to electric utility efforts. Separating out attribution from joint projects can be difficult and somewhat arbitrary. The Jurisdictional Review (Exhibit B, Tab 1, Schedule 1) examined how attribution was addressed in joint projects in the three case study states, and the Issues Memo (Exhibit B, Tab 6, Schedule 2) also addressed the difficulties of parsing out individual utility attribution. In general, most jurisdictions have not found it useful to try to explicitly estimate the individual utility attribution of savings for joint/collaborative projects.
ES7	Consider establishing a policy to define rules around energy savings calculation for fuel switching and district heating / cooling measures.	No opinion. The Navigant team does not have the information to express an opinion on the findings and the resulting recommendation.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

ES8	Consider establishing a policy that defines an eligibility floor and cap based on simple payback period for energy efficiency projects.	Disagree. This type of policy can have unintended side effects in designing cost-effective programs and providing opportunities for broad participation across customers eligible for a program.
ES9	Consider establishing an official definition for EUL and implementing a study to define EULs for program measures	No opinion. The Navigant team does not have the information to express an opinion on the findings and the resulting recommendation.
ES10	Track metrics for how long it takes from the final installation verification to the posting of incentive payments.	No opinion. The Navigant team does not have the information to express an opinion on the findings and the resulting recommendation.
ES11	Increase transparency of “influence adjustments” and do not include in gross savings	No Opinion. Do not have the information to express an opinion on the findings and the resulting recommendation.
ES12	Conduct a process evaluation to improve Large Volume influence on customer projects	Agree with comment. A process evaluation should be conducted for all large programs. As a note, some free-riders are to be expected in even the most well-designed program, and even relatively high levels of free-ridership are not necessarily bad as long as the program is cost-effective. Often, high levels of free-ridership occur with more mature programs and are accompanied by great amounts of spillover and market transformation / effects.

Witnesses: S. Dimetrosky
L. Gage
D. Violette

		A complete picture of program-influenced energy savings is needed that include all the components of NTG.
ES13	Consider approaches to market that leverage third-party vendors.	Agree with comment. Clearly, this consideration is a best practice for most any EE program. The DNV study found trade ally influence to be relatively low. However, this finding could be due to the survey design where this influence was explored only when the customer “recalled” trade allies as being influential in their decision. Exploring the role of trade allies known to have participated with the program more directly might have shown the influence of these important market actors to be more significant. Customers may not be aware of all the different ways trade allies can influence program savings and, if aware, they may not accurately recall the role of trade allies after a two-year time period. This could have increased the program influence identified in the NTG study.

Witnesses: S. Dimetrosky
L. Gage
D. Violette