uniongas
A Spectra Energy Company

March 7, 2016

BY COURIER & RESS

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

Dear Ms. Walli:

Re: EB-2015-0276 - Union Gas Limited - 2014 Disposition of Demand Side Management Deferral and Variance Accounts – Interrogatory Responses

Please find attached Union's responses to the interrogatories received in the above noted proceeding. The interrogatory responses will be filed in the RESS and copies will be sent to the Board.

If you have any questions concerning this application and evidence please contact me at (519) 436-5334.

Yours truly,

[*Original Signed by*]

Vanessa Innis
Manager, Regulatory Initiatives

cc: Alex Smith (Torys)
EB-2015-0276 Intervenors

Encl.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit A, Tab 2, p. 11

Preamble: The OEB's Decision and Order on Union's clearance of its 2013 DSM accounts application (EB-2014-0273) stated the OEB is supportive of the proposed boiler efficiency base case study in 2015 to be conducted in co-operation with Enbridge with the findings being incorporated in the evaluation of the 2014 results. In its application, Union stated that the Technical Evaluation Committee (TEC) initiated the boiler baseline study in March 2015 and the study results are anticipated in 2016.

a) Please provide the current status of the baseline boiler study.

b) Please provide the meeting minutes from the September 2015 TEC meeting. Please also provide any other documentation providing further insight into the delay in completing the baseline boiler study.

c) Please explain Union's position related to applying the results of the boiler baseline study on a prospective basis following the completion of the study (e.g., not applying the results of the study until 2017) in the context of the OEB's Decision and Order on Union's clearance of its 2013 DSM accounts application (EB-2014-0273) and the OEB's combined Decision and Order on Union and Enbridge's DSM Plans (EB-2015-0029/EB-2015-0049). In your response, please reconcile not applying the results of the boiler baseline study to the program evaluation results of 2014, 2015 and 2016 with the need to ensure that the best and most accurate results are being used when determining lost revenues and shareholder incentive amounts.

d) Please confirm how long the current boiler baseline efficiency figure of 80.5% has been used by Union to evaluate and calculate final program results.

e) Please provide the number of projects that rely on a boiler efficiency base case of 80.5%.

f) Please provide the total amount of savings and the percentage of savings relative to all programs and to only commercial and industrial programs that were attributable to boilers with a thermal efficiency assumed to be 80.5%.

g) Please quantify the shareholder incentive associated with the savings claimed from commercial boilers with 80.5% efficiency.

h) Please compare the current boiler baseline efficiency figure used by Union to those which are used in other leading jurisdictions.

i) Please re-calculate the 2014 shareholder incentive amount using a boiler baseline efficiency standard of 85%.

Response:

a) Union and Enbridge worked collaboratively with the Technical Evaluation Committee ("TEC") to develop the boiler baseline study Request for Proposal ("RFP") for a competitive bidding process and issued the RFP in November 2015. Due to a limited response, the TEC extended the proposal submission date and reposted the RFP. In mid-December 2015, five bidder proposals were received. The TEC did not proceed with the evaluation of the proposals as it was awaiting further instructions from the Board on the selection process and/or transition to the EAC.

   On March 4, 2016 Board Staff issued a memo entitled, "Transition of Technical Evaluation Committee Activities to the OEB EB-2015-0245". With respect to the boiler baseline study this memo indicates, "*Once the proposals have been evaluated and the consultant selected for the Boiler Baseline Study, in order to transition to the new framework, input on the study will be provided to the utilities by the EAC and OEB Staff instead of the TEC*."

b) Please see Attachment 1.

c) Union will follow the Board's 2015-2020 DSM Plan (EB-2015-0029/EB-2015-0049) Decision and Order, dated January 20, 2016, on the matter of applying the outcomes of the boiler baseline study. In its Decision, page 7, the Board states "*any updates to existing input assumptions, or new input assumptions identified during a year, should be applied prospectively when evaluating savings from prescriptive measures.*" The Board also states that this treatment of input assumptions should be effective starting in 2015.

   Union requested confirmation of its interpretation of the Decision in Union's EB-2015-0029 Written Comments, February 3, 2016. In the Board's EB-2015-0029/EB-2015-0049 Revised Decision and Order, page 3, dated February 24, 2016, the Board confirmed Union's interpretation of timing as it relates to the treatment of updated/new input assumptions.

   Results for the boiler baseline study are not anticipated until sometime in 2016. Given the timing of the anticipated boiler baseline results Union anticipates the clearance of its 2014 DSM accounts to be finalized before the boiler baseline study results are available, so they will not impact 2014 Lost Revenue Adjustment Mechanism ("LRAM") or DSM Incentive amounts. Union will apply the results of the boiler baseline study to its 2015 and 2016 LRAM values if the results are finalized before the 2015 and 2016 audits are completed. The results of the boiler baseline study will not impact 2015 and 2016 DSM Incentive as this would not be consistent with the Board's Decision that changes to input assumptions should be applied prospectively. The reason is that it ensures targets and achievements are based on the same set of inputs.

d) The 80.5% thermal efficiency boiler baseline value has been used by Union for prescriptive measures since 2012. Note that not all claimed boiler savings are attributable to boilers with a thermal efficiency assumed to be 80.5%.

e) A total of 85 boiler units in Union's 2014 results rely on a boiler base case efficiency of 80.5%.

f) The total amount of savings attributable to boilers with a thermal efficiency assumed to be 80.5% is 21,105,468 cumulative natural gas savings (m^3).

This represents 1.1% of the savings relative to all programs (Total cumulative natural gas savings (m^3) of all programs equals 1,889,459,431 m^3).

This represents 2.3% of the savings relative to only commercial and industrial programs (Total cumulative natural gas savings (m^3) for commercial and industrial only equals 899,912,291 m^3).

g) The boiler savings associated with an 80.5% base case efficiency have no impact to the DSM Incentive given that both the Resource Acquisition and Low Income Scorecard exceeded the upper band on cumulative gas savings[1].

h) The 80.5% thermal efficiency boiler baseline value is comparable to values used in other leading jurisdictions. Massachusetts, New York, Illinois, California, Minnesota, and the Mid-Atlantic states all use 80%.

i) Please see the response at part g) above. As a result, there is no impact on the DSM Incentive.

[1] Resource Acquisition Scorecard achieved 172% and was capped at 150%, whereas Low Income Scorecard achieved 165% and was capped at 150%.

Approved Technical Evaluation Committee Meeting Minutes
Wednesday, September 16, 2015 (Teleconference, 1pm – 3:30pm)

Intervenor Attendees: Chris Neme, Julie Girvan (1pm-2:40pm), Jay Shepherd

Independent Members: Bob Wirtshafter, Ted Kesik

Enbridge Representatives: Ravi Sigurdson, Marc Hull-Jacquin (chair), Rebecca Mallinson (NTG portion)

Union Representatives: Tina Nicholson, Meredith Lamb

Board Staff Representative: Takis Plagiannakos

1. Committee Issues

The TEC reviewed and endorsed the June and July 2015 TEC Minutes. The action items list was reviewed and updated.

2. Technical Reference Manual (TRM)

a. Subcommittee Update

Enbridge updated the Committee on the current status of the TRM. To date, 24 substantiation documents are completed (11 filed with the OEB, 13 are TEC-endorsed, 8 are under review, 13 require a 1st iteration, of which 11 are boilers). Heat Reflector Panels and Commercial Showerheads also require a 1st iteration.

b. Prescriptive Boilers Savings Methodology

In an attempt to resolve ongoing challenges relating to savings assumptions and calculations of boiler-related substantiation documents, C Neme highlighted three options for consideration by the TEC:

1. Adopt a calculation of natural gas savings based on thermal efficiency;
2. Endorse the current substantiation documents for application to savings claimed by the utilities in 2015. Upcoming boiler related study results (anticipated in 2016) would apply to future savings.
3. Do not endorse the current substantiation documents and have the utilities risk filing the existing savings assumptions without TEC endorsement.

Factors influencing the decision include the following:

- In October 2014, Enbridge provided a presentation to ERS Inc. and the TRM subcommittee that explained the various features that could be added to a boiler in the Enbridge eTools software. Enbridge provided its rationale for how much it felt each feature improved the boiler's efficiency.
- ERS Inc. was unable to identify a comparable method in other jurisdictions, as these tend to employ a savings calculation based on thermal efficiency. The subcommittee is of the view this method understates energy savings, the degree to which will be under review in the Boiler Baseline Study (completion in 2016).

Agreements

- The TEC endorsed the current savings assumptions for prescriptive boilers for application to savings claimed by utilities for their respective 2014 DSM Audits and Clearance of DSM Accounts. For the Board's benefit, the utilities will include language explaining the added expiration date of December 2015, in the upcoming Annual Input Assumptions filing.

c. TRM Online Component (MindTouch)

Enbridge confirmed with MindTouch that T Plagiannakos will be their primary contact. The utilities are currently finalizing the contract with MindTouch, pending international tax considerations.

3. Board Staff update on Evaluation Advisory Committee (EAC)

T Plagiannakos indicated his office is encountering time challenges due to competing demands, and that an RFP for the Evaluation Contractor (EC) would not likely be drafted for comment by the new EAC until late October. TEC members expressed concern that this timeline will cause the utility audit processes to be significantly delayed while noting the high improbability of the utility DSM Annual Reports meeting a filing deadline of April 30, 2016.

TEC members and T Plagiannakos discussed possible roles and responsibilities of the EC. In particular, members recommended avoiding bias or conflicts of interest by separating the administration of the evaluation and audit processes from implementation of these. For example, members suggested the EC's role could incorporate the following:

- Maintain and update the Technical Reference Manual;
- Advise the EAC on evaluation priorities; and
- Draft Requests for Proposals for audit and evaluation projects.
- If the EAC felt certain projects didn't pose a threat of bias, they could assign them to the EC as appropriate.

Agreement

- Board Staff will call a meeting of the EAC in the first week of October, 2015. Discussion will include:
    - defining members' roles and responsibilities (possibly in the form a Terms of Reference); and
    - including the combined expertise of the appointed stakeholder representatives and utilities in gaining input for the draft RFP for the Evaluation Contractor.

4. Boiler Baseline Study (BBS)

The TEC endorsed the BBS Request for Proposal for inclusion in a Request for Intent to Bid. However, some members felt it would be more appropriate to include the BBS Request for Proposals with the Request for Proposals to conduct an analysis of the inputs used to calculate boiler annual seasonal efficiency savings (currently in development).

Agreement

- The TEC endorses the BBS Request for Proposal.
- The BBS Request for Proposal will be sent to solicit intents to bid when the Request for Proposal to conduct an analysis of the inputs used to calculate boiler annual seasonal efficiency savings is complete.

5. Net to Gross Study

The Subcommittee was unable to meet in August due to vacations and the DSM Plan proceedings. The next meeting is scheduled for September 24, 2015. The goal of this meeting will be to discuss 2013 audit recommendations relating to the NTG study as well as the project timeline and next steps, such as the consultant's work plan and transferring data from the utilities to the consultant.

6. Persistence Study

In response to questions posed to Board Staff at the July 2015 TEC meeting on the value and appropriateness of conducting a Persistence Study, T Plagiannakos indicated the current broad concept of the study would be to:

- Confirm that a measure is still in place and in use; and
- Confirm the actual savings persistence of the installed measure.

TEC members and Board Staff discussed when and how to transfer the TEC's initial work to the new EAC. Members highlighted the direction provided in an August 2015 letter from OEB (pg.4) where "initiation of a Persistence Study" is listed among the TEC's ongoing work. TEC members urged Board Staff to consider transferring their work to the EAC before a RFP is drafted and a vendor selected.

Note: On September 17, 2016, Board Staff was of the view that "the work that has been initiated by the TEC with respect to the Persistence Study will be transitioned to the Board in October [2015] when the first Evaluation Advisory Committee meeting is planned to take place."

Upcoming Meetings: November 24, 2015

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit A, Tab 3, p. 1

Preamble: The Lost Revenue Adjustment Mechanism (LRAM) deferral account has a debit balance of $0.848 million which includes volume savings for contract rate classes related to 2013 audited full year DSM activities at 2014 rates and the audited monthly volumes related to 2014 DSM activities at 2014 rates. The balance does not include volume variances for general service rate classes, as the LRAM volume impacts were captured in the Normalized Average Consumption deferral account that was disposed of in Union's 2014 Disposition of Deferral Account Balances (EB-2015-0010) proceeding. Union notes that this treatment is consistent with the Settlement Agreement approved by the OEB in Union's 2014-2018 Incentive Regulation Mechanism (IRM) Agreement (EB-2013-0202).

a) Please explain why the LRAM deferral account includes amounts related to 2013 DSM activities and why these amounts were not subject to disposal in a previous proceeding.

b) Please explain, and provide specific references, for how the LRAM volume impacts for the general service class was captured in the Normalized Average Consumption deferral account that was disposed of in Union's 2014 Disposition of Deferral Account Balances proceeding (EB-2015-0010).

c) Please provide details on the treatment of lost revenues compared to forecasted DSM impacts as outlined in the Settlement Agreement approved by the OEB in Union's 2014-2018 IRM proceeding (EB-2013-0202).

d) Please discuss, and provide the detailed calculations with live excel working files, of Union's load forecast that was used to determine the 2014 LRAM balance of $0.848 million. In particular, please discuss and clearly show the following:

i. How the load forecast was adjusted to account for DSM activity,
ii. What assumptions were used related to DSM savings estimates for different programs (and offerings) and how these estimated savings were allocated to the applicable rate classes,
iii. What level of historic DSM savings (those from previous years that are assumed to persist in the future) were built into the load forecast regression analysis;
iv. What level of new, estimated DSM savings for future year DSM programs (e.g., those included within the 2015-2020 DSM plan) were built into the load forecast through a manual adjustment, and

v. Clearly show how Union has applied its final DSM evaluation results to the reductions made to its load forecast in order to calculate the LRAMVA amount.

e) Please discuss and clearly show the programs (and/or offering) and the final net savings from these programs (and/or offerings) that contributed to the actual net partially effective savings figures for all rate classes outlined in the table shown in Exhibit A, Tab 3, Schedule 2, Page 3 of 3 - LRAM 2014 – Audited. If appropriate, please similarly comment on the programs that have contributed savings in Table 11.0 – 2014 LRAM Statement, Page 106 of Union's 2014 Annual Report.

f) Please show how the savings shown in Appendix E of Union's 2014 annual report have been attributed to the available DSM programs offered to customers and how the total savings from Union's DSM programs have been applied to the various rate classes.

g) Please discuss why there have been no LRAM volumes in 2014 rates from either the 2013 or 2014 program years.

h) Please discuss the process that Union undertakes in updating its load forecast to account for DSM savings and the regularity of updates made to its forecast to account for new reductions in natural gas usage attributable to DSM programs (e.g., is this on an annual basis, at the time of Union's cost of service, etc.).

i) Please explain your approach to developing your load forecast and taking into account impacts of DSM activities in the context of Section 12 of the DSM Guidelines (EB-2008-0346) which states:

> "Utilities recover their allowed distribution revenues through both a fixed and a variable distribution rate. These rates are based on forecast consumption levels for their respective franchise area that **take into account, among other things, the expected impact of naturally occurring energy conservation and the impact of planned DSM activities** [emphasis added]. If the actual impact of natural gas DSM activities undertaken by the natural gas utility in its franchise area results in greater (less) natural gas savings than what was incorporated into the forecast, the natural gas utility will earn less (more) distribution revenue than it otherwise would have, all other things being equal.

Further, the DSM Guidelines state:

"…the LRAM amount is a retrospective adjustment and may be an amount refundable to or receivable from the utility's customers, depending respectively on whether the actual natural gas savings resulting from the natural gas utility's DSM activities are less than or greater than what was included in the forecast for rate-setting purposes."

Response:

a) The 2013 audited first year Lost Revenue Adjustment Mechanism ("LRAM") monthly volumes related to 2013 DSM activities at 2013 rates were addressed in the 2013 DSM Deferral filing (EB-2014-0273). The audited 2013 full year DSM activities at 2014 rates for contract rate classes are included in this proceeding as there were no contract rate class LRAM volumes for 2013 or 2014 included in 2014 rates.

b) Per Exhibit A, Tab 1, pages 25-26 (Corrected) of Union's 2014 Deferral Account Disposition and Earnings Sharing proceeding (EB-2015-0010) evidence:

> *"The 2014 forecast NAC for each rate class was determined in EB-2013-0202 and approved by the Board in Union's 2014 Rates proceeding (EB-2013-0365). The 2012 actual NAC, weather normalized using the 2014 weather normal was used to determine the 2014 forecast NAC. Setting the 2014 forecast NAC based on the 2012 actual NAC recognizes that over the two year span to the current year, any saved volumes and associated lost revenues due to Demand Side Management ("DSM") will be captured by the variance between the target and the actual consumption. This is because the DSM saved volumes are included within the actual reported consumption"*.

As noted above, the 2012 actual Normalized Average Consumption ("NAC") used to determine the 2014 forecast NAC represents Union's actual 2012 billed consumption (weather normalized). The actual 2012 billed consumption includes any volume impacts (LRAM) associated with Union's DSM activities.

Similarly, the 2014 actual NAC for each rate class is weather normalized using the 2014 weather normal, which is based on the Board-approved 50:50 blended weather methodology that incorporates both the 30-year average and 20-year declining trend estimates of annual heating degree-days. The 2014 actual NAC represents Union's actual 2014 billed consumption and includes any volume impacts (LRAM) associated with Union's DSM activities.

The NAC Deferral Account is intended to record the variance in revenue between forecast (Board-approved) and actual NAC for the general service rate classes. These variances include the impacts of changes in average use and Union's DSM activities. Accordingly, the forecast and actual NAC use actual billed consumption (weather normalized), which inherently includes any LRAM volume impacts.

c) LRAM is addressed in Union's 2014-2018 Incentive Regulation proceeding (EB-2013-0202), Settlement Agreement, Section 6.4, page 16 , where it states, *"[t]he parties agree that contract rates will be adjusted annually to take into account volume reductions due to DSM activity (LRAM) per the Board's EB-2011-0327 Decision or any subsequent Decision"*.

In EB-2013-0202, at Exhibit A, Tab 1, page 28 Union describes LRAM as follows:

> *"Union's DSM programs result in volume consumption reductions for all rate classes. During Union's 2008-2012 IRM, Union adjusted the volumes to calculate rates through the annual rate setting application to capture the LRAM volume impacts for all rate classes.*
>
> *For the 2014-2018 IRM, Union would continue this process for the contract rate classes. As noted in Section 4.6 above, Union would adjust the volume to calculate rates for General Service rate classes using NAC during the 2014-2018 IRM, which includes the LRAM volumes."*

As described further at part d) below, Union does not include an estimate of DSM savings in the determination of its volume forecast for rate setting purposes.

d)

i) The volume forecast used in the determination of Union's 2014 rates (EB-2013-0365) was the 2013 Board-approved volume forecast adjusted for 2012 audited LRAM volume impacts. As noted in the 2013 DSM Deferrals proceeding (EB-2014-0273) Exhibit A, Tab 4, page 2 (Corrected), the 2011 LRAM volume impacts was not reflected in 2013 Board-approved volume forecast.

ii) Union did not include an estimate of DSM savings for 2013 or 2014 in its volume forecast used to determine 2014 rates. The total LRAM from both of these years is being sought for recovery in the LRAM deferral account through this proceeding.

iii) Please see the response to part i) above.

iv) Union did not include an estimate of DSM savings for future years in its volume forecast used to determine 2014 rates.

v) The volume forecast used in the determination of Union's 2014 rates did not include an impact for estimated 2013 or 2014 LRAM volume adjustments. Therefore, the volumes used in Exhibit A, Tab 3, Schedule 2, pp. 2 and 3 reflect the post evaluation LRAM volumes. 2014 audited LRAM Volumes reflect those found in the 2014 Annual Report (audited by Evergreen Economics), Exhibit B, Tab 1, Table 11.0, page 106. 2013 audited LRAM volumes reflect those filed by Union in its 2015 Rates (EB-2014-0271) final Rate Order, Working Papers, Schedule 17, dated December 4, 2014.

e) Please see Attachment 1.

f) Please see Attachment 2.

g) The 2013 and 2014 LRAM volumes were not included in 2014 rates due to the timing of the audited DSM results relative to the timing of the 2014 rates application. The Final DSM

2013 Annual Report is dated November 4, 2014 and the Final DSM 2014 Annual Report is dated December 4, 2015 which are both subsequent to the filing of the 2014 Rates application dated October 31, 2014.

h) LRAM volume adjustments for contract rate classes are treated as a Y-factor adjustment which is subject to annual pass-through when setting rates. Forecast volumes of contract rate classes are adjusted annually to take into account volume reductions due to DSM activity (LRAM).

Initially LRAM volume adjustments are managed through DSM deferrals in the year and year following their occurrence. Once audited LRAM volumes are available, LRAM volume savings are used to adjust the volume forecast in the annual rate setting process. Based on the timing indicated in g) above, the audited 2013 volumes are reflected when setting Union's 2015 rates. Similarly, the audited 2014 volumes were reflected when setting Union's 2016 rates.

i) Please see the response to part h) above.

UNION GAS LIMITED
LRAM Volumes by Rate Class & Program
2014 Program Year

Line No.	Particulars (m^3)	C/I Prescriptive	C/I Custom	Large Volume	Total LRAM Volumes
		(a)	(b)	(c)	(d) = (a) + (b) + (c)
	South				
1	M4	70,117	7,735,137	-	7,805,254
2	M5	39,173	6,346,674	-	6,385,847
3	M7	64,058	6,381,888	-	6,445,946
4	T1	-	-	2,733,487	2,733,487
5	T2	-	-	29,053,637	29,053,637
		173,347	20,463,699	31,787,123	52,424,170
	North				
6	Rate 20	19,576	3,936,891	-	3,956,466
7	Rate 100	-	-	17,300,456	17,300,456
8		19,576	3,936,891	17,300,456	21,256,922
9	Total	192,923	24,400,590	49,087,579	73,681,092

UNION GAS LIMITED
Net Cumulative Gas Savings by Program
2014 Program Year

Line No.	Particulars (m^3)	2014
		(a)
	Resource Acquisition	
1	Residential	61,659,518
2	Commercial/Industrial Prescriptive	216,057,244
3	Commercial/Industrial Custom	683,855,048
		961,571,810
	Low Income	
4	Low Income Single Family	36,105,326
5	Low Income Multi Family - Prescriptive	19,187,677
6	Low Income Multi Family - Custom	2,399,166
		57,692,169
	Large Volume	
7	Large Industrial T1	81,607,775
8	Large Industrial T2	502,418,895
9	Large Industrial R100	286,168,782
		870,195,452
10	Total	1,889,459,431

UNION GAS LIMITED
Net Cumulative Gas Savings by Rate Class
2014 Program Year

Line No.	Particulars (m^3)	2014
		(a)
	South	
1	M1	160,332,269
2	M2	226,921,542
3	M4	158,261,751
4	M5	137,169,780
5	M7	121,481,034
6	T1	81,607,775
7	T2	502,418,896
		1,388,193,047
	North	
8	Rate 01	37,885,819
9	Rate 10	49,122,039
10	Rate 20	128,089,744
11	Rate 100	286,168,782
		501,266,384
12	Total	1,889,459,431

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 3, pp. 4-5

Preamble: In response to the 2014 Audit recommendation #5, Union discusses that it has developed a formalized approach to capture customer's standard maintenance and operations practices via a standard form. Union stated it will use this form to support the base case and demonstrate incremental savings from the customer's standard practices.

a) Please provide a copy of the standard form for Operations & Maintenance (O&M) projects used for the 2015 audit.

b) Please discuss the approach that Union plans to undertake in documenting the baseline for 2015 O&M projects.

c) Please discuss whether or not Union has developed specific questions to solicit proper documentation of the baseline for behavioural and maintenance projects.

Response:

a) Union developed six standard project base case documentation forms for use with all custom DSM projects beginning in 2015. These forms include two forms applicable to O&M projects and four additional forms applicable to equipment projects. Please see the attachments as listed for the base case documentation forms:

    1. Attachment 1 - O&M Maintenance Projects
    2. Attachment 2 - O&M Optimization Projects
    3. Attachment 3 - Equipment – Add-on/ New Projects
    4. Attachment 4 - Equipment – New Construction Projects
    5. Attachment 5 - Equipment – New Upgrades Replacement Projects
    6. Attachment 6 - Equipment – Replacement Projects

b) All 2015 custom projects required a completed base case documentation form. Union developed two project base case documentation forms, and related discussion points, for 2015 custom maintenance project applications to:

- Capture details relevant to how a customer maintains its system;
- Determine how Union's DSM program influences the amount of maintenance completed; and,
- Assess the priority of the maintenance work (i.e. influencing the customer's behaviour in prioritizing this work).

Union developed each base case documentation form with related discussion points as they are essential to determine an appropriate project baseline for each custom project. Only savings from the portion of maintenance that was incremental to what the customer would have done in the absence of Union's DSM program were claimed in 2015.

c) Union did not develop a script of specific questions. As described in the responses to part a) and part b) above, Union developed the six separate documentation forms with specific sections and discussion points identified above to allow the form to be completed in consultation with the customers for all custom projects to facilitate proper project base case documentation.

Custom Project Base Case Summary

O&M Maintenance Projects

Project ID: ______________________ **Meeting Date:** ______________________

Customer: ______________________

Contact Name: ______________________

Contact Title: ______________________

Is this work mandated through any regulation, safety concerns, or to maintain equipment / manufacturer warranty? (No or Partial)

____

(if partial, please explain what % was safety, regulation, or warranty related and why)

O&M – Maintenance[1] Projects

Do you have a documented maintenance practice for this repair activity? Please explain.

Would you have completed the optional repairs without the DSM program? (No or Partial)

____

(if partial, please explain what "minimum"[2] % would be completed)

Energy efficient project description:

Additional comments (optional):

[1] An O&M "Maintenance" project is one in which a customer has completed maintenance to improve energy performance (e.g. steam leak, condensate leak, steam trap repairs), as opposed to continuing to operate less efficiently (i.e. "as-is").
[2] The "minimum" amount of repair identified will represent the reduction factor applied to the project savings.

Custom Project Base Case Summary

O&M Optimization Projects

Project ID: ______________________ **Meeting Date:** ______________________

Customer: ______________________

Contact Name: ______________________

Contact Title: ______________________

Is this work mandated through any regulation, safety concerns, or to maintain equipment / manufacturer warranty? (No or Partial)

____

(if partial, please explain what % was safety, regulation, or warranty related and why)

O&M – Optimization[1] Projects

Description of existing process / system:

(age of existing process, available specifications, confirmation that existing process could have continued to operate as-is)

Energy efficient project description:

Additional comments (optional):

[1] An O&M "Optimization" project is one in which a customer has modified their existing process to use energy more efficiently (e.g. line speed improvement), as opposed to continuing to operate "as-is".

Custom Project Base Case Summary

Equipment - Add-on/New Projects

Project ID: ____________________ **Meeting Date:** ____________________

Customer: ____________________

Contact Name: ____________________

Contact Title: ____________________

Is this work mandated through any regulation, safety concerns, or to maintain equipment / manufacturer warranty? (No or Partial)

____

(if partial, please explain what % was safety, regulation, or warranty related and why)

Equipment – Add-on[1] / New[2] Projects

Base case description:

Energy efficient project description:

Additional comments (optional):

[1] Equipment "Add-on" projects are those in which a customer added a new piece of equipment onto their system that did not exist previously to improve energy efficiency, as opposed to operating "as-is".
[2] "New" Equipment projects are those in which a customer purchased and installed a new piece of equipment that is more energy efficient than what they otherwise would have purchased.

Custom Project Base Case Summary

Equipment - New Construction Projects

Project ID: ____________________ **Meeting Date:** ____________________

Customer: ____________________

Contact Name: ____________________

Contact Title: ____________________

Is this work mandated through any regulation, safety concerns, or to maintain equipment / manufacturer warranty? (No or Partial)

____

(if partial, please explain what % was safety, regulation, or warranty related and why)

Equipment – New Construction[1] Projects

Base case description:

Energy efficient project description:

Additional comments (optional):

[1] A "New Construction" Equipment project is one in which a customer has built a more energy efficient building beyond the requirements of the Ontario Building Code.

Filed: 2016-03-07
EB-2015-0276
Exhibit C.Staff.3
Attachment 5

Project ID: ____________________

Customer: ____________________

Contact Name: ____________________

Contact Title: ____________________

Meeting Date: ____________________

Is this work mandated through any regulation, safety concerns, or to maintain equipment / manufacturer warranty? (No or Partial)

____

(if partial, please explain what % was safety, regulation, or warranty related and why)

Equipment – New Upgraded Replacement[1] Projects

Description and "remaining useful life"[2] of existing equipment:

(Specifications, model, age, and for how long would you have continued to use the original equipment in its less efficient condition?)

Description of the new purchased equipment (high efficient case):

Description of the less efficient option that the customer would have otherwise purchased:

Additional comments (optional):

[1] "New Upgraded Replacement" Equipment projects are those in which a customer could have continued to use their original equipment for a defined period of time, but chose to retire that piece of equipment early. The customer must have purchased and installed a new piece of equipment that is more energy efficient than what they otherwise would have purchased.

[2] The "remaining useful life" represents the length of time a customer would have continued to use a piece of equipment in its original condition (instead of replacing it). The "remaining useful life" will determine the lifetime for estimating project savings if it is less than the replacement equipment's EUL.

Custom Project Base Case Summary
Equipment - Replacement Projects

Project ID: ____________________ **Meeting Date:** ____________________
Customer: ____________________
Contact Name: ____________________
Contact Title: ____________________

Is this work mandated through any regulation, safety concerns, or to maintain equipment / manufacturer warranty? (No or Partial)

____

(if partial, please explain what % was safety, regulation, or warranty related and why)

Equipment – Replacement[1] Projects

Description of existing equipment / system:

(specifications, model, age)

"Remaining useful life"[2] of existing equipment:

(for how long would you have continued to use the original equipment in its less efficient condition?)

Energy efficient project description:

Additional comments (optional):

[1] Equipment "Replacement" projects are those in which a customer replaced an existing piece of equipment with a "1-for-1" equivalent to improve energy efficiency, as opposed to operating "as-is".
[2] The "remaining useful life" represents the length of time a customer would have continued to use a piece of equipment in its original condition (instead of replacing it). The "remaining useful life" will determine the lifetime for estimating project savings if it is less than the replacement equipment's EUL.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 3, pp. 5-6

Preamble: In the 2014 Audit recommendation #6, the Auditor noted that "to identify obvious free riders, a possible criterion is to have projects with a simple payback of less than one year be ineligible for the program. In the 2014 Audit recommendation #8, the Auditor noted that steam leaks, steam traps repairs, and condensate leaks fall into this category, each often resulting in paybacks of less than one year. In Union's response to these recommendations, Union confirmed that it will no longer be incenting projects classified as O&M Repair as of 2016.

a) Please explain why Union did not apply the 2014 Audit recommendation in the 2014 results.

b) Please discuss how Union is planning to incorporate the audit recommendations into the 2015 audit.

Response:

a) The AC reached consensus on the recommendations, accepted all modifications to Union's claims as appropriate, and rendered its opinion on policy based and forward-looking program design recommendations as outlined in the Audit Summary Report, Exhibit B, Tab 3.

Given the timing of the audit, Union was able to provide additional context that it had considered these recommendations and was proposing modifications to program design to address the concerns outlined by the Auditor and the AC.

The Auditor adhered to the objectives, scope and requirements set forth in the Request for Proposal ("RFP"). This included proposing modifications where the Auditor deemed it necessary and appropriate, as well as identifying assumptions in program design that should be modified prospectively. The Auditor then issued its independent opinion that Union's claims were accurate in all material aspects.

As outlined in The Joint Terms of Reference on Stakeholder Engagement for DSM Activities (EB-2011-0295), the scope of work for the Audit Committee ("AC") is to make recommendations based on the Audit Report and endeavour to reach consensus on recommendations concerning the utility's claims regarding DSM annual results.

Recommendations #6 and #8 were broad policy recommendations regarding classes of projects which, in the Auditor's professional opinion, should be ineligible under a DSM program. If and where this impacted Union's actual 2014 claims, the Auditor recommended project level adjustments.

b) Exhibit B, Tab 3 contains the AC's response and agreements by recommendation. In particular, in the resolution for Recommendation #6 it states, *"[t]he AC also agrees that if classes of projects – including projects below a certain payback threshold – are to be made ineligible that this policy should be established in advance"* (page 5). No such policy was established for projects in 2015.

With respect to payback thresholds, in its 2015-2020 DSM Plan (EB-2015-0029/EB-2015-0049) Decision and Order dated January 20, 2016, the Board did not direct Union to change its program selection criteria to require all participants to have a payback of at least one year (page 21) to address free ridership concerns in the custom program. The Board found that, *"implementing a payback threshold of greater than one year may exclude some free riders but does not fully address this issue."*

On August 21, 2015 the Board issued a letter regarding the 2015-2020 DSM Evaluation Process of Program Results (EB-2015-0245). The letter describes the general role of the main parties involved in the evaluation process. As directed in the letter, Union is working with the newly formed EAC for the 2015 program evaluation process.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 1, p. 97 and Exhibit B, Tab 2, p. 11

Preamble: Union's Audit Committee (AC) accepted the 2013 Audit recommendation #7 that "interactions between Union and customers need to be documented in the project file as they occur if they are to be used as support for claiming projects are not free riders." In the status update, Union stated that it will continue to refine the custom project documentation included in project files.

In the 2014 Audit Report, the Auditor revealed that in conversations with Union during the audit process, there has still been no significant process to date on documenting standard maintenance practices. The Auditor further noted that the verifiers were unaware that maintenance practices needed to be documented … [and] it was clear from our meetings and the CPSV reports that the verifiers had not considered this as part of their job requirements" (p. 11 of 2014 DSM Audit Report).

a) Please explain why Union did not put greater effort into documenting the customer's maintenance practices to substantiate the 2014 project savings.

b) Please explain how the lack of documentation of standard practices has affected the estimation of 2014 project savings.

Response:

a) In 2014, Union worked appropriately with customers and relied on its judgement and expertise to screen out savings from projects that would have otherwise been completed without the DSM program. Union's experience, based on its long-term account managed customer relationships, is that many of its customers do not have formally documented maintenance practices, or a workflow management system; in such cases, Union has provided log sheets to customers to complete in order to track repairs that are eligible for the DSM program.

b) The Audit finding of "lack of documentation" did not affect Union's original estimation of 2014 project savings; however, through the 2014 audit process, Union's claimed net savings were reduced by 50%.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 3, p. 4

Preamble: In response to the 2014 Auditor's recommendation #3, Union discusses that conducting new free ridership studies each year using a sample from the current year's custom participants is unreasonable given the separate net-to-gross study underway.

a) Please discuss what changes are required to Union's audit process to incorporate annual free ridership assessments in the 2015 CPSV custom project review.

b) Please discuss the issues, if any, in implementing free ridership assessment questions as part of the 2015 custom project review.

c) Please discuss the general approach and what evidence should be collected from customers to determine how project advancements will be determined in the 2015 audit. This question seeks to follow-up on the C/I verifier's comment that "there was no hard evidence to suggest *which* measures would have been excluded and *when* this may otherwise have occurred" (Exhibit B / Tab 2 / 2014 C&I Custom Projects, p. 7).

Response:

a) To clarify, in Recommendation #3 of the Independent Audit of the 2014 Program Results, Exhibit B, Tab 2, page 4, the Audit Committee ("AC") noted that a number of the details about how Net-to-Gross ("NTG") ratios should be monitored and adjusted may be resolved by the parties following the study currently underway by the Technical Evaluation Committee ("TEC"). Subject to the outcome of that study, and a review of the cost-effectiveness of regular NTG studies, the AC agreed that annual studies are preferable due to the large contribution of custom projects to total savings. The AC agreed that it is not reasonable to conduct a separate NTG study for the purposes of 2015 audit given the current work underway.

   Union will adhere to the evaluation process outlined in Section 7.1 of the Board's Guidelines (EB-2014-0134) and further detailed in the August 21, 2015 Board letter (EB-2015-0245). Part of the newly outlined DSM Evaluation Governance involves a third party Evaluation Contractor retained by the Board. The Evaluation Contractor will draft an Evaluation, Measurement & Verification ("EM&V") Plan for the natural gas utilities' DSM programs for approval by the Board. The detailed annual evaluation and audit process will be developed as part of the EM&V plan. Union cannot comment on changes required to facilitate this type of assessment since the new audit process for 2015 has yet to be determined.

b) Implementing free ridership assessment questions as part of the 2015 custom project review would be duplicative and conflict with the NTG study currently underway, which is based on 2013-2015 participant data. In Recommendation #3, the AC also noted the need to review the cost-effectiveness of regular NTG studies.

However, Union will adhere to the evaluation process outlined in Section 7.1 of the Board's Guidelines (EB-2014-0134) and further detailed in the August 21, 2015 Board letter (EB-2015-0245). The Evaluation Contractor will carry out the evaluation and audit processes of all DSM programs, including undertaking NTG studies. Union expects implementation timelines to be determined by the Evaluation Contractor with input from the Evaluation Advisory Committee.

c) Considerations for advancement are unique and dependent on individual customer circumstances. Union works with customers to identify advancement opportunities, such as "early replacement" projects, where a customer has advanced the replacement of less efficient technology that is still functioning with more efficient, new technology. Union has documented the condition of the equipment that is replaced and relies on its judgement based on discussions with customers to identify appropriate advancement.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, p. 19

Preamble**:** The Auditor noted that an adjustment of 50% has been applied to all projects involving steam leak repairs. Further, the Auditor noted that a 50% adjustment is based on professional judgment, as it was beyond the scope of the audit to attempt to quantify actual savings above baseline for these measures.

a) Please confirm whether the 50% reduction to the steam leak savings projects is based on evidence or any past practice from prior audits.

b) Please provide any additional reference, or rationale, for why a 50% reduction was chosen.

c) Please discuss whether Union's AC or the TEC has commented on the appropriateness of a 50% reduction to the savings from steam leak repairs.

Response:

a) As referenced, the 50% reduction was based on the Auditor's professional judgement. The Auditor did not have an estimate of how much the current values overstate savings for these measures. There is no precedent from prior audits where a blanket adjustment has been made specifically to this class of projects.

b) In addition to the rationale noted in part a) above, at Exhibit B, Tab 2, page 19, the Auditor also stated, *"We believe that 50 percent is a fair adjustment, as a 100 percent adjustment is likely too extreme and a 0 percent adjustment too low."*

c) The Audit Committee ("AC") accepted the Auditor's recommendation and the resulting decrease in the net cumulative natural gas savings for steam leak projects from their verified values (please see Exhibit B, Tab 3, page 8, Recommendations #13 and #14). No discussion has occurred at the Technical Evaluations Committee ("TEC") to assess the appropriateness of this reduction as it is falls within the purview of the AC.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, Tables 6-9 (Low Income Custom Projects), pp. 15-18
Exhibit B, Tab 2, Tables 10-13 (Commercial/Industrial Custom Projects), pp. 21-29
Exhibit B, Tab 2, Tables 14-17 (Large Volume Projects), pp. 32-41

a) Please provide a table indicating whether the Auditor considered there was adequate documentation of the baseline conditions with the projects listed in the references above.

b) In a separate table, please indicate the type and number of studies that have been financed by Union and the corresponding projects.

Response:

a) The following was prepared by Evergreen Economics:

Table 1 - Low Income Custom Project Baseline Adequacy

CPSV ID	Project Description	Baseline Adequacy
2014-COM-0095	Roof Insulation	Adequate
2014-COM-0282	VFD on MAU	Adequate
2014-COM-0299	Windows	Adequate
2014-COM-0179	VFD on MAU	Adequate
2014-COM-0181	VFD on MAU	Adequate
2014-COM-0300	Windows and Doors	Adequate
2014-COM-0302	Windows	Adequate
2014-COM-0312	HVAC Controls	Adequate
2014-COM-0306	Solar Pre-Heater	Adequate
2014-COM-0313	HVAC Controls	Adequate

Table 2 - Commercial/Industrial Project Baseline Adequacy

CPSV ID	Project Description	Baseline Adequacy
2014-IND-0178	Steam leak repairs	Inadequate
2014-IND-0569	Multi-measure process and energy intensity upgrades	Adequate
2014-COM-0087	High efficiency, direct fired h&V unit	Adequate
2014-IND-0183	Insulate dryer drum	Adequate
2014-IND-0112	Steam leak repairs & 2 process heating coil replacements	Inadequate
2014-IND-0166	Process oven burner upgrade and heat recovery	Adequate
2014-IND-0056	Deaerator heat recovery	Adequate
2014-COM-0079	Steam leak repairs	Inadequate
2014-COM-0051	Greenhouse expansion - multi-measure	Adequate
2014-IND-0025	Greenhouse expansion - multi-measure	Adequate
2014-IND-0024	Greenhouse expansion - multi-measure	Adequate
2014-IND-0114	Greenhouse expansion - multi-measure	Adequate
2014-IND-0172	Insulation of steam supply lines	Adequate
2014-COM-0320	Greenhouse expansion - multi-measure	Adequate
2014-IND-0021	Greenhouse expansion - multi-measure	Adequate
2014-IND-0022	Greenhouse expansion - multi-measure	Adequate
2014-IND-0570	Insulate steam, condensate, hot water piping	Adequate
2014-IND-0333	Heat exchanger upgrade	Adequate
2014-IND-0210	Heat exchanger upgrade	Adequate
2014-COM-0240	Upgrade building systems to LEED standards	Adequate
2014-IND-0115	Steam leak repairs	Inadequate
2014-IND-0261	Insulate piping, valves and heat exchangers	Adequate
2014-COM-0345	Boiler control upgrades and adjustments	Adequate
2014-COM-0239	Upgrade building systems to LEED standards	Adequate

Table 3 - Large Volume Project Baseline Adequacy

CPSV ID	Project Description	Baseline Adequacy
2014-IND-0649	Steam leak repairs	Inadequate
2014-IND-0670	Steam leak repairs	Inadequate
2014-IND-0487	Steam leak repairs	Inadequate
2014-IND-0664	Steam trap replacements	Inadequate
2014-IND-0356	Steam trap replacements	Inadequate
2014-IND-0522	Steam trap replacements	Inadequate
2014-IND-0452	Process improvement to allow productive use of steam generated on weekends	Adequate
2014-IND-0675	Evaporator steam injector repair	Adequate
2014-IND-0371	Control programming to close dampers when OA not needed for process	Adequate
2014-IND-0620	Repair of boiler preheater	Adequate
2014-IND-0612	Re-route condensate from condensing turbine back to boiler	Adequate
2014-IND-0615	Burner upgrade on process furnace	Adequate
2014-IND-0608	COG pipeline replacement/cleaning	Adequate
2014-IND-0622	COG pipeline replacement	Adequate
2014-IND-0431	Feedwater economizer on backup boiler	Adequate
2014-IND-0299	High-efficiency turbine generator	Adequate
2014-IND-0287	Kiln insulation replacement	Adequate
2014-IND-0543	Steam trap repairs	Adequate
2014-IND-0609	COG pipeline replacement/cleaning	Adequate
2014-IND-0630	Pipe insulation repairs	Adequate
2014-IND-0632	Pipe insulation repairs	Adequate
2014-IND-0667	Pipe insulation repairs	Adequate

b) Please see Attachment 1.

Type and Number of Studies with Corresponding Projects Financed by Union

Low Income:

Project ID	Supported by Study?	Study ID	Type of Study
2014-COM-0095	Yes	2010-COM-0310	Engineering Feasibility
2014-COM-0282	No	N/A	N/A
2014-COM-0299	No	N/A	N/A
2014-COM-0179	No	N/A	N/A
2014-COM-0181	No	N/A	N/A
2014-COM-0300	No	N/A	N/A
2014-COM-0302	Yes	2012-COM-0099	Engineering Feasibility
2014-COM-0312	No	N/A	N/A
2014-COM-0306	No	N/A	N/A
2014-COM-0313	No	N/A	N/A

C/I:

Project ID	Supported by Study?	Study ID	Type of Study
2014-IND-0178	No	N/A	N/A
2014-IND-0569	No	N/A	N/A
2014-COM-0087	No	N/A	N/A
2014-IND-0183	No	N/A	N/A
2014-IND-0112	No	N/A	N/A
2014-IND-0166	No	N/A	N/A
2014-IND-0056	No	N/A	N/A
2014-COM-0079	No	N/A	N/A
2014-COM-0051	No	N/A	N/A
2014-IND-0025	No	N/A	N/A
2014-IND-0024	No	N/A	N/A
2014-IND-0114	No	N/A	N/A
2014-IND-0172	No	N/A	N/A
2014-COM-0320	No	N/A	N/A
2014-IND-0021	No	N/A	N/A
2014-IND-0022	No	N/A	N/A
2014-IND-0570	No	N/A	N/A
2014-IND-0333	Yes	2014-IND-0243	Engineering Feasibility
2014-IND-0210	Yes	2010-IND-0435	Engineering Feasibility
2014-COM-0240	No	N/A	N/A
2014-IND-0115	No	N/A	N/A
2014-IND-0261	Yes	2013-IND-0146	Engineering Feasibility
2014-IND-0345	Yes	2010-IND-0034	Engineering Feasibility
2014-COM-0239	Yes	2014-COM-0148	Building simulation through Union's Design Assistance Program (DAP)

Type and Number of Studies with Corresponding Projects Financed by Union

Large Volume:

Project ID	Supported by Study?	Study ID	Type of Study
2014-IND-0649	Yes	N/A	IEMS monitoring system
2014-IND-0670	No	N/A	N/A
2014-IND-0487	No	N/A	N/A
2014-IND-0664	Yes	2014-IND-0245	Steam Trap Survey
2014-IND-0356	No	N/A	N/A
2014-IND-0522	Yes	2014-IND-0661	Steam Trap Survey
2014-IND-0452	Yes	N/A	IEMS monitoring system
2014-IND-0675	Yes	N/A	IEMS monitoring system
2014-IND-0371	No	N/A	N/A
2014-IND-0620	No	N/A	N/A
2014-IND-0612	No	N/A	N/A
2014-IND-0615	Yes	2011-IND-0629	Process Improvement
2014-IND-0608	No	N/A	N/A
2014-IND-0622	No	N/A	N/A
2014-IND-0431	No	N/A	N/A
2014-IND-0299	No	N/A	N/A
2014-IND-0287	No	N/A	N/A
2014-IND-0543	Yes	2012-IND-0458	Engineering Feasibility
2014-IND-0609	No	N/A	N/A
2014-IND-0630	No	N/A	N/A
2014-IND-0632	No	N/A	N/A
2014-IND-0667	No	N/A	N/A

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2

Preamble: For the large volume portfolio, 13 of 22 large volume custom projects audited (with exception to 2014-IND-0452, 2014-IND-0675, 2014-IND-0371, 2014-IND-0612, 2014-IND-0615, 2014-IND-0608, 2014-IND-0622, 2014-IND-0431, 2014-IND-0609) did not have sufficient data for the Custom Project Savings Verification (CPSV) contractor to conduct an evaluation of savings using an IPMVP protocol, so the CPSV contractor used another procedure to evaluate these project's savings.

a) Please explain the Auditor's approach in reviewing the appropriateness of custom project savings which were not evaluated using International Performance Measurement & Verification Protocol (IPMVP) by the verifiers.

b) Please provide the Auditor's assessment of the evaluation of savings associated with each of these projects.

Response:

a) The Auditor's approach to reviewing the appropriateness of custom project savings is the same for all custom projects and is described in Exhibit B, Tab 2, page 6. The scope and requirements of the audit is established by the Audit Committee ("AC") and is outlined in the auditor Request for Proposal ("RFP"), which states *"[t]he auditor selected for this task will be expected to exercise his/her expert judgment to determine the elements of the audit, and to set the approach and process that will be followed in the audit in order to meet the regulatory requirements."*

   In the Custom Project Savings Verification ("CPSV") Terms of Reference, which was endorsed by the Technical Evaluation Committee ("TEC") and provided to the Auditor for consideration, the assessment methodology states that the Verifier is expected to develop its own independent estimate of the savings for the project using information collected during site-visits and interviews as well as its own expertise. The CPSV Verifier was asked to indicate which IPMVP option it followed in its review of each CPSV project on the coversheet but could deviate from the option with explanation.

b) The Auditor's assessment of the evaluation of Large Volume project savings can be found at Exhibit B, Tab 2, pages 30-42.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, Tables 6-9 (Low Income Custom Projects), pp. 15-18

Please provide a new table in Excel format that includes the following:

a) Annual gas savings for each project.
b) Annual electricity, water and other savings for each project, if any.
c) Total annual cost savings associated with a) and b) above.
d) Incremental costs of the project.
e) Incentive amount provided to the customer.
f) Simple payback based on the information above (before the incentive was provided).

Response:

a)-f) Please see Attachment 1.

Low Income Custom Projects

Project ID	Project Description	Audited m3 Annual Gas Savings (m^3/Yr) a.	Audited Annual Electrical Savings (kWh/Yr) b.	Audited Annual Water Savings (Liters/Yr) c.	Total Annual Cost Savings d.	Audited Incremental Cost ($) e.	Incentive ($) f.	Simple Payback* (years) g.	Rate Class h.	2014 Avg Gas Unit Price[1] ($/$m^3$) i.	2014 Electricity Unit Price[2] ($/kWh) j.	2014 Water Unit Price[2] ($/L) k.
2014-COM-0095	Roof Insulation	3,112	-	-	$ 641	$ 15,270	$ 3,840	23.8	M1	$ 0.20603	$ 0.10379	$ 0.00000293
2014-COM-0282	VFD on MAU	5,764	6,146	-	$ 1,825	$ 3,628	$ 1,814	2.0	M1	$ 0.20603	$ 0.10379	$ 0.00000293
2014-COM-0299	Windows	4,129	110	-	$ 862	$ 22,069	$ 7,431	25.6	M1	$ 0.20603	$ 0.10379	$ 0.00000293
2014-COM-0179	VFD on MAU	3,941	6,885	-	$ 1,934	$ 9,665	$ 4,832	5.0	01	$ 0.30935	$ 0.10379	$ 0.00000293
2014-COM-0181	VFD on MAU	2,982	1,162	-	$ 1,043	$ 5,109	$ 2,555	4.9	01	$ 0.30935	$ 0.10379	$ 0.00000293
2014-COM-0300	Windows and Doors	1,396	57	-	$ 294	$ 10,217	$ 14,377	34.8	M1	$ 0.20603	$ 0.10379	$ 0.00000293
2014-COM-0302	Windows	11,736	-	-	$ 2,392	$ 15,347	$ 24,115	6.4	M2	$ 0.20384	$ 0.10379	$ 0.00000293
2014-COM-0312[3]	HVAC Controls	-	-	-	$ -	$ 17,850	$ 8,925	N/A[3]	01	$ 0.30935	$ 0.10379	$ 0.00000293
2014-COM-0306	Solar Pre-Heater	21,722	-	-	$ 4,428	$ 228,900	$ 81,812	51.7	M2	$ 0.20384	$ 0.10379	$ 0.00000293
2014-COM-0313	HVAC Controls	44,141	-	-	$ 8,998	$ 205,880	$ 100,080	22.9	M2	$ 0.20384	$ 0.10379	$ 0.00000293
		98,923	**14,362**	**-**	**$ 22,417**	**$ 533,935**	**$ 249,781**					

*Simple Payback has been provided for illustrative purposes only and includes all audited project savings.

[1]Average Gas Unit Prices are the average 2014 unit rate per m^3 by rate class delivered to customers on system supply exclusive of fixed customer charges (non-fixed charges include delivery, demand, transportation, storage and gas commodity).

[2] Electricity and Water Unit Prices are the 2014 values from the OPA Conservation and Demand Management Cost Effectiveness Guide, October 15, 2010, Appendix A, Ratepayer Assumptions.

[3] Savings for this project were removed for reasons of project eligibility.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, Tables 10-13 (Commercial/Industrial Custom Projects), pp. 21-29

Please provide a new table in Excel format that includes the following:

a) Annual gas savings for each project.
b) Annual electricity, water and other savings for each project, if any.
c) Total annual cost savings associated with a) and b) above.
d) Incremental costs of the project.
e) Incentive amount provided to the customer.
f) Simple payback based on the information above (before the incentive was provided).

Response:

a)-f) Please see Attachment 1.

Commercial/Industrial Custom Projects

Project ID	Project Description	Audited m3 Annual Gas Savings (m^3/Yr) a.	Audited Annual Electrical Savings (kWh/Yr) b.	Audited Annual Water Savings (Liters/Yr) c.	Total Annual Cost Savings d.	Audited Incremental Cost ($) e.	Incentive ($) f.	Simple Payback* (years) g.	Rate Class h.	2014 Avg Gas Unit Price[1] ($/$m^3$) i.	2014 Electricity Unit Price[2] ($/kWh) j.	2014 Water Unit Price[2] ($/L) k.
2014-IND-0178	Steam leak repairs	842,234	-	20,032,448	$ 181,992	$ 80,283	$ 40,000	0.4	20	$ 0.21601	$ 0.10379	$ 0.00000293
2014-IND-0569	Multi-measure process and energy intensity upgrades	2,754,000	12,911,000	289,000	$ 1,801,208	$ 89,598,370	$ 120,000	49.7	M7	$ 0.16746	$ 0.10379	$ 0.00000293
2014-COM-0087	High efficiency, direct fired H&V unit	13,974	-	-	$ 2,879	$ 4,000	$ 1,296	1.4	M1	$ 0.20603	$ 0.10379	$ 0.00000293
2014-IND-0183	Insulate dryer drum	47,291	-	-	$ 8,827	$ 19,800	$ 7,309	2.2	M5	$ 0.18665	$ 0.10379	$ 0.00000293
2014-IND-0112	Steam leak repairs & 2 process heating coil replacements	174,392	-	3,158,710	$ 30,307	$ 5,040	$ 2,520	0.2	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-IND-0166	Process oven burner upgrade and heat recovery	265,793	-	-	$ 46,178	$ 49,680	$ 26,579	1.1	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-IND-0056	Deaerator heat recovery	366,540	-	4,727,608	$ 63,695	$ 15,615	$ 7,808	0.2	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-COM-0079	Steam leak repairs	140,884	-	2,917,443	$ 28,727	$ 4,600	$ 2,300	0.2	M2	$ 0.20384	$ 0.10379	$ 0.00000293
2014-COM-0051	Greenhouse expansion - multi-measure	514,195	-	-	$ 104,814	$ 314,830	$ 31,954	3.0	M2	$ 0.20384	$ 0.10379	$ 0.00000293
2014-IND-0025	Greenhouse expansion - multi-measure	1,676,703	-	-	$ 312,950	$ 1,290,000	$ 62,140	4.1	M5	$ 0.18665	$ 0.10379	$ 0.00000293
2014-IND-0024	Greenhouse expansion - multi-measure	1,158,947	-	-	$ 201,350	$ 849,847	$ 56,200	4.2	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-IND-0114	Greenhouse expansion - multi-measure	1,160,603	-	-	$ 201,638	$ 655,675	$ 59,800	3.3	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-IND-0172	Insulation of steam supply lines	604,538	-	-	$ 105,030	$ 15,500	$ 7,750	0.1	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-COM-0320	Greenhouse expansion - multi-measure	538,335	-	-	$ 109,735	$ 151,448	$ 40,000	1.4	M2	$ 0.20384	$ 0.10379	$ 0.00000293
2014-IND-0021	Greenhouse expansion - multi-measure	2,727,061	-	-	$ 508,995	$ 1,647,500	$ 70,200	3.2	M5	$ 0.18665	$ 0.10379	$ 0.00000293
2014-IND-0022	Greenhouse expansion - multi-measure	1,970,483	-	-	$ 367,783	$ 1,405,750	$ 61,400	3.8	M5	$ 0.18665	$ 0.10379	$ 0.00000293
2014-IND-0570	Insulate steam, condensate, hot water piping	718,537	-	-	$ 120,323	$ 106,000	$ 40,000	0.9	M7	$ 0.16746	$ 0.10379	$ 0.00000293
2014-IND-0333	Heat exchanger upgrade	434,687	-	-	$ 72,791	$ 115,003	$ 40,000	1.6	M7	$ 0.16746	$ 0.10379	$ 0.00000293
2014-IND-0210	Heat exchanger upgrade	158,754	-	-	$ 29,631	$ 50,000	$ 12,357	1.7	M5	$ 0.18665	$ 0.10379	$ 0.00000293
2014-COM-0240	Upgrade building systems to LEED standards	747,828	3,623,938	-	$ 530,202	$ 13,000,000	$ 40,000	24.5	M1	$ 0.20603	$ 0.10379	$ 0.00000293
2014-IND-0115	Steam leak repairs	50,315	-	1,056,563	$ 9,394	$ 9,392	$ 4,696	1.0	M5	$ 0.18665	$ 0.10379	$ 0.00000293
2014-IND-0261	Insulate piping, valves and heat exchangers	21,221	-	-	$ 3,687	$ 51,191	$ 1,728	13.9	M4	$ 0.17374	$ 0.10379	$ 0.00000293
2014-COM-0345	Boiler control upgrades and adjustments	117,183	-	-	$ 23,887	$ 12,480	$ 14,948	0.5	M2	$ 0.20384	$ 0.10379	$ 0.00000293
2014-COM-0239	Upgrade building systems to LEED standards	45,299	-	-	$ 9,333	$ 445,000	$ 3,336	47.7	M1	$ 0.20603	$ 0.10379	$ 0.00000293
		17,249,797	**16,534,938**	**32,181,772**	**$ 4,875,353**	**$ 109,897,004**	**$ 754,321**					

*Simple Payback has been provided for illustrative purposes only and includes all audited project savings.

[1]Average Gas Unit Prices are the average 2014 unit rate per m^3 by rate class delivered to customers on system supply exclusive of fixed customer charges (non-fixed charges include delivery, demand, transportation, storage and gas commodity).

[2] Electricity and Water Unit Prices are the 2014 values from the OPA Conservation and Demand Management Cost Effectiveness Guide, October 15, 2010, Appendix A, Ratepayer Assumptions.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, Tables 14-17 (Large Volume Projects), pp. 32-41

Please provide a new table in Excel format that includes the following:

a) Annual gas savings for each project.
b) Annual electricity, water and other savings for each project, if any.
c) Total annual cost savings associated with a) and b) above.
d) Incremental costs of the project.
e) Incentive amount provided to the customer.
f) Simple payback based on the information above (before the incentive was provided).

Response:

a)-f) Please see Attachment 1.

Large Volume Custom Projects

Project ID	Project Description	Audited m3 Annual Gas Savings (m^3/Yr) a.	Audited Annual Electrical Savings (kWh/Yr) b.	Audited Annual Water Savings (Liters/Yr) c.	Total Annual Cost Savings d.	Audited Incremental Cost ($) e.	Incentive ($) f.	Simple Payback* (years) g.	Rate Class h.	2014 Avg Gas Unit Price[1] ($/$m^3$) i.	2014 Electricity Unit Price[2] ($/kWh) j.	2014 Water Unit Price[2] ($/L) k.
2014-IND-0649	Steam leak repairs	977,000	-	204,300,000	$ 163,081	$ 15,890	$ 7,945	0.10	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0670	Steam leak repairs	488,000	-	10,450,000	$ 80,548	$ 526,227	$ 20,000	6.53	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0487	Steam leak repairs	427,600	-	8,672,000	$ 70,577	$ 530,045	$ 20,000	7.51	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0664	Steam trap replacements	154,750	-	3,837,000	$ 33,057	$ 8,019	$ 4,009	0.24	100	$ 0.21355	$ 0.10379	$ 0.00000293
2014-IND-0356	Steam trap replacements	587,000	-	-	$ 97,622	$ 25,149	$ 12,574	0.26	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0522	Steam trap replacements	1,676,500	-	34,490,000	$ 276,714	$ 218,337	$ 20,000	0.79	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0452	Process improvement to allow productive use of steam generated on weekends	1,612,000	-	16,550,000	$ 268,135	$ 1,352,455	$ 65,000	5.04	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0675	Evaporator steam injector repair	615,200	-	6,514,000	$ 102,331	$ 16,000	$ 8,000	0.16	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0371	Control programming to close dampers when OA not needed for process	172,800	-	-	$ 28,738	$ 920	$ 460	0.03	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0620	Repair of boiler preheater	2,943,000	-	-	$ 628,465	$ 264,391	$ 20,000	0.42	100	$ 0.21355	$ 0.10379	$ 0.00000293
2014-IND-0612	Re-route condensate from condensing turbine back to boiler	7,259,000	-	221,000,000	$ 1,550,775	$ 362,465	$ 55,975	0.23	100	$ 0.21355	$ 0.10379	$ 0.00000293
2014-IND-0615	Burner upgrade on process furnace	3,980,000	-	-	$ 849,912	$ 348,212	$ 50,000	0.41	100	$ 0.21355	$ 0.10379	$ 0.00000293
2014-IND-0608	COG pipeline replacement/cleaning	1,931,000	-	-	$ 412,357	$ 261,272	$ 80,000	0.63	100	$ 0.21355	$ 0.10379	$ 0.00000293
2014-IND-0622	COG pipeline replacement	2,569,000	-	-	$ 548,599	$ 62,300	$ 20,000	0.11	100	$ 0.21355	$ 0.10379	$ 0.00000293
2014-IND-0431	Feedwater economizer on backup boiler	36,870	-	-	$ 6,132	$ 300,000	$ 50,000	48.93	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0299	High-efficiency turbine generator	92,830	-	-	$ 15,438	$ 800,000	$ 24,870	51.82	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0287	Kiln insulation replacement	152,000	-	-	$ 25,279	$ 134,657	$ 10,319	5.33	T1	$ 0.16631	$ 0.10379	$ 0.00000293
2014-IND-0543	Steam trap repairs	2,315,000	-	51,300,000	$ 382,113	$ 205,467	$ 20,000	0.54	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0609	COG pipeline replacement/cleaning	3,989,000	-	-	$ 658,163	$ 956,000	$ 100,000	1.45	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0630	Pipe insulation repairs	4,908,000	-	45,940,000	$ 809,928	$ 337,691	$ 10,000	0.42	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0632	Pipe insulation repairs	1,631,000	-	16,330,000	$ 269,154	$ 109,244	$ 10,000	0.41	T2	$ 0.16499	$ 0.10379	$ 0.00000293
2014-IND-0667	Pipe insulation repairs	6,016,000	-	60,160,000	$ 992,784	$ 367,734	$ 21,546	0.37	T2	$ 0.16499	$ 0.10379	$ 0.00000293
		44,533,550	**-**	**679,543,000**	**$ 8,269,902**	**$ 7,202,475**	**$ 630,698**					

*Simple Payback has been provided for illustrative purposes only and includes all audited project savings.

[1]Average Gas Unit Prices are the average 2014 unit rate per m^3 by rate class delivered to customers on system supply exclusive of fixed customer charges (non-fixed charges include delivery, demand, transportation, storage and gas commodity).

[2] Electricity and Water Unit Prices are the 2014 values from the OPA Conservation and Demand Management Cost Effectiveness Guide, October 15, 2010, Appendix A, Ratepayer Assumptions.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2

Preamble: OEB staff compiled the following information based on a review of the large volume custom projects:

Large Volume Custom Project	Project identified to have "add-on" (Element #22 of CPSV template)
2014-IND-0356	Yes
2014-IND-0452	Yes
2014-IND-0371	Yes
2014-IND-0620	Yes
2014-IND-0612	Yes
2014-IND-0615	Yes
2014-IND-0608	Yes
2014-IND-0622	Yes
2014-IND-0431	Yes
2014-IND-0299	Yes
2014-IND-0287	Yes
2014-IND-0543	Yes
2014-IND-0609	Yes
2014-IND-0630	Yes
2014-IND-0632	Yes
2014-IND-0667	Yes

a) For the projects identified to have add-on components, please clarify the definition of an "add-on" as it did not appear to be consistently defined for all projects.

b) Please identify, where appropriate, the add-on component of the project as it was not clearly described for all cases noted above.

c) Please clarify the definition of a "boiler efficiency factor" that was associated with each of these projects.

d) Please clarify whether the boiler efficiency factor represents the enhanced boiler base case efficiency that has resulted from the "add-on" to the project, and if it has been taken into consideration for the estimation of savings.

Response:

a) Union defines “add-on” projects as those in which a customer adds a new piece of equipment onto their system that did not exist previously in order to improve energy efficiency, as opposed to operating “as-is”.

b) The add-on reference for these projects is meant to reflect that the project savings are associated with modifications to the customers’ existing process infrastructure. The add-on components are as follows:

Project ID	Add-on component
2014-IND-0356	New steam traps and trap components
2014-IND-0452	Addition of intermediate storage tanks for weekend process buffering
2014-IND-0371	Control program logic
2014-IND-0620	Boiler preheater component replacement
2014-IND-0612	Condensate return lines
2014-IND-0615	Burner fuel: air control equipment
2014-IND-0608	Coke oven gas distribution line
2014-IND-0622	Blast furnace gas distribution manifold
2014-IND-0431	Boiler feed water economizer
2014-IND-0299	New turbine with improved heat rate
2014-IND-0287	Pipe Insulation
2014-IND-0543	New steam traps and trap components
2014-IND-0609	Coke oven gas distribution line
2014-IND-0630	Pipe Insulation
2014-IND-0632	Pipe Insulation
2014-IND-0667	Pipe Insulation

c) The “boiler efficiency factor” represents the combustion efficiency of the steam generating equipment at the customer’s facility (i.e. the amount of useful heat derived by the boiler following the combustion of natural gas).

d) The only project affected the base case boiler efficiency factor with an enhancement is 2014-IND-0620. The enhanced boiler efficiency factor was considered in the estimation of savings for the project.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2
Projects 2014-IND-0670, 2014-IND-0487, 2014-IND-0287, 2014-IND-0630, 2014-IND-0632, 2014-IND-0667

Preamble: For various large volume projects ranging from steam leaks to insulation replacements, a 20% reduction was applied to the savings assuming that 20% of the work performed was not driven by energy conservation, but due to safety concerns.

a) Please explain how the 20% reduction to annual savings was determined.

b) Please clarify whether this adjustment is based on specific information communicated by the customer to the custom project verifier.

c) Please confirm the specific questions asked during the verifier's on-site visit to derive this adjustment.

d) Please provide the reason for each project that was applied a 20% reduction to its annual savings.

Response:

The following was prepared by Diamond Engineering Company:

a)-d) A knowledgeable individual at the Union Gas Customer's location referenced in the projects above was contacted by the Verifier and asked specifically what portion of the work performed as outlined in the project would have been performed for safety reasons alone. Two customers reached the 20% value without prompting and the balance felt this was a reasonable estimate. This agreement is understandable because the percentage of steam and process piping that could be touched or where a steam leak could injure a worker is roughly the same for each location. For this reason, the 20% reduction was applied to each project.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, pp. 43-44

Preamble: For the Commercial & Industrial (C/I) portfolio, the Auditor noted in recommendation #8 that steam leaks showed very high leak rates and repairs were urgent, however, the savings for the repairs were included in the claimed savings. The Auditor further noted that these repairs likely would have been made for safety or severity reasons regardless of program availability.

a) Please provide the source of the Auditor's observation that "steam leaks showed very high leak rates and repairs were urgent" as the additional information did not appear to be documented in the C/I project review.

b) Please explain the appropriateness to claim savings from steam leak repairs that would have been made for safety or severity reasons regardless of program availability.

c) Please explain why a reduction in savings associated with steam leaks such as the one applied in the large volume projects was not applied to the C/I projects.

Response:

a) The following was prepared by Evergreen Economics:

Although customer maintenance logs were not consistently available for all sites, the available logs provided insight into the nature of steam and condensate leaks. In the case of COM-0178, the following three entries were made:

Steam leak on main line up #29/30 conveyor gallery. leaking is blowing into walkway. Area is roped off from both sides. Please repair as soon as possible.	Leak rate estimated at 2,795 lbs steam/hour; 842,000 cubic meters gas/year equivalent
On #3 rental boiler, one of the steam drum safety valve sprung a leak at its base. It appears that the gasket has failed. The boiler was immediately shut down and isolated to allow to cool down for repairs.	Leak rate estimated at 895 lbs steam/hour; 261,000 cubic meters gas/year equivalent
Steam leak at #3 boiler main outlet	Leak rate estimated at 2,795 lbs steam/hour; 842,000 cubic meters gas/year equivalent

These three leaks alone accounted for 75% of the total leak rate incented at this site, and led to our observation of "steam leaks showed very high leak rates and repairs were urgent." In another case, we found that local flooding was caused by a condensate leak, and although this leak required immediate attention, it was also incented.

b) Union does not claim savings from projects that it deems are safety or severity related. Union works with customers (with which Union maintains long-term, account managed relationships) to identify these projects. This determination relies on judgement by the utility and the customer.

Custom projects are assessed individually and rely on customer-specific circumstances and business requirements. Union establishes the level of savings that could result without the DSM program on a customer-by-customer basis.

As noted in Exhibit B, Tab 3, page 6, the resolution to the Auditor's Recommendation #8 confirms that Union agrees that projects that are obvious safety hazards should not be eligible for incentives.

Recommendation #8 Resolution:

> *"The AC agrees with the Auditor's recommendation that savings from projects that are obvious safety hazards should not be eligible for incentives. The AC also agrees that if classes of projects – including projects below a certain payback threshold – are to be made ineligible that this policy should be established in advance.*
>
> *Starting in 2014, Union no longer provided incentives for gas leak projects. As of 2016, it will no longer be incenting projects classified as O&M Repair. O&M repair projects are those in which a customer has completed a repair (i.e. maintenance) to improve energy performance, as opposed to continuing to operate less efficiently. The most common types of projects would be steam leak and steam trap repairs. It would also encompass descaling and heat exchanger cleaning projects."*

c) The Auditor applied an adjustment of 50% to all projects involving steam leak repairs in both the Large Volume portfolio as well as the Commercial/Industrial custom portfolio. Please see the Independent Audit of the 2014 DSM Program Results, Exhibit B, Tab 2, Table 10, page 21 for more information.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 3, pp. 6-7

Preamble: The Auditor noted in recommendation #9 that a number of greenhouse expansion and new construction projects had no previously existing building referenced as a baseline condition. As a result, Union has customized greenhouse baselines based on what the customer would commonly and reasonably have chosen to do.
On a go-forward basis, the AC agreed to use the 2014 C/I verifier's preliminary opinion as standard practice for its new greenhouse baseline determination to simplify the evaluation and auditing process.

a) Please provide the verifier's estimate of the standard practice baseline for greenhouse expansion projects. Please reference the source(s) that were used to determine the standard baseline.

b) Please provide the magnitude of the savings increase (or decrease) this can contribute to the 2014 greenhouse expansion baseline projects.

Response:

a) The Verifier's estimate of the standard practice baseline for greenhouse expansion projects can be found at Exhibit B, Tab 1, Appendix M, pages 75-76. The Verifier notes this information was a "preliminary opinion" on average greenhouse market practices and was based only on observations made during site visits to seven 2014 greenhouse projects selected for Custom Project Savings Verification sampling.

b) This issue was identified through the audit process and the Auditor took it into account when determining the final savings. The result was no impact to Union's 2014 savings.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, p. ii

Preamble**:** Union's market transformation program, Optimum Home, achieved a shareholder incentive of $557,358 (as noted in Exhibit B, Tab 1, p. 108) but does not appear in the Auditor's list of programs that were reviewed as part of the Audit.

a) Please confirm whether or not the market transformation program was verified or audited, as there were no explicit comments on the verification of the program. If it was not verified, please provide rationale for its exclusion.

Response:

a) Confirmed. The list of tasks required for the audit, as established by the Audit Committee ("AC") in the Request for Proposal, is incorporated in the Independent Auditor of the 2014 DSM Program Results at Exhibit B, Tab 2, pages 3-4, and includes the expectation that *"the auditor will review the accuracy and reasonableness of Union Gas Limited's claims regarding achievement relative to Resource Acquisition, Large Volume, Low Income and Market Transformation performance metrics."*

Evergreen Economics (the "Auditor") receives guidance and direction from the AC but exercises its expert judgement to determine the elements of the audit and to set the approach and process that will be followed in the audit in order to meet the regulatory requirements. Specifically, to provide an audit opinion on the DSM Variance Account, Lost Revenue Adjustment Mechanism and DSM Shareholder Incentive amounts proposed by the natural gas utility, which includes Union's market transformation program.

The Auditor was provided the Audit Tool, which includes the necessary information to support the Market Transformation scorecard metric achievement calculation. At Exhibit B, Tab 2, page iv, the Auditor notes that the *"the majority of the audit was dedicated to reviewing the savings estimates for the various custom programs."* Accordingly, the majority of the report is spent discussing these programs.

UNION GAS LIMITED

Answer to Interrogatory from
Board Staff

Reference: Exhibit B, Tab 2, pp. ii-iii

Preamble: The audit report specified that the prescriptive and quasi-prescriptive C/I programs was reviewed as part of the Audit. The audited net cumulative gas savings for C/I prescriptive makes up more than 10% (e.g. 216,057,244 CCM/1,889,459,431 CCM in the audit report) of Union's overall CCM claim.

a) Please indicate how the C/I prescriptive savings claim was verified and audited. Specifically, please indicate how the Auditor ensured that best available input assumptions was used to calculate savings and how the unit installations were confirmed.

b) If this program was not verified or audited, please provide rationale for its exclusion.

Response:

a) The list of tasks required for the audit, as established by the Audit Committee ("AC") in the Request for Proposal ("RFP") is incorporated in the Auditor's Report at Exhibit B, Tab 2, pages 3-4, and includes the expectation that the Auditor will assess *"the reasonableness of prescriptive measure input assumptions – measure lives, annual gas savings and free rider rates – for the calculation of LRAM and DSM Shareholder Incentives."* The Auditor can make recommendations to change input assumptions with explanation and, to the extent practical, documented with appropriate references and/or other forms of substantiation. The required tasks also include reviewing procedures for tracking program participants and determining whether they lead to accurate counts.

   To meet the requirements listed in the RFP, the Auditor develops principles to guide the audit methods and listed activities undertaken during the course of the audit (as shown at Exhibit B, Tab 2, pages 4-5). Among other activities, the Auditor reviews Union's Audit Tool to verify program participant counts are accurate, and reviews the Audit Tool and supporting documentation for prescriptive and quasi-prescriptive measures to ensure that all algorithms and prescriptive values are used correctly to calculate the savings and were consistent with program documentation filed with the Ontario Energy Board.

b) This program was audited as described above. Please see the response at part a).

UNION GAS LIMITED

Answer to Interrogatory from
Association of Power Producers of Ontario ("APPrO")

Reference: i) Exhibit A Tab 2 page 9:

However, the Auditor did not find this to be sufficient or that significant progress had been made to date. As a result, "savings for steam leak projects were reduced by 50 percent due to the lack of required documentation on customer standard maintenance practices" as part of the 2014 audit recommendations. The AC and Union agreed with this reduction of savings from the verified results.
ii) Exhibit A Tab 3 Table 4 page 9
iii) Exhibit A tab 2 page 9:
The auditor noted:
The 50 percent adjustment is based on professional judgment, as it was beyond the scope of the audit to attempt to quantify actual savings above baseline for these measures. We believe that 50 percent is a fair adjustment, as a 100 percent adjustment is likely too extreme and a 0 percent adjustment is too low."

Preamble: In the first reference Union indicates that the Auditor reduced the savings related to steam leaks for 2014 custom projects. In the second reference, the table illustrates the 2014 large volume scorecard targets achieved, which included the effects of the auditor's recommendation. APPrO is interested in understanding the impact of providing these standard maintenance practices.

a) Please have the Auditor detail their recommendation for the minimum standard practice documentation requirements for steam projects.

b) Does the Auditor recommend similar minimum standard practice documentation requirements for any other activities, including those other activities that might be considered maintenance projects? Please elaborate and provide similar minimum documentation requirements.

c) The adjustment made by the Auditor reduces the cumulative natural gas savings that are used as the metric to determine the DSM incentive payments received by the utility. How does Union propose to incent customers to meet these documentation requirements in the future?

d) Will the lack of such documented standard practices result in a customer being ineligible in the future to receive DSM incentives? Please explain.

e) If a customer has a documented standard practice to repair steam projects, or any other maintenance project, how will this affect customers' access to future DSM incentives as well as the calculation of cumulative savings for purposes of the determination of utility incentive amounts?

f) Please recalculate Table 4, under the assumption that the auditor accepted the steam leak savings as initially proposed.

Response:

a) The Auditor has provided its recommendation for the minimum standard practice documentation requirements in its Audit Report. Please see Exhibit B, Tab 2, pages 11-12.

b) The Auditor's recommendation applies to all maintenance and behavioral projects. The Audit Committee ("AC") agreed to this recommendation. At Exhibit B, Tab 3, pages 4-5, the Independent Audit of 2014 DSM Program Results states:

> ***"Recommendation #5:*** *For maintenance and behavioral projects, the customer's standard maintenance and operations practices must be formally documented, as has been agreed to by Union in prior years. This can be accomplished by developing a standard form that each customer fills out with their project application that is sufficiently flexible to accommodate differences across customers. If documentation is not completed, these projects should be disallowed and the savings set to zero.*
>
> ***Resolution:***
> *The AC agrees that the customer's standard maintenance and operations practices must be documented and that if the documented evidence is not sufficient to support the base case, then savings for that project should be set to zero."*

The AC also agrees that capturing a customer's standard maintenance and operations practices can be accomplished with a standard form that is filled out as part of the project application. For 2015 O&M custom projects, Union has developed a formalized approach to capture customer's standard maintenance and operations practices via a standard form. Union will use this form to support the base case and demonstrate incremental savings from the customer's standard practices.

c) In light of the Board's 2015-2020 DSM Plan (EB-2015-0029/EB-2015-0049) Decision, in the future, customers that do not comply with the documentation requirement will not receive incentives.

d) Yes, lack of sufficient base case documentation resulted in customers being ineligible for DSM customer incentives in 2015.

e) As approved in the EB-2015-0029/EB-2015-0049 Decision, Union will no longer provide customer incentives for O&M repair projects for T1 customers in 2016 through its Commercial/Industrial custom program. Guidelines for access to future DSM customer incentives for Rate T2 and Rate 100 customers in 2016 and beyond are still being evaluated, based on the Board's EB-2015-0029/EB-2015-0049 Decision.

f) Table 1 below reflects the Large Volume scorecard with the assumption that the auditor accepted the steam leak savings as initially proposed by the Verifier.

Table 1

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Rate T2 / Rate 100 Cumulative Natural Gas Savings (m^3)	795,074,195	1,060,098,927	1,325,123,659	40%	950,210,788	79%	*32%*
Rate T1 Cumulative Natural Gas Savings (m^3)	156,530,251	208,707,001	260,883,751	60%	103,261,120	-1%	*-1%*
						Total Scorecard Target Achieved	***31%***
						Scorecard Incentive Achieved	***$0***

UNION GAS LIMITED

Answer to Interrogatory from
Building Owners and Managers Association ("BOMA")

Reference: EB-2015-0276, Exhibit A, Tab 1, Appendix A. Page 4 of 6

Integrated Energy Management Systems ("IEMS"): A custom program offered to customers to assess, implement, and utilize an integrated system to manage a facility's energy costs, consumption and intensity.

Does this program apply to the Commercial and Institutional Sector? Does it include Prescriptive Program elements, Capital Projects and/or O&M Projects?

Response:

No, the IEMS program, which has now ended, did not apply to the Commercial and Institutional Sector, it was a program offered only to Industrial Manufacturing customers. No, the program did not explicitly include any of the elements listed.

UNION GAS LIMITED

Answer to Interrogatory from
Building Owners and Managers Association ("BOMA")

Reference: EB-2015-0276, Exhibit A, Tab 2, Pages 9/10 of 12

Further, for future projects, the Auditor recommended: "for maintenance and behavioral projects, the customer's standard maintenance and operations practices must be formally documented, as has been agreed to by Union in prior years. This can be accomplished by developing a standard form that each customer fills out with their project application that is sufficiently flexible to accommodate differences across customers. If documentation is not completed, these projects should be disallowed and the savings set to zero."

The AC and Union agreed that the customer's standard maintenance and operations practices must be documented and that if the documented evidence for future projects is not sufficient to support the base case, then savings for that project should be set to zero.

Union's custom DSM program has adopted continuous improvement processes, with consideration of the input of customers and Union's DSM Consultative stakeholders, to ensure it evolves to address changing markets and policies. As such, the above audit recommendations and adjustments are taken as motivation to make substantial and demonstrative changes in documentation to adequately address the concerns of Union's respective stakeholders. For the2015 program year, Union has implemented a formalized base case documentation form to be filled out by participating customers. The objective of the form is to explicitly document each customer's base case practices, absent Union's influence. Union expects the form will give future auditors sufficient information to confirm the appropriateness of Union's claimed savings, and address Board staff's suggestions of a minimum threshold for project base case documentation.

BOMA is concerned about the impact of this requirement on customers. Please provide a copy of the formalized base case documentation form to be filled out by participating customers. Are there different forms for different sectors or segments? If so, please provide them.

Response:

Please see the response at Exhibit C.Staff.3.

UNION GAS LIMITED

Answer to Interrogatory from
Building Owners and Managers Association ("BOMA")

Reference: EB-2015-0276, Exhibit B, Tab 2, Page v

No recommendations or adjustments to verified gas savings or EULs were necessary for low -income custom projects this year. It is recommended that the realization rates for electricity and water savings be capped at 100 percent in situations where the verification process results in extremely high realization rates.

Please explain how realization rates could exceed 100%? If this means that the savings were higher than reported and verified, why should they be capped at 100%?

Response:

Realization rates can exceed 100% if savings are found to be higher than those claimed or verified.

Two 2014 Low Income custom projects (2014-COM-0179 and 2014-COM-0181) had verified project-level electricity realization rates of 38,249% and 5,054% respectively. If these project-level electricity realization rates were used to calculate the Low Income portfolio-level electricity realization rate, the resulting portfolio-level electricity savings would have been unrealistically and unreasonably high. The Auditor recommended capping the realization rates for these two projects at 100% to avoid this outcome. The Audit Committee ("AC") accepted the Auditor's recommendation.

The AC also agreed that in this type of situation, the extremely high incremental electricity savings found during verification should be added to the individual project claims, only without modifying their realization rates. This ensures that the savings are fully captured without skewing portfolio-level realization rates and savings.

UNION GAS LIMITED

Answer to Interrogatory from
Building Owners and Managers Association (“BOMA”)

Reference: EB-2015-0276, Exhibit B, Tab 3. Page 5

For maintenance and behavioral projects, the customer’s standard maintenance and operations practices must be formally documented, as has been agreed to by Union in prior years. This can be accomplished by developing a standard form that each customer fills out with their project application that is sufficiently flexible to accommodate differences across customers. If documentation is not completed, these projects should be disallowed and the savings set to zero.

Resolution: The AC agrees that the customer’s standard maintenance and operations practices must be documented and that if the documented evidence is not sufficient to support the base case, then savings for that project should be set to zero. The AC also agrees that capturing a customer’s standard maintenance and operations practices can be accomplished with a standard form that is filled out as part of the project application. For 2015 O&M custom projects, Union has developed a formalized approach to capture customer’s standard maintenance and operations practices via a standard form. Union will use this form to support the base case and demonstrate incremental savings from the customer’s standard practices.

How will this recommendation and resolution address the incidence of deviations from a customer’s documented standard practice and its typical practice?

Response:

For 2015, each custom project is based on unique customer circumstances, and any deviations between a customer’s “standard” and “typical” maintenance will be documented on the project file.

UNION GAS LIMITED

Answer to Interrogatory from
Building Owners and Managers Association ("BOMA")

Reference: EB-2015-0276, Exhibit B, Tab 3. Page 10

Table 1 – Impact of Audit Recommendations on 2014 Cumulative Gas Savings

Table 2– Impact of Audit Recommendations on 2014 DSM Utility Incentives

Interrogatory: Please explain how the reduction in gas savings had no impact on Utility Incentives.

Response:

The reduction in gas savings shifted the Large Volume scorecard from a pre-audit result of 31% to an audited result of 6%. Both of these results are below the 50% scorecard threshold that results in DSM Incentive for Union.

The reduction in gas savings shifted the Resource Acquisition scorecard from a pre-audit result of 204% to an audited result of 172%. This has no impact because both results are above the scorecard threshold cap of 150%.

The reduction in gas savings shifted the Low Income scorecard from a pre-audit result of 174% to an audited result of 165%. This has no impact because both results are above the scorecard threshold cap of 150%.

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit A, Tab 2, page 9, lines 1 through 5.

Savings for large volume customer steam leak projects were reduced by the DSM results auditor by 50% due to lack of required documentation on customer standard maintenance practices.

a) Please recalculate LRAM and shareholder incentive amounts assuming that savings for large customer steam leak projects are eliminated in their entirety.

b) Please restate Exhibit A, Tab 4, Schedules 1 and 2 based on the recalculated amounts provided in response to part (a) and file the restated schedules.

Response:

a) Please see Attachment 1 for recalculation of the LRAM amounts.

   There is no impact to the DSM Incentive from removing Large Volume savings for steam leak projects, as there was no DSM Incentive earned on the Large Volume portion of the scorecard inclusive of the steam leak projects. Therefore, no recalculation of the DSM Incentive is provided.

b) Please see Attachment 2 and Attachment 3.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2014 LRAM Deferral Account Balance (assuming savings for Large Customer Steam Leak Projects are eliminted)

Line No.	Particulars ($)	Amounts by DSM Plan Year 2013 (1)	2014 (2)	Total
		(a)	(b)	(c)
	South			
1	M4	100,971	78,521	179,492
2	M5	338,884	146,491	485,375
3	M7	16,023	21,691	37,714
4	T1	7,552	1,089	8,641
5	T2	7,169	1,687	8,856
6		470,599	249,479	720,078
	North			
7	Rate 20	23,989	21,606	45,595
8	Rate 100	43,305	27,849	71,154
9		67,294	49,455	116,749
10	Total	537,893	298,933	836,826

Notes:
(1) Exhibit C.IGUA.1, Attachment 1, Page 2.
(2) Exhibit C.IGUA.1, Attachment 1, Page 3.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2013 - Audited

Line No.	Particulars ($)	2013 Audited Volumes (1) $10^3 m^3$	2013 LRAM Volumes in 2014 Rates $10^3 m^3$	2013 Net LRAM Volumes $10^3 m^3$	2014 Delivery Rates $\$/10^3 m^3$	Revenue Impact ($)
		(a)	(b)	(c) = (a) - (b)	(d)	(e) = (c) x (d)
	South					
1	M4	10,037	-	10,037	10.060	100,971
2	M5	14,773	-	14,773	22.940	338,884
3	M7	4,762	-	4,762	3.365	16,023
4	T1	10,489	-	10,489	0.720	7,552
5	T2	91,909	-	91,909	0.078	7,169
6		131,969	-	131,969		470,599
	North					
7	Rate 20	4,393	-	4,393	5.461	23,989
8	Rate 100	20,021	-	20,021	2.163	43,305
9		24,414	-	24,414		67,294
10	Total	156,382	-	156,382		537,893

Notes:
(1) EB-2014-0271, Rate Order, Working Papers, Schedule 17.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2014 - Revised for Exhibit C.IGUA.1

Line No.	Particulars	2014 Audited Volumes (1) 10^3 m^3	2014 LRAM Volumes in 2014 Rates 10^3 m^3	2014 Net LRAM Volumes 10^3 m^3	2014 Delivery Rates $\$/10^3$ m^3	Revenue Impact ($)
		(a)	(b)	(c) = (a) - (b)	(d)	(e) = (c) x (d)
	South					
1	M4	7,805	-	7,805	10.060	78,521
2	M5	6,386	-	6,386	22.940	146,491
3	M7	6,446	-	6,446	3.365	21,691
4	T1(2)	1,513	-	1,513	0.720	1,089
5	T2(2)	21,623	-	21,623	0.078	1,687
6		43,773	-	43,773		249,479
	North					
7	Rate 20	3,956	-	3,956	5.461	21,606
8	Rate 100(2)	12,875	-	12,875	2.163	27,849
9		16,831	-	16,831		49,455
10	Total	60,604	-	60,604		298,933

Notes:

(1) Based on Audited 2014 DSM evaluation results. The monthly volumetric reductions for the month the measure is implemented and the remaining months of the year is calculated based on the Settlement Agreement in EB-2011-0327, page 34.

(2) Savings eliminated that are attributable to steam leak projects for large volume customers.

UNION GAS LIMITED
Allocation of 2014 DSM Deferral Account Balances
Assuming Savings for Large Customer Steam Leak Projects are Eliminated

Line		Acct	Union North					Union South											
No.	Particulars ($000's)	No.	Rate 01	Rate 10	Rate 20	Rate 100	Rate 25	M1	M2	M4	M5A	M7	M9	M10	T1	T2	T3	Total (1)
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
	Delivery Related Deferrals:																	
1	Lost Revenue Adjustment Mechanism	179-75	-	-	46	71	-	-	-	179	485	38	-	-	9	9	-	837
2	Demand Side Management Variance Account	179-111	(559)	43	407	(342)	-	1,173	843	864	(962)	714	-	-	(748)	231	-	1,664
3	Demand Side Management Incentive	179-126	940	369	375	-	-	3,656	1,939	725	493	490	-	-	-	-	-	8,988
4	Total Delivery-Related Deferrals		381	412	828	(270)	-	4,830	2,782	1,769	16	1,242	-	-	(739)	239	-	11,489

Notes:
(1) Lost Revenue Adjustment Mechanism ("LRAM") per Exhibit B.IGUA.1 a)
Demand Side Management Variance Account and Demand Side Management Incentive per Exhibit A, Tab 3, Schedule 1.

UNION GAS LIMITED
General Service Unit Rates for Prospective Recovery/(Refund) - Delivery
2014 DSM Deferral Account Disposition
Assuming Savings for Large Customer Steam Leak Projects are Eliminated

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	Forecast Volume (10^3m^3) (2)	Unit Rate for Prospective Recovery/(Refund) (cents/m^3)
			(a)	(b)	(c) = (a/b)*100
	Union North				
1	Small Volume General Service	01	381	216,479	0.1760
2	Large Volume General Service	10	412	107,138	0.3843
	Union South				
3	Small Volume General Service	M1	4,830	664,131	0.7272
4	Large Volume General Service	M2	2,782	348,442	0.7984
5	Total General Service		8,405		

Notes:
(1) Exhibit C.IGUA.1, Attachment 2.
(2) Forecast volume for the period April 1, 2016 to September 30, 2016.

UNION GAS LIMITED
Contract Unit Rates for One-Time Adjustment - Delivery
2014 DSM Deferral Account Disposition
Assuming Savings for Large Customer Steam Leak Projects are Eliminated

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	2014 Actual Volume (10^3m^3)	Unit Rate (cents/m^3)
			(a)	(b)	(c) = (a/b)*100
	Union North				
1	Medium Volume Firm Service	20	828	536,085	0.1544
2	Large Volume High Load Factor	100	(270)	1,711,285	(0.0158)
3	Large Volume Interruptible	25	-	184,836	-
	Union South				
4	Firm Com/Ind Contract	M4	1,769	484,166	0.3654
5	Interruptible Com/Ind Contract	M5A	16	258,788	0.0061
6	Special Large Volume Contract	M7	1,242	392,825	0.3162
7	Large Wholesale	M9	-	67,404	-
8	Small Wholesale	M10	-	312	-
9	Contract Carriage Service	T1	(739)	469,906	(0.1573)
10	Contract Carriage Service	T2	239	4,303,222	0.0056
11	Contract Carriage- Wholesale	T3	-	288,979	-
12	Total Contract Service		3,084		

Notes:
(1) Exhibit C.IGUA.1, Attachment 2.

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit A, Tab 2, page 9, lines 1 through 5.

For the 2015 program year, Union has implemented a formalized base case documentation form to be filled out by participating customers, to explicitly document base case practices absent Union's influences.

a) Please file a copy of the referenced form.

Response:

a) Please see the response at Exhibit C.Staff.3 a).

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit A, Tab 2, page 11, lines 13 *et seq.*; Exhibit B, Tab 1, page numbered 93.

The TEC has selected a consultant for an updated custom free ridership study, and the study methodology and scope of work has been prepared.

Reference: Exhibit B, Tab 2, page 10.

The DSM results auditor states:

"...it appears that Union is in a better position than the Board to complete a [custom projects free ridership] study in time for use in the 2015 program evaluation, and we urge Union to begin this process immediately."

a) Please provide an update on the status of the TEC's free ridership study, and file a copy of the developed methodology and scope of work.

b) Please provide an update on the expected completion date of the TEC's free ridership study.

c) Please detail Union's expectations regarding opportunities for interested stakeholders who do not have representatives on the TEC to review the draft study report and provide input/comment prior to the study being finalized.

d) Please indicate when and how Union expects the study's results to be approved by the Board for use in future DSM rate setting activities.

e) Please file a copy of the consultant's "kick off presentation" as referenced at Exhibit B, Tab 1, page numbered 119 (in Appendix B).

f) Please file a copy of the consultant's summary document pertaining to the difference between two proposed calculation methods as referenced at Exhibit B, Tab 1, page numbered 128 (in Appendix B).

g) Please indicate whether Union is willing and able to complete a free ridership study in time for use in the 2015 program evaluation process, as recommended by the DSM results auditor in October, 2015, and if not why not.

Response:

a) DNV GL, the consultant undertaking the Custom Commercial and Industrial Net-to-Gross ("NTG") Study, is in the process of developing and delivering a detailed work plan, which will be presented at the next TEC meeting, currently scheduled in March 2016.

On March 4, 2016 Board Staff issued a memo entitled, "Transition of Technical Evaluation Committee Activities to the OEB EB-2015-0245". With respect to the NTG study this memo indicates, "*Following input from the TEC, this study will be transitioned to OEB*" and that "*OEB Staff will assume oversight of the study and will confirm the completion of major milestones for the utilities to process payments of consultant's invoices.*"

Please see Attachment 1 for DNV GL's "Measurement of NTG Factors for Ontario's Natural Gas Custom Commercial and Industrial DSM" proposal for the TEC.

b) The NTG study results are expected in 2016.

c) The DSM Guidelines issued by the Board on June 30, 2011 in EB-2008-0346 contemplate the development of Terms of Reference ("ToR") for stakeholder engagement (page 42-43). In cooperation with stakeholders, Union and Enbridge developed a joint ToR which was filed and approved by the Board in Union's 2012-2014 Multi-year DSM Plan (EB-2011-0327). To date, the TEC has operated according to the ToR (dated November 4, 2011) which state the role and responsibility of the intervenor members is to "report back to the intervenor members of the larger DSM Consultative in such manner as the intervenors determine". Union trusts that all interested stakeholders are receiving communication updates and review opportunities, as appropriate.

d) Union anticipates the results of the NTG study to be finalized in 2016. However, Union cannot provide specific timelines as this study will be transitioning to the Board, as per the March 4, 2016 Board staff memo referenced in the response to part a). Union interprets "DSM rate setting activities" to mean impacts to Union's Lost Revenue Adjustment Mechanism ("LRAM") volumes as they relate to annual rate setting. In this case, Union expects the outcomes of the NTG study to be used as the best available input assumptions and be applied to 2016 LRAM volumes during the audit of 2016 results.

e) Please see Attachment 2.

f) Please see Attachment 3.

g) For the 2015 program evaluation process, Union will adhere to the Board's Filing Guidelines (EB-2014-0134). In Section 7.0, Program Evaluation (including Adjustment Factors), it states that "the Board will take on the coordination function of the [Evaluation, Measurement and Verification] EM&V process" and "the Board will set out specific roles and responsibilities for the parties involved in the different steps of the evaluation and audit process in a future correspondence".

On August 21, 2015 the Board issued a letter regarding the 2015-2020 DSM Evaluation Process of Program Results (EB-2015-0245). The letter describes the general role of the main parties involved in the evaluation process. As directed in the letter, Union is working with the newly formed EAC for the 2015 program evaluation process. Union will look to the newly hired Evaluation Contractor to provide timelines and application of free ridership rates for 2015.

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

Ontario Natural Gas Technical Evaluation Committee

RFP-002-2013

Prepared by KEMA Consulting Canada, Ltd.

December 23, 2013

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List of Exhibits

1. Introduction

1.1 KEMA Consulting Canada, DNV KEMA Offer This Proposal

KEMA Consulting Canada, Ltd. ("DNV KEMA Energy & Sustainability" or "DNV KEMA") is pleased to submit this proposal to conduct this **Measurement of NTG Factors for Ontario's Natural Gas Custom Commercial and Industrial DSM** for Ontario Natural Gas Technical Evaluation Committee (TEC). This project will develop Free Ridership and Spillover factors for custom commercial and industrial programs, to be used in retrospective evaluation and forward planning.

In 2012 KEMA became part of Det Norske Veritas (DNV), a global provider of services for managing risk. In 2013, a merger between DNV and Germanischer Lloyd (GL) took place. Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers in the maritime, oil & gas, energy and other industries to make the world safer, smarter and greener.

In the Energy industry, DNV GL delivers world-renowned testing and advisory services to the energy value chain including renewables. Its expertise spans onshore and offshore wind power, solar, conventional generation, transmission and distribution, smart grids, and sustainable energy use, as well as energy markets and regulations. DNV GL's 3000 energy experts support clients around the globe in delivering a safe, reliable, efficient, and sustainable energy supply. For more information please visit .

1.2 Key Challenges for a Successful Project

To be successful, this project must meet several challenges:

- Identify study methods that can provide cost-effective and credible quantitative estimates of free ridership and spillover for large customers and custom projects, recognizing the known limitations of available methods for customers of this type, and in line with Ontario's Demand-Side Management Guidelines.
- Develop an overall study plan that balances the desire for accuracy at different levels, and recognizes the limitations of achievable accuracy, within the available budget.
- Design and implement the data collection to ensure the best possible respondent cooperation and meaningful answers to key questions.
- Analyze the collected data using clear, consistent, and defensible methods, to provide the factors of interest.

- Present plans and results clearly to ensure the TEC can make good decisions and have high confidence in the results.

1.3 Why Choose DNV KEMA?

DNV KEMA is uniquely qualified to meet these challenges and conduct a successful study.

- **We are recognized industry leaders in development of attribution methods for studies of this type.** We have developed guidelines for attribution method selection, along with explicit survey analysis or "scoring" rules, in several recent studies. This prior work includes evaluations for Focus on Energy[1], the Massachusetts Program Administrators[2] and evaluations of the American Recovery and Reinvestment Act of 2009Energy Efficiency programs for the US Department of Energy. Much of this work has explicitly addressed the challenges of large and custom projects. Recent evaluation work for Enbridge and Union Gas has drawn on our Focus and Massachusetts work.

- **The individuals directly responsible for this industry leadership will lead this project.** The senior staff we propose for this study have led the development of these method guidelines, and have applied them in numerous contexts.

- **We have extensive experience with continuous improvement programs.** DNV KEMA has served for the past five years as the Measurement and Verification consultant for the U.S. Department of Energy's Superior Energy Performance program and related participation in the International Standards Organization Technical Committees associated with ISO50001.

- **We have materials, tools, and procedures in place to serve as a strong foundation for this work.** We have existing data collection instruments, scoring rules, and analysis tools that will serve as the starting point for this study.

- **Our proposed approach offers several features that will enhance the quality of the FR and SO estimates:**

  – Our data collection will use a combination of methods best suited to different types of customers, to balance the needs for more detail on more complex projects with the needs to limit customer response burden and overall costs.

[1] Goldberg M.L. et al Net-to-Gross Method Selection Framework for Evaluating Focus on Energy Programs, March 2006

[2] Prepared for *Massachusetts Program Administrators Cross-Cutting C&I Free-Ridership and Spillover Methodology Study Final Report*, Chapter 3. April 2011.

- Our protocols and training will ensure high response rates for this challenging target population.
- Interviews for complex projects will be conducted by experienced evaluation engineers to ensure informed probing of what would have been done absent the different stages of program assistance.
- Spillover estimates will be improved by incorporating explicit engineering estimates of savings from identified spillover projects.
- We will utilize interviews with the program's customer representatives or Energy Consultants to ensure that depth interviews for large and complex projects are well targeted.
- Both free ridership and spillover rates will be calculated as fractions of gross savings, rather than as proportions of participants or projects. This approach gives more stable and meaningful factors for application to future programs where the mix of projects and participants may be different.
- Our sample design methods provide the best possible efficiency for estimation of the ratios of interest. That is, we will be able to provide the best possible accuracy for the targeted segments, within the study budget constraints.

- **We have extensive experience with evaluation protocols.** DNV KEMA has worked with and contributed to the development of evaluation protocols and guidelines in many jurisdictions, including California, Ontario, Massachusetts, and Wisconsin. We have reviewed the Ontario guidelines and find them to be consistent with our practices and approaches.

- **We have extensive experience with collaborative multi-stakeholder processes.** DNV KEMA routinely conducts impact evaluation work in such environments. Our current work in Massachusetts, California, Michigan, and TVA all involve work for multiple stakeholders, with varying structures. In addition, we previously conducted audits of Enbridge and Union Gas's DSM evaluations under the collaborative process in place at that time.

- **We offer a flexible approach based on broad and deep capabilities.** We believe that the approach outlined in this proposal will best serve the needs of the TEC. At the same time, we have conducted similar studies using a range of detailed methods, and are well equipped to adjust specifics of our approach in light of more complete information on the programs and the preferences of the TEC.

- **We have a demonstrated track record of providing clear, well written reports..**

2. Approach and Methodology

2.1 High Level Approach

Several recent efforts have reviewed available methods and developed typologies of appropriate methods for different conditions. This work includes:

- Focus on Energy's Method Selection Framework
- Massachusetts C&I Free Ridership and Spillover Study
- U.S. Department of Energy's Uniform Methods Project (Net-to-Gross chapter currently in draft)
- Evaluation of the U.S State Energy Program (SEP) and Energy Efficiency and Conservation Block Grants (EECBG)funded under the American Recovery and Reinvestment Act of 2009.

DNV KEMA led the Focus and Massachusetts efforts (under subcontract to PA Consulting /TetraTech) and is currently conducting the SEP/EECBG evaluations. Conclusions in the draft Uniform Methods Project are generally consistent with ours.

For custom programs and programs with small numbers of diverse participants, viable approaches include participating end user self-report, and project-specific interviews with vendors/contractors. Econometric analysis, either directly modeling energy consumption or modeling measure adoption is ill suited to these conditions. The reason is that econometric analysis requires large numbers of relatively homogenous customers and measures. In addition, top-down analysis of consumption or saturation trends by geographic area can be effective at assessing overall portfolio effects over time, but cannot easily identify effects of individual programs or program years. Accordingly, while some of these alternative approaches are intriguing, and we are exploring them in other contexts, we do not recommend them for this project.

2.2 Summary of DNV KEMA's Proposed Approach

Based on these considerations, DNV KEMA's proposed approach includes the following:

1. As a starting point for all our free-ridership surveys and interviews we will review information from the programs on the engagement of the program with the customer.
2. For large and complex projects, we anticipate that this step will include interviews with program staff who were involved with particular projects, as well as program tracking data and document review.

    a. For large customers and those with complex projects, we will conduct the free-rider surveys by expert in-depth interview (IDI). The flexibility of an interview is needed to probe the alternatives that were considered and the program role in the decisions probe the alternatives that were considered and the program role in the decisions made. In-depth interviews also will yield higher response rates, which are important for this group, where a limited number of customers account for a large fraction of program savings.

b. For small customers and simple projects, we will use computer-assisted telephone interviews (CATI).

This combination of approaches will provide good quality information cost-effectively.

3. For customers who indicate in a free-rider survey that the contractor or vendor had a substantial influence on their project decisions, we will supplement these participating customer surveys with project-specific surveys with the contractors or vendors. These vendor surveys identify situations where the program influenced the vendor, who in turn influenced the customer, even if the customer does not fully recognize the link to the program. Vendor interviews may also be used in advance of the customer interview, if the program information on the project is limited.

4. For customers who indicate in a spillover survey that they took additional measures as a result of prior program participation, an engineer will conduct a follow-up call to collect sufficient information on the spillover measures to estimate associated savings.

Below we discuss the techniques we use to ensure as meaningful estimates as possible using this overall approach. Topics addressed are:

- Survey design and staging
- Translating survey questions into free ridership and spillover parameters
- Sample design
- Further detail on our spillover methodology

2.3 Survey Design and Staging

2.3.1 Survey Timing and Linkages

The information on free ridership is best obtained as close as possible to the time of the decisions. The information on spillover is best obtained after some time has passed since the program measure, to allow time for addition implementation, but not so far later that the influence of the program measure would be lost.

Additional measures that were implemented as a result of satisfaction with an initial measure are attributable to the program only if the initial measure was attributable to the program. Thus, we need to determine the attribution of the program measure to determine attributable spillover from that measure. Hence, we need to ask free rider questions for our spillover respondents. This combination can be accomplished either by separately conducting an early free rider survey and a later spillover survey with the same respondents, or by conducting both at the same time.

To contain costs and overall time of this project, we propose an approach that balances the timing needs of the two surveys. We propose to conduct all the surveys in 2014. For free ridership, we will survey 2012 and 2013 program participants. For spillover, we will survey 2011 and2012 participants. The 2011 and 2012 participant surveys will include both free ridership and spillover questions, but due to the longer elapsed time we likely will not use the 2011 participants for the free rider estimation, only to qualify the spillover responses. The 2013 participant surveys will include only free rider questions.

Large customers are likely to be participants in multiple years. For multi-year customers, we will conduct surveys that address both free ridership for 2012 to 2013 activity, and spillover from 2011 and 2012.

Union Gas's Large Volume program has only been in operation since January of 2013. We propose to assess spillover for these customers based on their participation in earlier programs. Free ridership for this group can be based either on their 2013 projects only, or based on a combination of 2013 projects and 2012 projects in earlier programs. If the TEC wishes to determine free ridership and spillover for these customers specific to the current program, a subsequent spillover survey will be required, entailing additional costs.

2.3.2 Considerations for Self-Directed Programs

Beginning in 2013 Union Gas has a self-directed program for large customers. Under this program structure, large volume customers have until August of each year to use the funds they have contributed to the program, or these funds will be made available to other customers. It is hoped that this "use it or lose it" structure will encourage these customers to take more energy-efficiency actions than they otherwise might. At the same time, this set-up could also make these customers more inclined to file rebate claims for activities they would otherwise have done on their own. Our experience with self-directed programs in other areas is that attribution is neither unusually high nor unusually low compared to large-customer segments in other programs.

Regardless of how this change affects program attribution, the same basic approach is still the best available for ferreting out program attribution. DNV KEMA will design the detailed survey instruments and scoring methods to reflect the applicable funding rules.

2.3.3 Considerations for Continuous Improvement Programs

Both the Enbridge and Union Gas programs are designed to engage customers in active energy management and continuous improvement. To this end, the programs support a stream of activities related to energy management, operations and maintenance practices, opportunity identification and assessment, as well as facilitation and funding for capital projects.

Many of these elements have been present in customer and large-customer programs for many years. In recent years, increasing attention has been given to the potential for generating an ongoing stream of efficiency improvements by engaging commercial and industrial customers in continuous improvement programs. When a customer commits to an ongoing energy management system, the documentation and tracking required by that system can be key to assessing the influence of outside programs on individual projects and on later spillover.

Under ISO50001 guidelines, an energy management system includes

- Identification of significant energy uses at the facility
- Identification of projects and operational practices to improve energy performance
- Ongoing measurement and tracking of energy performance indicators
- Responsibility for regular reporting internally

In this context, understanding how the utility program contributed to the implementation of an energy savings measure requires consideration of the full series of steps that led to that measure.

- Does the customer have an energy management system that it previously did not?
- Was the measure identified through that energy management system?
- How important was the utility to the implementation of that energy management system, to the identification of the measure, to the implementation of the measures once identified?

DNV KEMA has been examining continuous improvement programs with and without utility support in our role as the US Department of Energy's ISO50001 Measurement and Verification advisor. Senior staff committed to this project have been leading that work, and will bring understanding of those processes to the design and interpretation of questions on program influence.

2.3.4 Obtaining Meaningful Responses to Customer Survey Questions on Free Ridership

DNV KEMA has developed an approach that effectively elicits high quality and credible responses to customer surveys on program attribution.

1. **Understand what to ask about.** Review the measure or measures, their relationship, the sequence of decisions made, and the program actions associated with those activities. Typically this involves review of program documentation by a qualified engineer, and may also involve interviews with program staff.
2. **Reach the right respondents.** For many complex projects, there is one individual at the facility who understands the project details, and another who made the ultimate financial decision. Typically it is important to capture both these perspectives. When it's not practical to interview multiple respondents for a single facility, it's important to ask the single respondent to consider not just their own perspective ("what would you have done") but also the perspectives of other

key decision-makers ("would the individuals responsible for the ultimate decision have achieved this without the assistance of the program"). Steps to ensure we have a well-informed respondent are described below.

3. **Set up and frame the key questions.** The question of ultimate interest for free ridership is what the organization would have done without the full stream of assistance provided by the program. Before asking that question, we lay the groundwork with framing questions that help return the respondent to their frame of mind (and the company context) at the time the decisions were made.
4. **Separate different dimensions of what might otherwise have been done**. A typical energy efficiency measure involves a combination of decisions:

   - To install new equipment
   - The efficiency of that equipment,
   - How much to install, or how many lines, rooms, or facilities to address
   - When to install it.

   DNV KEMA's question sequences carefully separate questions about installing something, the efficiency level, the quantity, and the timing. Our experience is that respondents readily understand these distinctions and provide more clear-cut answers than when these elements are mixed into a single question.
5. **Ask at the right time.** Probing the basis for decisions is best done close in time to when the decision was made. However, a complex project may be implemented in stages and require multiple decisions. We typically defer interviewing a customer about attribution for a large project until that project is complete, to avoid repeated response burden on the customer.

2.3.5 Finding the Right Decision-Maker

As noted, a key challenge in these kinds of surveys is identifying the right decision-maker. To locate the right decision-maker we plan to do the following:

- *Look at multiple program tracking databases for project contact names:* We assume that we will be working with multiple tracking databases to develop our sample frames, considering different programs and program years. In developing our participant sample frame we will try to link as many contact names as we can with a given participating company to increase our chances of finding the right decision-maker. Of course, if the program tracking database provides a clear designation of who is the primary customer contact for a given project, we will prioritize that person in our calling order.

- *Collect customer contact information from the Account Representatives/Energy Advisers:* It has been our experience that for larger C&I customers and chain stores especially, the utility account representatives or program energy advisers often have contact names for companies that may not be listed in the program tracking database.[3] For example, many large chain retailers participate in these incentive programs and while the contact in the tracking database may be the local store manager, the real decision-maker may be the retailer's energy manager who works in the corporate office.

- *Understand the decision-making structure of the company:* Understanding the organization's decision-making structure is of course part of setting up the attribution questions; it also is important for ensuring we have information from the right respondent. For example, is there a dollar threshold above which a project decision needs to be made at a corporate level rather than at the facility level? If so, and the project is big enough, we may want to administer the net-to-gross questions to the CFO rather than the facility manager.

- *Verify that the contact was familiar with the measures in question:* Before going ahead with a survey with any contact, we will first confirm their familiarity with the decision to implement the project listed in the program tracking database (the "tracked project"). We will provide the surveyors with a brief description of the energy-efficient measures/projects installed through the program based on the program tracking databases. We will also provide information on the year the project was implemented and where it was implemented.

- *Obtaining additional contact information from survey respondents:* Towards the end of the surveys we will ask participants who identified potential spillover projects for the names and contact information for any others in their company or organization that may be familiar with the project. In our previous participant spillover studies, these additional contact names have proven useful when our engineers were doing follow-up calls to collect more detailed project information needed for the calculation of energy savings.

2.3.6 Obtaining Meaningful Responses to Customer Survey Questions on Spillover

We use similar principles and approaches when asking about spillover to those indicated for the free ridership questions. Our questions are designed to elicit:

- What additional efficiency measures were adopted
- The efficiency of these measures
- The quantity of these measures
- The timing of these measures

[3] Throughout this report we will use the term "energy adviser" to refer to member of the C&I program staff who provide advice and support to C&I customers on the development of energy efficiency projects whether in the field or in the office.

- The baseline conditions.

We also establish via our survey questions that these measures were implemented because of the measures that were previously implemented with program support. We review tracking data to confirm that these additional measures did not also receive program support.

Also critical when attributing spillover measures to the program, as noted, is confirmation that the original measure was itself program-attributable. Our proposed approach accomplishes this by including free rider questions as part of the spillover surveys. Our Spillover approach is described in more detail below.

2.3.7 Combining Information from Customer and Contractor Surveys

We do not rely on program staff to provide direct estimates of program attribution for projects they were involved with, but we do use their information to guide what we ask customers about. There are times, however, when a contractor can provide useful information about a project. This is the case when the customer is making decisions based on contractor recommendations and pricing, and those recommendations and prices are affected by the program in ways the customer doesn't recognize. For example, the customer may not realize that a program rebate was rolled into a multi-element project, but the contractor does. The contractor may not recommend certain kinds of advanced equipment in the absence of a supporting program. We give credit to the program either based on direct influence reported by the customer, or for indirect influence on the vendor when the vendor influenced the customer.

2.4 Translating Survey Questions into Free Ridership and Spillover Parameters

2.4.1 Free Ridership and Spillover for a Particular Respondent

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

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

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

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

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

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

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

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

2.4.2 Interpreting Customer Responses on Program Effect on Timing.

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

2.4.2.1 Scaling based on reported acceleration

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

2.4.2.2 Dual baseline

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

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

2.4.3 Determining Attribution Parameters for the Program.

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

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

Where

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

Likewise for spillover (SO):
SO = (Spillover Savings)/(Gross Savings)
(Spillover Savings) = estimated total spillover savings, from expanding the SO survey sample
(Gross Savings)$_{SP}$ = estimated program gross savings, from expanding the SO survey sample.

Overall NTG is then calculated as

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

2.5 Sample Design

The RFP asks for a discussion of the viability of achieving a 90/10 precision target within the prescribed budget for the market segments targeted by the study, and in particular to provide separate estimates for Union's Large Volume Industrial customers. As a starting point, we consider the segments indicated in Table 1.3 of the RFP.

We plan to sample at the customer level. We assume that most customers will have no more than three projects in a given year, and most projects will be of only one or two measure types, so that we will usually be able to inquire about all of these in a single survey or interview of reasonable length.

Where a customer has a large number of projects, projects are complex, or have a large number of measure types, we will use a subsampling approach, described below, We anticipate that this approach will be needed for many of the large customers in Union Gas's Large Volume program, an in Enbridge's Industrial program.

2.5.1 Overview of Preliminary Sample

Table 2-1 summarizes the estimated sample sizes, and the corresponding precision, for each overall program. The table shows that each program can achieve better than 90/10 precision with the proposed sample sizes. Achieving these precisions is dependent upon achieving high response rates for the large customers. The precision depends also on interpreting the estimates as referring to a fixed, finite population.

We are designing the samples to attempt 90/10 overall precision representing future participation. To project to arbitrary future participants, treated as effectively an infinite population, we develop the sample design without applying the Finite Population Correction. Corresponding projected achievable precision is indicated in the table under the "(No FPC)" column. However, if the results are interpreted as applying to the finite historic population from which the sample was drawn, the FPC applies. These are the results are shown in the final column of Table 2-1

Given the high variability of the large customers, their contribution to total savings, and their limited numbers, the targeted precision cannot be achieved in all cases if we think of these estimates as applying to unknown future participants. On the other hand, future projects in the large customer segments will mainly come from the same customers as in the current and recent programs. From this perspective, the use of the FPC is appropriate.

Table 2-1: Summary of Sample Sizes and Precision at 90% Confidence, with and without FPC

Company	CATI Surveys 2012-13 Participants	In-Depth Interviews 2012-13 Participants	CATI SO screens 2011 Participants	Engineering SO Interviews	Vendor In-Depth Interviews	Program Energy Advisor Interviews	Total CATI	Total In-Depth	Projected NTG Precision (No FPC)	Projected NTG Precision (with FPC)
Enbridge										
Commercial Custom	399	25	212	21			611		7%	5%
Industrial	38	23	30	3			68		17%	10%
Overall	437	48	242	24	40	10	679	112	9%	5%
Union Gas	-	-	-	-					0%	0%
C&I Custom	266	50	158	17			425		8%	6%
Large Volume	-	34	-	2			-		23%	10%
Overall	266	84	158	18	40	10	425	143	16%	7%
Combined	703	132	401	43	80	20	1,104	255	13%	5%

2.5.2 Developing the Sample Design

Critical to the sample size determination is the *error ratio* for each sampling cell with respect to the ratio to the estimated. The error ratio for ratio estimation is the equivalent of the coefficient of variation for estimation of a population mean.[4] Our experience with conducting similar NTG studies of commercial-industrial customers is that the error ratio for the free-rider NTG factor is between 0.7 and 0.8 within reasonably defined sampling cells. Accordingly, without fully specifying the stratification, we can estimate the overall sample sizes required to meet a 90/10 criterion.

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

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

2.5.3 Recommended Segments to Be Targeted

We recommend against targeting tight precision for small proportions or for small segments. That approach would lead to high sample size requirements for the program components whose uncertainty is least important. For example, if a program has 10% free ridership, the 90/10 standard would aim for error bounds of ± 1 percentage point, while a program with 50% free ridership would need error bounds of ± 5 percentage points. All else being equal, the lower free rider program would require roughly 9 times the sample size. Arguably, it's the higher free rider program where better information would be of more value.

Likewise, if we impose the same relative precision target for segments of all sizes, the sample size requirements explode as finer segments are considered. We therefore start with segments for which stand-alone estimates are of natural interest, and examine the practicality of developing 90/10 estimates for each.

[4] The error ratio is the root-mean-square deviation around the ratio line y = Rx, relative to the estimated y value.

2.5.4 Target Parameter for 90/10 Precision

As described above, we calculate the net-to-gross ratio as

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

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

NTG = 1-FR + SO.

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

The recent work in Ontario indicates that free ridership is on the order of 10% to 60% across program segments, 50% overall on a savings-weighted basis. Spillover is on the order of 5%.

The parameter to which we apply the 90/10 requirement is the overall NTG factor. We begin by determining the sample sizes needed for 90/9 for the net-of-free-rider factor (1-FR). Because spillover is generally small, the precision of the full NTG will in most cases be close to that of the net-of-free-rider factor, even with a modest spillover sample size.

2.5.5 Stratification

Within each segment of interest, we will stratify the customers by factors such as combined project size, customer size, project complexity, and end uses. Detailed stratification will depend on the types and frequencies of measures in the programs. Stratification improves precision for a given sample size, and also ensures that different types of projects and customers are included in the sample.

2.5.6 Subsampling

As noted, subsampling of projects, project groups, or measure groups will be necessary for customers with large numbers of diverse projects. We plan to ask each sampled customer about attribution for up to three bundles of measures or projects. For customers of up to three measure types, the survey will collect attribution information on each measure type as a bundle. For customers with multiple similar measure types, we will typically ask about groups of measures, and apply the same approach as when each individual measure type is queried.

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

2.5.7 Preliminary Sample

As described above, we plan to conduct surveys with 2011-12 participants for Spillover, and with 2012-13 participants for Free Ridership. For planning purposes, we assume that each program year has the same distribution of projects as 2012. We further assume an average of 1.5 projects per customer.

The table below indicates for each sector the number and gross savings of the 2012 projects. Also indicated is the assumed error ratio for the net-of-free-riders NTG, based on DNV KEMA's prior work. This error ratio determines the sample size required for a 90/9 (1-FR) estimate, without using the FPC.

Table 2-1: Estimated Free Rider Survey Sample Sizes

Program/ Market Sector	Number of 2012 Projects	Estimated 2012 participants	Estimated participants in 2 program years	Gross lifetime savings 2012 (10^6 m3)	Assumed 1-FR Error Ratio	Participant sample size for 90/9 no FPC	Maximum achievable sample size @ 50% response rate	Projected total FR survey sample size
Enbridge								
Commercial Custom	835	557	1,113	743		591	557	424
Commercial Existing	490	327	653	286	0.80	214	327	214
Large New Construction	70	47	93	182	0.80	214	47	47
Multi-Residential	275	183	367	275	0.70	164	183	164
Industrial	91	61	91	610	0.80	214	46	46
Overall	926	617	1,204	1,353		805	602	470
Union Gas								
Commercial & Industrial Custom	475	317	633	1,453		753	317	317
Commercial Existing	160	107	213	161	0.70	164	107	107
Commercial New Construction	8	5	11	40	0.80	214	5	5
Small Industrial Agriculture	78	52	104	251	0.75	188	52	52
Small Industrial Non-Agriculture	229	153	305	1,001	0.75	188	153	153
Large Industrial Rate T1 and 100	180	41	41	3,166	0.80	214	34	34
Overall	655	358	674	4,619		967	244	244
Overall	1,581	975	1,879	5,972		1,772	846	714

Table 2-2. Sample Sizes and Estimated Precision at 90% Confidence for Arbitrary Future Participants (no FPC)

Program/ Market Sector	Projected total FR survey sample size	Estimated CATI Surveys 2012-13 Participants	Estimated In-Depth Interviews 2012-13 Participants	Estimated CATI SO screens 2011 Participants	Estimated Engineering SO Interviews	Estimated 1-FR precision	Estimated (1+SO) precision	Estimated combined NTG precision
Enbridge								
Commercial Custom	424	399	25	212	21	7%	2%	7%
Commercial Existing	214	209	5	107	11	9%	2%	9%
Large New Construction	47	37	10	23	2	19%	4%	20%
Multi-Residential	164	154	10	82	8	9%	2%	9%
Industrial	46	23	23	23	2	20%	4%	20%
Overall	470	422	48	235	23	10%	2%	10%
Union Gas								
Commercial & Industrial Custom	317	266	50	158	17	8%	2%	8%
Commercial Existing	107	102	5	53	5	11%	3%	11%
Commercial New Construction	5	-	5	3	1	57%	12%	58%
Small Industrial Agriculture	52	47	5	26	3	17%	4%	18%
Small Industrial Non-Agriculture	153	118	35	76	8	10%	2%	10%
Large Industrial Rate T1 and 100	34	-	34	-	2	23%	6%	23%
Overall	244	266	84	158	18	16%	4%	16%
Overall	714	688	132	393	42	12%	3%	13%

Also shown in Table 2-1 is the estimated number of participating customers per two-year period. For most segments, we assume that in two program years there will be twice the total number of participants as in 2012. For Union's Large Industrial program, the program application document indicates 41 participants. We assume this is the total number eligible, and that all will participate in each year. For Enbridge's general industrial program, we assume 50% more customers in two years than in one, on the assumption that half the customers are very large and participating almost every year, and half are smaller.

Based on our recent experience, with the survey methods we plan, we believe that the survey response rate is likely to be on the order of 50%, possibly lower for smaller customers. Accordingly, the maximum achievable number of responses is 50% times the total number of projects. The projected FR survey sample size shown in the table (total across the two years of participation) is the smaller of the number needed for 90/10 precision and the maximum achievable.

For Union's Large Volume program, we assume a higher rate of sample completion. This customer group accounts for over half the 2012 savings. Accordingly, achieving a high response rate for this group is essential to provide good precision for the program as a whole. We will make it a high priority to achieve as good cooperation with this group as possible, and will work with Union staff to achieve that.. Likewise, a high response rate is necessary and assumed for the large customers in their Industrial program, and we will work with Enbridge to achieve that.

The next table indicates a likely split of the total FR sample between CATI and IDI. These surveys will be conducted with 2012 and 2013 participants. Also indicated in the table is the number of planned CATI surveys to obtain spillover from 2011 participants. We propose to target an equal number of SO CATI surveys for 2011 participants, giving us three-year spillover, as for 2012 participants, giving us two-year spillover. Engineering follow-up interviews are estimated to be needed for 5 percent of spillover survey respondents, based on our prior experience as well as the Ontario 2008 findings.

The final columns of Table 2-2 indicate the projected precision at 90 percent confidence for the 2 NTG factors (1-FR) and (1+SO), and for the overall NTG. Because of limited numbers of customers, 90/10 accuracy is not achievable for some of the targeted segments, but the target is achievable for each utility as a whole.

2.6 Further Detail on DNV KEMA's Participant Spillover Approach

The discussion above addresses our approaches for both free ridership and spillover. Because spillover estimation is more challenging, and often more controversial, we provide additional detail here on our approach for spillover.

2.6.1 Key Issues and Challenges for Spillover

Spillover "refers to effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program."[5] As in many jurisdictions, Ontario's Demand-Side Management Guidelines recognize the importance of spillover in determining program benefits, and also require "comprehensive and convincing empirical evidence" to support any program spillover claim.

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

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

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

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

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

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

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

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

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

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

- *Estimating program attribution for potential spillover measures* - A common way of assessing participant spillover is to ask how much the participant's experience with the tracked program-influenced measure influenced their decision to implement measures that are candidates for spillover attribution. It is difficult to turn this "fuzzy" assessment of program influence into a more concrete attribution factor necessary for attributing a certain quantity of therms from the spillover measure to the program.

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

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

2.6.2 Understanding Energy-Related Standard Practices

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

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

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

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

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

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

2.6.3 Calculating Program Attribution for Candidate Spillover Actions

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

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

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

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

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

To determine Attribution Factor A we will use the net-to-gross question battery already described in this proposal. For Attribution factor B we will use a scoring method that will be triggered off the question, "If you had not made the earlier energy-efficiency improvements I just listed, how likely would you have been to make this additional energy efficiency improvement?" The scoring method, which we used in Wisconsin for many years, is shown in Table 2-3. If the participant said they were very likely to have made the additional energy efficiency improvement without the program, then we will terminate the survey since there will be no participant spillover to be measured.

Table 2-3: Program Attribution for Subsequent Measures

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

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

2.6.4 Avoiding Double Counting of Energy Savings

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

2.6.5 Estimating Energy Savings for Participant Spillover Measures

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

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

3. Experience, Skills and Qualifications of Team Members

In this section, we show the project's management structure and summarize the experience, skills and qualifications for project team members. As the Project Manager, Ben Jones will be the primary liaison with the TEC and the utilities and will be responsible for making sure high quality deliverables are produced on schedule and within project budgets. Under Ben will be three task managers who will manage the in-depth interviews, the CATI surveys, and the net-to-gross analysis. Figure 3-1 shows the full project management structure.

Figure 3-1. Project Management Structure

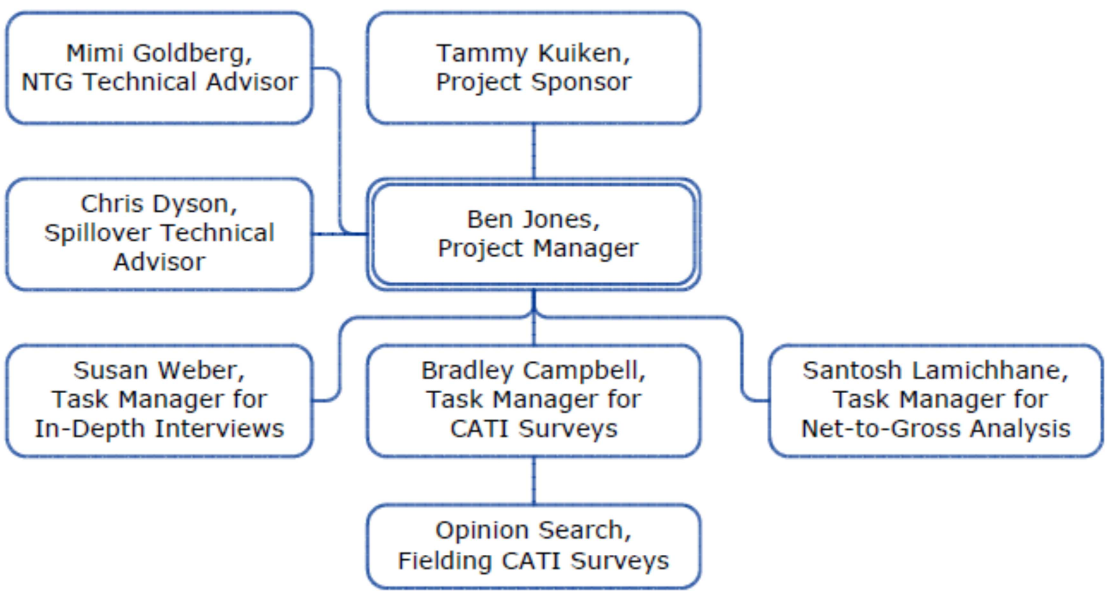

Table 3-1 highlights the deep experience the team brings to this project in evaluation of C&I custom programs including NTG analysis, survey design and in-depth interviews with large customers. Full resumes for all project team members are included in Appendix A. Brief bios of key team members are listed in the next subsection.

Table 3-1. Summary of Team Members' Project Role and Relevant Experience, Skills and Qualifications

Team Member	Project Role	Experience and Skills				
		NTG Analysis	C&I Custom Program Eval	C&I Survey Design	C&I Interviews NTG	Ontario Client Projects
Miriam Goldberg	Sr. Technical Advisor	X	X	X	x	x
Christopher Dyson	Technical Advisor	X	X	X	x	x
Tamara Kuiken	Project Sponsor	X	X	X	x	x
Ben Jones	Project Manager	X	X	X	x	x
Susan Weber	Task Mgr-IDIs	X	X	X	x	x
Bradley Campbell	Task Mgr-CATI	X	X	X	x	x
Santosh Lamichhane	Task Mgr-NTG Analysis	X	x	X	x	
Jeremiah Robinson	Engineering Interviews	X	x	X	x	
Edilson Abreu	Engineering Interviews	X	x		x	
Samuel Harms	Analyst	X			x	
Greg Gronski	Analyst	X			x	
Colleen Driscoll	Analyst	X			x	
Sarah Tuttle	Analyst	X			x	

3.1 Experience, Skills and Qualifications of Key Team Members

Miriam Goldberg, Ph.D., DNV KEMA's Director and Country Manager, Policy Advisory and Research, Americas, will serve as senior technical advisor to this project. Dr. Goldberg oversees a team of 135 professionals including econometricians, survey specialists, and building engineers for DNV KEMA's consulting services on the "customer side" of the meter. This work spans demand-side planning and evaluation, and customer research for general operational support.

Dr. Goldberg is a leading expert in energy efficiency program evaluation and received the 2009 International Energy Program Evaluation Conference (IEPEC) Lifetime Achievement Award in recognition for her leadership in and contributions to energy-efficiency and demand response programs evaluation. With over 35 years of experience, she has directed studies of a wide range of programs, including commercial/industrial, low-income, general residential, and load management programs. She is an expert in the application of statistical methods to program evaluation, including sample design, surveys, and data analysis. Her expertise covers attribution methods, load research, billing data analysis, discrete choice modeling, end-use studies, pricing analysis, and segmentation.

Dr. Goldberg was has made numerous contributions to Net-to-Gross methodologies over the years. She was lead author of the methods decision framework developed for Focus on Energy, which was used to guide the 2008 Ontario Gas evaluation. She also led the development of a related methods selection framework for the Massachusetts Program Administrators. She has been the architect of detailed survey design and analysis procedures relying on customer self-reports, as well as integration of surveys responses from customers and vendors. She has also developed net-to-gross methods based on econometric modeling of stated and revealed preference data, using market sales data, using consumption data analysis, and integrating multiple methods across different channels. She was co-developer of the "double inverse Mills Ratio" self-selection correction for billing data analysis.

Dr. Goldberg's work has contributed to improving methods of measuring savings, to make demand-side resources more credible and reliable. In addition to directing many Demand Response evaluations, Dr. Goldberg has overseen several assessments of demand response baseline methodology, and served as chair of the Working Group on Measurement and Verification for the National Action Plan on Demand Response. She is currently helping to develop Measurement and Verification Protocols for the Superior Energy Performance program for Industrial facilities. She co-authored the Uniform Methods Protocol for Wholehouse Retrofit based on billing analysis. She has conducted methodological assessments for impact evaluation, and load profiling for market settlement. She was an author of an early California Framework for Assessing the Benefits and Costs of Publicly Funded Energy Efficiency Programs, including the public policy rationale for intervention in energy efficiency markets. She authored multiple chapters of the EPRI Guidebook on Nonresidential Program Evaluation. She has a Ph.D. in Statistics and an M.S. in Mechanical and Aerospace Engineering from Princeton University, as well as a B.A. in Mathematics from Harvard University.

Christopher Dyson, Principal Consultant, will be a technical advisor to the project. Mr. Dyson has managed numerous program evaluations that involved the calculation of free ridership and spillover and co-authored an International Energy Program Evaluation Conference (IEPEC) paper on best practices in participant spillover methods.

Mr. Dyson has over 15 years of experience evaluating energy efficiency and demand response programs. He has extensive recent experience as a project manager and primary author of a number of impact and process evaluations of commercial and industrial (C&I) and residential energy efficiency programs. Mr. Dyson is currently serving as project manager for large evaluation of five Tennessee Valley Authority (TVA) C&I programs and is managing key tasks for the impact evaluation of California's Upstream Lighting Program.

Mr. Dyson is also currently managing a number of projects that are calculating net-to-gross ratios for Massachusetts C&I and residential lighting programs. In 2013 he led the calculation of free ridership and spillover for the innovative Massachusetts Bright Opportunities program, which was one of the first programs in the country to offer upstream incentives for LED lighting products in the C&I sector. He has also has been part of a team of consultants who have calculated net-to-gross ratios for participants in the Massachusetts Energy Star residential lighting program over the past three years.

Mr. Dyson is also currently managing a multi-year (2010-2014) process evaluation of the Efficiency United (EU) portfolio of energy efficiency programs, which is administered by Michigan Community Action Agency Association (MCAAA). This portfolio includes C&I, HVAC, Energy Star CFLs/appliances, online audit and weatherization, appliance recycling, multifamily, and low-income programs, among others.

Mr. Dyson holds a Master of Arts in Public Policy Analysis and a Certificate in Energy Analysis from the University of Wisconsin–Madison, and a Bachelor of Arts from Yale University.

Tamara Kuiken, P.E, Principal Consultant, will serve as Project Sponsor. In this capacity she will be responsible for ensuring that appropriate corporate resources are available to the project and for ensuring project quality. Ms. Kuiken has extensive experience leading DNV KEMA's impact evaluations, including both engineering and attribution analysis. Ms. Kuiken has contributed to and directed studies in all sectors, including the commercial/industrial, residential, low income, agriculture, and institutional sectors. She has evaluated programs that address energy efficiency, load control, and renewable projects. Her engineering background provides a strong foundation for the evaluation of large commercial and industrial programs with complex custom installations.

Much of Ms. Kuiken's work has contributed to improving the methods of measuring program attributable savings, including free-ridership and spillover. Ms. Kuiken has measured attributable savings for programs in many regulatory jurisdictions and currently has a large role in the impact evaluations of the United States Department of Energy's State Energy Program and Energy Efficiency Community Block Grant program. She played a critical role in developing life-cycle attribution methods for the state of

Wisconsin's commercial and industrial programs and helped pioneer a dual baseline calculation in that state.

Ms. Kuiken has a M.S. and B.S. in Mechanical Engineering from Iowa State University.

Ben Jones, Consultant, will serve as project manager. ,. Mr. Jones is an experienced manager who has contributed to DNV KEMA's attribution methods development over the last six years. He has led large-scale quantitative analysis on numerous evaluations of energy efficiency and renewable energy programs. This work includes sample design, attribution analysis for individual customers, ratio estimation for net-to-gross and other adjustment factors, and standard error calculations. His current evaluation work includes implementation of attribution analysis for dozens of individual programs as part of DNV KEMA's national evaluations of the ARRA State Energy Programs and Energy Efficiency and Conservation Block Grants. He has conducted similar work for the past 4 years for the Michigan Community Action Agency Association, and previously for Wisconsin's statewide Focus on Energy Business and Renewable Programs and Alliant Energy's programs in both Iowa and Wisconsin. Fluent in Mandarin Chinese, he lived, worked and studied in Chongqing, China from 2001 to 2006.

Mr. Jones has a B.A. in Political Science and Near Eastern Studies from the University of Michigan. He received a Masters in International Public Affairs from the La Follette School of Public Affairs and a Masters Certificate in Energy Analysis and Policy from the Nelson Institute of Environmental Studies at the University of Wisconsin-Madison in 2008.

Susan Weber, Senior Consultant, will manage the in-depth interviews. Ms. Weber focuses on survey design and administration for in-depth interviews, telephone surveys, online surveys and focus group discussions. She has managed over 30 data collection efforts with non-residential customers during her 14-year tenure with DNV KEMA, and interviewed over 500 commercial and industrial customers and conducted C&I focus groups to support program evaluations. She is extremely effective at achieving high response rates and good quality data for interview of this type. Most recently, Ms. Weber was Project Manager for a Hydro-Quebec evaluation and led CATI and in-depth survey research. Prior to joining DNV KEMA, Ms. Weber was Research Manager at InterGen Energy, an international power plant developer, where she developed the firm's corporate research and information strategy. She holds a Bachelor of Arts degree from the University of Wisconsin-Madison, and a Master of Science degree in Information Science from Simmons College, Boston.

Bradley Campbell, Senior Analyst,will manage the CATI tasks. Mr. Bradley has worked in numerous areas of Market Research in his 3 years with DNV KEMA. In this time he has performed survey and interview management for state specific programs in Iowa, Wisconsin, Michigan, and Massachusetts as well as national and multi-state programs. Bradley has worked in project and task management of both pilot and full scale programs in Wisconsin and Michigan where he has worked with Wisconsin Public Service Community Pilots Program, Efficiency United and Energy Optimization programs. Evaluations in these areas, and others, have typically required evaluation of not only program processes and customer satisfaction, but program attribution, net to gross inputs, multi-party interviewing, demographic weighting and other impact evaluation details.

Bradley previously worked for the Wisconsin Department of Workforce Development as the lead Labor Market Research Analyst and Program Manager for the Current Employment Statistics survey, commonly known as the Payroll Survey. These statistical surveys were among the timeliest leading economic indicators. Bradley brings to DNV KEMA extensive analytic experience, and also has public training with expertise in program evaluation, analysis and management. He has worked in private and public industry, and strived to continuously improve government to better serve the needs of citizens through improved data, methods, policy, transparency and responsiveness.

Santosh Lamichhane will manage the Net-to-Gross analysis. Mr. Lamichane has worked on the impact evaluation of many energy efficiency programs and has performed and managed analytical tasks such as model-based statistical sample designs, calculating net-to-gross ratios, and producing estimates of net energy savings for both C&I and residential projects. In addition, he has performed engineering analysis and calculations, reviewed tracking databases, prepared samples for surveys, and used SAS program to write and modify codes to do analysis and automate tasks in a reproducible way. Mr. Lamichhane has also worked as a design engineer. Mr. Lamichane has a Master's degree in Public Affairs with a focus in energy analysis and policy. In addition, he has an Engineer-in-Training certification with a Bachelor's degree in electrical engineering.

Jeremiah Robinson, PE, will conduct in-depth interviews and savings estimation for complex projects and confirmed spillover activities. Mr. Robinson regularly performs engineering reviews for energy savings protocols and impact evaluations, field data collection, expert surveying, and data analysis using Excel and Access. With expertise in writing, editing, and spreadsheet development, he often assists in producing reports. Prior to joining DNV KEMA, Mr. Robinson worked for three years in electrical engineering building design and construction administration, with specializations in energy efficiency, lighting, and communications. He works well with building owners and contractors, and knows his way around mechanical rooms and jobsites. Mr. Robinson is a LEED® Accredited Professional and holds a B.S. in Engineering from Messiah College.

Edilson Abreu will conduct in-depth interviews and savings estimation for complex projects and confirmed spillover activities. Mr. Abreu has worked on engineering analysis for several impact evaluations since joining DNV KEMA. He is a graduate from Western Michigan University at Kalamazoo, earning a B.S. degree in Chemical Engineering with a focus in energy management systems. Edilson has academic experience in the design and implementation of energy management systems as well as the analysis and improvement of industrial and commercial HVAC and lighting systems. He earned his Engineer in Training certificate in 2013 and plans to acquire certifications as an Energy Manager and Energy Auditor from the Association of Energy Engineers.

4. References

DNV KEMA References

Client Name	National Grid
Address (City and Country)	Westboro, Massachusetts, USA
Contact Name	Wendy Todd
Title of Contact	Director, Program Strategy, Evaluation & Policy
Telephone No.	781-907-2232
E-mail Address	wendy.todd@nationalgrid.com
Length of Relationship	4 years
Type of Goods and/or Services Provided to this Client	Evaluation of the full portfolio of commercial and industrial programs operated by the investor owned utilities in Massachusetts. Our contract was recently renewed and expanded.

Client Name	California Public Utilities Commission
Address (City and Country)	San Francisco, California, USA
Contact Name	Carmen Best
Title of Contact	Supervisor, Demand Side Management Evaluation
Telephone No.	415-703-1797
E-mail Address	carmen.best@cpuc.ca.gov
Length of Relationship	7 years
Type of Goods and/or Services Provided to this Client	Impact evaluation of residential, codes and standards, and market effects programs operated by the California investor-owned utilities, including development and implementation of a range of attribution estimation methodologies.

Client Name	Ralph Prahl
Address (City and Country)	269 Mason Street Madison, WI 53705
Contact Name	Ralph Prahl
Title of Contact	Representative of the Energy Efficiency Advisory Council which oversees the Evaluation Measurement And Verification activities of the Massachusetts Program Administrators.
Telephone No.	608 238 9952
E-mail Address	ralph.prahl@gmail.com
Length of Relationship	15 years
Type of Goods and/or Services Provided to this Client	Mr. Prahl provides guidance to the program administrators and reviews all materials our comprehensive commercial/industrial program evaluation contract, as well as for the cross-cutting and residential contracts under which we are subcontractors. This work has included development of attribution method selection criteria, non-energy impact estimation, and a wide range of impact evaluations and market studies. In a prior role, Mr. Prahl served as a reviewer of our Spillover study for Focus on Energy.

Client Name	Michigan Community Action Agency Association
Address (City and Country)	2173 Commons Pkwy Okemos, MI 48864
Contact Name	Sharon Theroux
Title of Contact	Energy Programs Director
Telephone No.	517 321-7500
E-mail Address	therouxs@mcaaa.org
Length of Relationship	4 years
Type of Goods and/or Services Provided to this Client	Impact evaluations including attribution analysis.

4.1 Qualifications

With more than 30 years of experience in the evaluation industry, DNV KEMA is recognized as an international leader in the field of energy program evaluation. Our senior staff has pioneered the development of evaluation concepts, methodologies, and tools currently being used by practitioners throughout the United States and abroad. Our experience cuts across a wide range of evaluation goals and disciplines, touching on virtually every type of program, technology, and targeted sector.

Our experience in conducting impact evaluations and net-to-gross calculations have ranged from verification only to enhanced rigor M&V studies including engineering assessments, end-use metering, billing analyses, and complex simulation modeling. We have developed rigorous impact estimates at the measure, program, and full portfolio levels for commercial and industrial customers.

Table 4-1 shows key recent DNV KEMA program experience, particularly for net-to-gross analysis and C&I custom program evaluations. Many of our evaluation projects have used the collaborative multi-stakeholder approach similar to the structure employed by Ontario Natural Gas. In the next subsection we supply descriptions of project experiences that are relevant to the proposed scope of work. These are projects where we have developed and applied net-to-gross methodologies similar to those we propose for this work. Senior leadership we propose for this work have been responsible for the net-to-gross components in all of these engagements.

Table 4-1. Selected DNV Relevant Evaluation Experience

				Program by Fuel		
	NTG	**C&I Custom Program**	**C&I IDIs**	**Gas**	**Elec**	**Multi-Stakeholder Collaboration**
Massachusetts Program Administrators: *Evaluator, all C&I Programs* *Attribution Methods Selection Criteria, all programs* *Commercial/Industrial Non-Energy Impact Study*	x x	x x x	x x	x x x	x x x	Yes Yes Yes
Oak Ridge National Laboratory:						
ARRA State Energy Program Evaluation	x	x	x	x	x	Yes
ARRA Energy Efficiency Conservation and Block Grant Evaluation	x	x	x	x	x	Yes
Wisconsin Focus on Energy, Evaluator, Business Programs and Benefit/Cost, all Programs	x	X	x	x	x	Yes
Michigan MCAAA - Energy Optimization Studies Evaluator	x	X	x	x	x	Yes
Vectren Natural Gas DSM Evaluation	x			x		
TVA EM&V Portfolio Management	x	X	x		x	Yes
Alliant Energy Shared Savings Program Evaluation	x	X	x	x	x	
Alliant Energy, EE Program Evaluation		X		x	x	

4.2 Relevant Experience

Massachusetts Commercial and Industrial Evaluation Contractor, and Cross-Cutting program evaluation subcontractor 2010 – present

DNV KEMA has managed the evaluation of all commercial and industrial programs operated by Massachusetts Investor-Owned Utilities for the past four years. The project includes impact evaluations and in-depth interviews with commercial and industrial customers both in person and via telephone. In this role DNV KEMA is responsible for the successful planning, execution and delivery of all C&I evaluation activities in Massachusetts for 2010 through 2015. DNV KEMA has worked closely with the eight electric and gas program administrators and the Massachusetts Energy Efficiency Advisory Council's (EEAC) hired evaluation, measurement, and verification (EM&V) experts to ensure the research efforts performed for Massachusetts provide the public, customers and policy makers with confidence that the savings are real.

DNV KEMA research studies have evaluated the savings impacts and program delivery methods for all C&I programs and technologies promoted by the MA program administrators. Other studies focused on process evaluation, market effects studies and market characterization. Research methods and techniques employed include but are not limited to: in-depth interviews and computer assisted telephone interviews (CATI) interviews with program staff, market actors, stakeholders, program participants and non-participants, and industry experts; billing analysis; engineering review and analysis with desk reviews, site visits with metering, and performance data; literature reviews; and analysis of primary and secondary data (e.g. program tracking, customer usage data, survey data, construction data, sales data, etc). Our research has also focused on process evaluation, market effects studies and market characterization studies.

In addition to retrospective analysis, DNV KEMA's comprehensive evaluation investigates new markets, new approaches and new technologies to assist the Commonwealth of Massachusetts in its quest for all cost-effective energy efficiency.

In our role on the cross-cutting evaluation team for Massachusetts, DNV KEMA developed the net-to-gross decision framework for the Massachusetts programs. We also conducted the most comprehensive study to date of commercial-industrial non-energy impacts. This study involved in-depth interviews with hundreds of customers, related to both prescriptive and custom projects. The work also ensured that non-energy impacts associated with implemented measures were attributable to the program, using approaches similar to those needed for our proposed spillover study

Oak Ridge National Laboratory (ORNL) American Recovery and Reinvestment Act Evaluations—State Energy Programs and Energy Efficiency and Conservation Block Grants

DNV KEMA is currently evaluating two national programs funded by the American Recovery and Reinvestment Act. The State Energy Program is a $9.7M evaluation, covering over 700 individual programs in 56 states and territories. DNV KEMA has selected a statistical sample of 82 programs to represent the 6 broad programmatic areas that account for roughly 80 percent of SEP spending. We have designed methods for gross and net savings estimation specific to each broad area. For nonresidential and residential retrofit programs and renewable energy projects, we are selecting samples of end-user participants in each selected program. For the selected participants, we are reviewing program data and conducting surveys to determine details of projects implemented and construct gross and net savings estimates. The questionnaires and scoring methods used for this purpose are similar to those proposed for this study. In addition, we have developed a savings calculator that provides energy savings estimates for most common measure types, which can be applied with detailed or more general project information. The Energy Efficiency and Conservation Block Grant evaluation is a $4M effort, involving smaller scale grants, and applying similar methods to those used for the SEP evaluation.

Tennessee Valley Authority (TVA) EM&V Portfolio Management, 2012–2016

DNV KEMA is serving as the first program evaluation contractor for TVA's EnergyRight® Solutions program portfolio. These include a wide variety of energy efficiency, demand response, and renewable energy programs across all market segments that are implemented through TVA's 155 Local Power Companies and provided to 57 direct served customers. The Energy Right® Solutions portfolio includes a full spectrum of TVA designed and delivered residential, commercial, and industrial programs. In addition, DNV KEMA is providing TVA with a key resource helping to conduct program evaluations for several programs designed and delivered by the local power companies or by groups of local power companies. The evaluation has very high visibility and is subjected to an elevated degree of review, thereby requiring sufficient rigor to convince supply planners that the resource is real and sustainable.

DNV KEMA is currently evaluating TVA's EnergyRight® Solutions For Business and EnergyRight® Solutions for Industry program portfolios. These energy efficiency programs include both prescriptive and custom programs targeting all segments of the C&I markets. The evaluation combines impact evaluation, process evaluation, and quality assurance/quality control assessments of five separate programs into one seamless C&I portfolio evaluation. The impact evaluation includes onsite data collection and metering at over 200 C&I sites that have participated in TVA's programs across seven states, and is designed to yield a statistical precision of ± 10% with a confidence level of 90% for each of the programs. The impact analysis also includes calculations of net-to-gross ratios. The process evaluation includes surveys and interviews with program participants and a diverse set of stakeholders (contractors and trade allies, local power companies, program management, non-participant C&I sites). Data collection will continue through fall of 2013 with initial results expected in winter 2013/2014.

Alliant Energy Shared Savings Program Evaluation: 2009-2011

DNV KEMA performed a two-year comprehensive evaluation of the Wisconsin Power & Light (WP&L) Shared Savings Program. This work utilized methods similar to those described in this proposal for net-to-gross analysis. The program offers technical and financial incentives to business and agriculture customers for the implementation of energy efficiency measures. Alliant Energy–WP&L helps customers identify and evaluate energy savings projects then pays the full up-front cost of the capital investment. The customer pays back the loan each month on their utility bill over the contact term (typically 5 years). The program evaluation included impact and process evaluations, as well as an analysis of cost effectiveness. The impact evaluation was developed with the dual goals of producing stand-alone estimates of gross and net savings for the program and an assessment of the program's joint efforts with the Statewide Focus on Energy Business Program.

Alliant Energy, Energy Efficiency Program (EEP) Evaluation: 2010-2011

DNV KEMA is conducting impact and process evaluations of Alliant -Interstate Power and Light's Energy Efficiency Programs for the 2009 - 2013 program period. This work utilizes methods similar to those described in this proposal for net-to-gross analysis. The evaluation covers 21 programs that address a wide range of energy and demand related issues in all sectors, including energy efficiency, demand reduction, renewable generation and low-income program delivery. Energy efficiency impact methods include: billing analysis, on-site inspections, engineering review, and energy simulation modeling to verify savings estimates. The approach focuses on identifying changes to assumptions, calculations and program tracking to improve savings estimates for future program years. The process evaluation includes in-depth interviews with Alliant staff, sub-contractors, participants, trade allies and other stakeholders, participant surveys (telephone and web based), material and database reviews, and the development of program process flow diagrams. The evaluation results in identifying what is working and making recommendations for changes in processes, enhanced delivery approaches and planning assumptions.

Michigan Community Action Agency Association (MCAAA) - Energy Optimization (EO) Studies: 2009-2011

DNV KEMA serves as the evaluation contractor for the MCAAA on the EO programs. The Michigan Public Service commission designated MCAAA as the State EO Plan Administrator for utilities that choose not to self-administer their EO programs. Under this arrangement, the Efficiency United program is now offered to customers of 11 Michigan utilities. DNV KEMA conducted independent expert evaluation studies of the 2009–2011 EO programs to verify the incremental energy savings, in accordance with the "Clean, Renewable, and Efficient Energy Act," 2008 PA 295 (the Act). This work utilized methods similar to those described in this proposal for net-to-gross analysis.

Wisconsin Department of Administration and Wisconsin Public Service Commission, Wisconsin Focus on Energy Program Evaluation, 2001-2011.

From 2001 through 2011, DNV KEMA was the lead subcontractor for the evaluation of Wisconsin's *Focus on Energy* Programs. Our roles included

- Impact, process, and market effects evaluations of the Business programs, which address commercial, industrial, and agricultural sectors.
- Impact, process, and market effects evaluations of the Renewable energy programs, including included solar, wind, digesters, biomass, solar water heating, and wood in CHP.
- Impact evaluation of the Low Income and Targeted Income-qualified programs.
- Benefit-cost analysis of all program areas, incorporating energy, jobs, economic, and other non-energy impacts and costs.
- Overall cross-program process evaluation.

This work included:

- Developing high-level Strategic Evaluation Plans and Detailed Evaluation Plans, prioritizing and budgeting tasks for each program area.
- Conducting impact evaluations using onsite data collection, CATI surveys, in-depth interviews, engineering analysis, and statistical estimation methods.
- Developing a framework for selecting and applying net-to-gross estimation methods for different program and market conditions.
- Estimating spillover effects.
- Conducting process evaluations assessing program messaging, awareness, and satisfaction, among end-use customers and suppliers.
- Reviewing program logic models and metrics, and assessing market effects metrics

- Conducting measure cost studies.
- Assessing incentive levels for rebate programs.
- Estimating impacts and conducting process evaluation of Education and Training programs via participant follow-up and engineering analysis.
- Meeting regularly with implementation and administration staff to review program developments, and discuss evaluation approaches and findings.
- Coordinating with other evaluators on data bases, evaluation of common measures, and methodologies.
- Providing semi-annual and periodic comprehensive reports with current impact estimates and new research findings.

Vectren Corporation, Vectren Natural Gas DSM Evaluation, 2009

KEMA performed an impact evaluation of the Natural Gas DSM Programs in Indiana. We determined the program effect on the furnace market through supplier interviews and analysis. We also determined the net energy savings for participants in the prescriptive and custom programs through participant surveys. The combined attribution from the market study and participant surveys was used to determine net program savings. This study used an innovative approach to attribution analysis, combining interviews with customers and with vendors to determine program influence. The study's parallel analysis using historical market sales data provided close corroboration of the results.

California Public Utilities Commission, Energy Division, Project: Impact Evaluation of California Investor-Owned Utilities' 2010-2012 Residential/Advanced/Upstream Lighting Programs, 2010-2014.

DNV KEMA has been conducting impact evaluation of California IOU programs for the CPUC, including the upstream lighting programs, since 2007. A key part of this work has included development of net-to-gross estimates using multiple parallel and integrated approaches. These approaches include a combination of upstream and downstream "self-report" approaches, econometric modeling of stated and revealed preference data, pricing elasticity analysis, and a multi-state comparison study.

We are currently evaluating the 2010-12 program period.The residential lighting programs together comprise approximately 30 percent of the total anticipated energy savings the IOUs' 2010-2012 energy-efficiency program portfolio. Related data collection efforts support not only the impact evaluation of these programs but also complementary process evaluation, market characterization, and market effects studies. The study involves data collection and data analysis on the lighting market from several perspectives including:

- In-depth interviews with corporate representatives of lighting manufacturers and retail chains and other lighting market actors to inform net-to-gross estimates for energy-efficient lighting products;
- In-store customer intercepts surveys to examine customer decision-making regarding lamp purchases as well as the influence of point-of-purchase materials and IOU program discounts on customer choices. DNV KEMA is using discrete choice models to estimate program attribution.

The model predicts changes in consumer choice as a response to program activity. The model is sensitive to prices, retail channels, housing characteristics, and income and education levels of the consumer;

- Telephone surveys with retail store managers to help estimate lamp sales and the upstream programs' effects on sales;
- Telephone surveys with residential customers to examine awareness, purchase, installation, usage, and storage of various lamp types (including CFLs, LED lamps, and EISA-compliant incandescent lamps);
- Onsite surveys of a nested sample of telephone survey participants to provide California data to a multi-state CFL purchasing model;
- Retail shelf surveys to collect comprehensive inventories of lamps stocked retail stores to assess retail stocking practices, the diversity of available lamps, lamp pricing, and the effects of IOU program discounts on lamp prices across all major retail channels in California; and
- Detailed review and analysis of quarterly IOU program tracking data along with invoice comparisons to verify program shipments and to verify that discounted lamps meet the programs' requirements.

DNV KEMA will use these elements to estimate the gross unit energy savings (UES) of the measures included in the programs by developing estimates of hours of use, installation rates, displaced wattage, and coincidence factor. The gross savings estimates will be amended based on adjustments to the quantity of measures shipped through the program. Additionally, the data collection efforts and surveys will be used to estimate net savings from these programs. Evaluation results are expected during the first quarter of 2014.

Impact Evaluation of 2009 Residential Demand Response Program, Ontario Power Authority.

DNV KEMA conducted the 2009 Residential Demand Response (peaksaver®) Air Conditioner Impact Evaluation. This evaluation was the first comprehensive assessment of the impacts and effectiveness of the Residential and Small Commercial Demand Response Initiative. The evaluation addressed two control technologies (A/C switches, and A/C programmable thermostats), in multiple service territories. SmartMeters were used to collected end-use interval data. Analysis and reporting was in adherence with the Province of Ontario's Demand Response Protocol.

5. Schedule and Work Plan

This section summarizes the basic work plan and schedule for this evaluation. Once we launch this evaluation, our detailed Survey and Sampling Plan, which we will produce in Task 2, will provide additional details.

5.1 Task 1: Project Kickoff Meeting

The project kickoff meeting will have a number of objectives including:

- Becoming familiar with the managers and implementers of Ontario's Natural Gas Custom C&I programs as well as the TEC members;
- Gaining a better understanding how the programs are being implemented and how this may impact the net-to-gross analysis;
- Clarifying and refining the evaluation scope and objectives;
- Presenting and discussing the proposed evaluation approach;
- Discussing the program tracking databases – their location, information structure and quality;
- Discussing the project schedule, including the dates for key deliverables and the bi-monthly status updates; and
- Discussing next steps such as documents and data requests; communication protocols with program staff, and the scheduling of the in-depth interviews.

Three business days before the project kickoff meeting DNV KEMA will prepare an agenda and a list of evaluation team members who will attend the meeting -- whether in-person or through teleconference. Before the meeting the evaluation team members will familiarize themselves with the program details and other background materials. This should make the meeting more efficient and productive so that less time is spent reviewing the basics of program design and more time is spent discussing the practical details of program implementation and the evaluation needs of the program implementers.

Immediately after the project kickoff meeting, if it is feasible, the evaluation team would like to schedule a more informal discussion with program implementation staff about how the program is being implemented. DNV KEMA is particularly interested in the nature and frequency of the interactions of the program staff with the C&I customers. DNV KEMA has found through previous evaluations that such informal discussions can elicit useful information about how the program is being implemented that cannot be learned from program documents. In addition, this discussion will allow a richer exploration of program implementation issues and their implications for free ridership and spillover than will be possible in the formal project kickoff meeting, where this is only one of many agenda items.

Within five business days of the meeting, DNV KEMA will prepare and distribute a post-meeting memorandum. This memorandum will list the meeting's attendees, summarize the issues discussed and the outcomes of discussion, list requested documents or databases, and describe the next steps for the evaluation.

Soon after the project kickoff meeting we will conduct some additional interviews with program managers and implementers to better understand how these C&I programs are delivered. We have budgeted for six of these interviews. Topics we plan to cover in these interviews include:

- What marketing and outreach strategies the C&I programs employ including possible targeting of market subsectors;
- What is the nature of their routine communications and interactions with C&I customers and how this might vary with the size of the customer or the customer type (e.g. chain stores);
- What outreach they do to trade allies to encourage their participation in the program;
- Whether they have any policies in place to discourage free ridership;
- What training they offer to trade allies;
- What energy audits or technical assistance they offer to C&I customers;
- What assistance they offer to C&I customers in terms of long-term energy efficiency planning;
- What financial incentives they offer to C&I customers; and
- What barriers to C&I implementation the program is facing.

Deliverables:

- A meeting agenda three business days before the scheduled meeting date, and
- A post-Project Kickoff Meeting memorandum delivered five business days after the meeting.

5.2 Task 2: Develop Survey and Sampling Plan

Following the project kickoff meeting, DNV KEMA will prepare a survey and sampling plan. This plan will provide necessary additional detail to the evaluation as had been laid out in the proposal. It will also incorporate any revisions to the evaluation approach, objectives, or timelines that were agreed to at the project kickoff meeting. At a minimum, the final research plan will include:

- A description of the research objectives for the study;
- A discussion of any pertinent issues related to the project,
- A detailed outline of project tasks,
- A description of the data collection efforts (see more detail below)
- An outline of the proposed reports,
- A schedule of deliverables including points in the evaluation where the evaluators could possibly provide early feedback, and
- A discussion of project management procedures and communication protocols.

In addition, for each of the data collection efforts, the plan will include:

- A description of the source of the data,
- An outline of any data collection instruments
- A description of the proposed data collection efforts;
- A description of the data tracking mechanisms we will use to ensure responses are collected in a systematic and consistent manner across different interviewers;
- The methodology we plan to use to translate survey scores into free ridership and participant spillover results;
- A sampling plan, if applicable, and
- A description of the analysis plan.

One of the primary risks to evaluation schedules is the challenge of working with and integrating different program tracking systems into a dataset for sampling and analysis. For our budget and timelines, we assume that each tracking database we are working with has the information necessary for evaluation, including, but not limited to, measure descriptions and savings, customer contact information and contractor names and phone numbers. Our plan also assumes that there are a minimum of two and a maximum of four digital data tracking systems across the programs and years included in the study. If the number of different data tracking systems exceeds this number, or if these databases have a lot of incomplete or inaccurate data, then we will need to adjust our budgets and timelines accordingly.

Deliverables: DNV KEMA will submit:

- A draft version of the survey and sampling plan to the TEC within four weeks of the Project Kickoff Meeting, and

- A final version of the survey and sampling plan within 10 days after the receipt of the comments from the TEC representatives. The final survey and sampling plan will address any comments or suggestions offered by the TEC representatives.

Our budget and schedule assumes that tracking data indicating program activities by customer, location, technology code, and estimated savings are available electronically in a single data base for each program and year to be studied, and that the utilities will provide copies of project records for customers and projects selected for study.

5.3 Task 3: Data Collection

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

Table 5-1: Aspects of Influence on the Energy-Efficient Project

Aspects of Influence on the Energy-Efficient Project	Program Participants	Participating Contractors	Program Managers	Program Energy Advisers
Program influence on the participant's general practices	√		√	√
Program influence on the contractor's general practices and equipment recommendations		√	√	√
Program influence on the specific project	√	√		√ (possibly for larger projects)
Contractor influence on the specific project	√	√		√ (possibly for larger projects)

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

Table 5-2: Target Number of Completed Surveys/Interviews

Program Participants (CATI Surveys)	Program Participants (In-Depth Interviews)	Program Participants (Engineering Follow-Up Interviews for Spillover)	Participating Contractors (In-Depth Interviews)	Program Managers/Staff (In-Depth Interviews)	Program Energy Advisers
1,104	132	43	80	6	20

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

As mentioned in the methodology section, before beginning any interview or survey we will collect as much information as we can about the program's interactions with the C&I customer. So this would include not only any project information that would be contained in the core program tracking database, but also information about previous training, audits, or technical assistance provided to the customer as well as about the program's communications with the C&I customers that may be contained in CRM databases that the programs may maintain. For significant projects we would also likely supplement this information with interviews with program staff who were involved with that project.

Before contacting any participants by phone, we will mail out an advance letter to all the C&I customers in our sample. This letter, which will explain the purpose of the evaluation and will provide advance notice of the surveys, will be on utility letterhead with content approved by the utilities.

DNV KEMA adheres to industry best practices in survey and interview design and implementation. We are particularly sensitive about maintaining the established relationships the utilities have with their program participants. The DNV KEMA staff who will be conducting the in-depth interviews are knowledgeable about energy efficiency programs and are trained to complete in-depth interviews without introducing bias. The trainers review the guides thoroughly with interview staff and use simulated interviews to increase their familiarity with any skip patterns and to improve the flow of the interview guide.

For all in-depth interviews, DNV KEMA staff will contact the potential respondent via telephone and explain the purpose of the interview and schedule for a time that is convenient to the respondent. Respondents are assured confidentiality so that they may express their observations and opinions freely.

DNV KEMA has SharePoint-based data collection tools for in-depth interviews that have the flexibility to capture the richer responses sought by the in-depth interview method while at the same providing a structure to reduce the chance that interviewees will inadvertently skip a question or ignore skip instructions in the interview guide. After the initial in-depth interviews are completed, DNV KEMA staff will review the interview responses to insure that the interviewers are collecting the desired information.

For the CATI surveys, we will work with our Ontario-based partner Opinion Search to insure the information is collected as intended. Opinion Search's own quality control procedures are described in the subcontractor section below. In addition to these procedures, some of the quality control steps that DNV KEMA staff will take include:

- *Testing CATI programming:* DNV KEMA staff will thoroughly test all CATI programs to insure that the questions are worded correctly, the correct pre codes are provided, and the skip patterns and logic tests are properly followed.

- *Listening in on the initial surveys:* DNV KEMA staff will listen in on the initial calls to insure that the questions are being read properly, that the respondents clearly understand the questions, that the skip patterns and logic tests are being properly followed, and that the surveys are not too long.

- *Reviewing the initial data:* DNV KEMA staff will examine data collected during the first two days of survey fielding to insure that the expected information is being captured and that the skip patterns and logic tests are being properly followed.

- *Quality control of survey data:* To ensure the continuing quality of data collected, we will periodically review these data to watch out for programming errors or missing or incorrect responses.

5.3.1 Program Actor Interviews

In the previous section we described some of the topics we plan to cover in the in-depth interviews with program managers that will follow soon after the Kickoff Meeting. The following is a list of some of the topics that we plan to cover in the in-depth interviews with the program energy advisers and participating contractors.

- Program energy advisers
  - Their typical responsibilities
  - Their level of technical knowledge
  - The nature of their routine communications and interactions with C&I customers and how this might vary with the size of the customer or the customer type (e.g. chain stores)
  - Whether they target program recruitment at C&I customers of certain types or in certain areas
  - How they become aware of potential energy efficiency projects

- How they promote energy efficiency
- How they identify which customer representatives are the key project decision makers
- Which customer representatives are the key project decision makers and how this might vary depending on company/organization size or type
- At what stage in project development they typically get involved with a project
- What are the barriers to program participation and how they try to mitigate them
- What information, financial incentives or technical assistance they offer to C&I customers for energy efficiency projects
- What they perceive to be their most valuable contributions to the development of energy efficiency projects
- How frequently the rely on program technical support staff for project support
- How closely they monitor the progress of active projects
- Whether they have received any training or guidance on how to minimize free ridership
- Whether there are any warning signs that a project might be a free rider
- What roles trade allies play in project identification and how they interact with them

▪ Participating contractors

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

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

▪ General program involvement and influence
  - How they became involved with the C&I program
  - Why they became involved with the program
  - How frequently they offer program incentives
  - How frequently they interact with program staff
  - How they keep track of C&I program incentives and requirements
  - Whether the C&I programs have provided them with any sales leads
  - Whether they have received any training from the program
  - Whether there are other services that the program provide them
  - To what degree the C&I program incentives and other services influence the implementation of energy efficiency projects in the C&I sector
  - What types of C&I customers are more likely to be influenced by program incentives and which types are less likely to be influenced

- Whether they are offering energy-efficient products or services through the program that they did not offer before becoming involved with the program
- Whether they are recommending energy-efficient products or services more frequently now than they did before becoming involved with the program
- Whether they have suggestions as to what kind of interventions would increase the program's influence in the project

The topics listed above are those we plan to cover in the general in-depth interview guides. Yet as indicated in our methodology section, we will call back some of the energy advisers and contractors to collect additional information about the project that will be useful for measuring program attribution. In such cases we will ask some project-specific questions such as:

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

5.3.2 Participating Customer Interviews and Surveys

For the CATI surveys and in-depth interviews with participants, we will develop flexible instruments that will have different modules depending on the year in which the C&I customer participated. Table 5-3 shows how these modules will be distributed across the program years.

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Table 5-3: Net-to-Gross Survey Modules Depending on Program Year

Net-to-Gross Modules	2011 Participants	2012 Participants	2013 Participants
Free Ridership	√*	√	√
Spillover	√	√	

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

There is no spillover module for the 2013 participants because we are assuming that not enough time has elapsed for the large majority of these participants to have done a spillover project. It is possible that some of the largest customers may have done a spillover project in this short timeframe. Since these large customers will be covered by in-depth interviews, we will give the interviewers the flexibility to administer the spillover questions if a spillover project is identified. However, our survey cost estimates assume that for most of the 2013 participants we will not administer the battery of spillover-related questions. As the table indicates, we will be collecting free ridership information from the 2011 participants because this information is required for our participant spillover methodology, but we will not be using these data for our core free ridership calculations because we would prefer to use more recent program years.

The types of questions we will be asking the program participants have already been covered to some extent in the methodology section. The questions topics will include:

- The general decision-making concerning energy-related purchases and practices
  - Who in their company or organization makes decisions about equipment replacement and retrofit projects and how this might vary with the size or cost of the project
  - What information sources are used in making these decisions
  - Whether the company/organization has any formal requirements or informal guidelines about the purchasing of energy-using equipment and, if so, what are these requirements/guidelines
  - Whether their company has a corporate "green " mandate
- The development of the specific program-incentivized project
- Where the idea for the project originated and who were the key persons involved in the project conception -- whether within the participant's company/organization or without (e.g., contractors, C&I program energy advisers)
- Who was involved in the planning and development of the project details
- Who was involved in the decision to go ahead with the project
- At what stage in this project conception, planning and development process did the C&I program get involved

- Whether the program provided any services to the respondent's company/organization beyond the financial incentives (e.g., training, audits, technical assistance, helping find a contractor, selling the project to upper management, etc.). To inform the free ridership questions, the interviewers will have information on all program activities reported by the tracking databases, but this query is designed to collect information on program activities that may be unreported and also to find out which program activities were top-of-mind for the respondent.

- Whether the project changed from its original conception and what these changes were and why they were made

- The free ridership question battery -- See the description of these questions in the methodology section and the appendices

- The spillover question battery - See the description of these questions in the methodology section and the appendices

- Firmographic information – Including information about the type and size of the business or organization and whether they lease or own their facilities

Deliverables: DNV KEMA will submit:

- Draft and final versions of the interview guides for energy advisers, participating contractors, and participating customers three weeks after the Project Kickoff meeting; and

- Draft and final versions of the participant CATI survey instrument three weeks after the Project Kickoff meeting.

5.4 Task 4: Data Analysis

Once the CATI surveys and in-depth interviews have been completed, we will begin the analysis phase. Our approach for calculating free ridership and participant spillover has already been described in the methodology section. However, there are a number of other important aspects of this data analysis task.

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

For customers of up to three measure types, the survey will collect attribution information on each measure type. We apply the free ridership and spillover "scoring" methods to determine the FR and SO factors for each measure type. We then apply these factors to the associated gross savings to produce net-of-free riders and spillover savings for that customer.

For customers with multiple similar measure types, we will typically ask about groups of measures, and apply the same approach as when each individual measure type is queried. For customers with large numbers of projects and measures, we will have a subsample of 3 groups selected with probability proportional to size. We will expand this subsample to the customer level to determine savings net of free ridership and spillover for that customer.

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

During the initial processes we evaluate data reliability via checks for expected number of completes vs. actual, consistency of response types, survey codes and post-coding of verbatim responses. Once the collected data has been deemed reliable we begin the analysis process through calculation of case weights (also known as survey weights or population weights).

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

The last analysis step involves expanding the attribution and spillover savings to the population via ratio estimation, and generating the combined NTG ratio for each segment of interest, as described in Section 2. We will estimate inside and outside spillover separately for each segment, and sum them to determine total spillover. That is, for each customer in our sample, we will have

G = Gross savings

NFR = Net of free rider savings

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

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

We will then calculate corresponding ratios across the segment:

1 – FR = (Weighted sum of NFR)/(Weighted sum of G)

SO_{inside} = (Weighted sum of S_{OI})/(Weighted sum of NFR)

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

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

NTG = (1-FR)(1+SO).We calculate spillover as a fraction of net of free rider savings, but this can also be reported as a fraction of gross savings.

5.5 Task 5: Reporting

DNV KEMA recognizes the importance of providing clear and timely reports on project progress, evaluation activities and results. Our approach to reporting for this project includes:

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

- *Bi-monthly study updates to the TEC:* As requested in the RFP, the DNV KEMA project manager will provide the TEC with study updates via teleconference on a bi-monthly basis in alignment with scheduled TEC meetings. These bi-monthly study updates will provide similar information as in the monthly emailed status reports, although the more interactive format of the teleconference should allow for greater discussion and quicker resolution of any key issues.

- *Draft report:* At the conclusion of the evaluation, DNV KEMA will submit to the TEC a draft report that will present all the information requested in the RFP's research objectives including:

  - Estimates of program free ridership factors by market sectors and precision targets for both the Enbridge and Union Gas' custom C&I programs;

  - Estimates of participant inside and outside spillover by market sectors and precision targets for both the Enbridge and Union Gas' custom C&I programs; and

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

  Along with these key findings, we will also show how these estimates were derived and what data from the in-depth interviews and CATI survey were used to inform these estimates.

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

5.5.1 Schedule

The following figure shows our proposed schedule for this evaluation. After the Kickoff Meeting in February 2014 we will finalize the Survey and Sampling Plan in April and begin data collection in May. We will begin data analysis in July and produce a draft report in late August with a final report in late September. This schedule is contingent on the data we request being delivered to the evaluation team in a timely manner and containing the information needed for our evaluation,

Table 5-4: Proposed Evaluation Schedule

Tasks	2014							
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Kickoff Meeting/Initial Staff Interviews								
Tracking Data Merge/Cleaning								
Develop Survey & Sampling Plan								
Data Collection								
Data Analysis								
Draft Report							**29th**	
Draft Comments								
Final Report & Presentation								**26th**

6. Fees and Costs

DNV KEMA proposes to conduct the work described in this proposal on a time and materials basis. Our estimated costs and labor rates are indicated in the table below. All rates and costs indicated are in Canadian dollars (CAD). These rates correspond to approximately a six percent discount from our standard rates, in recognition of our prior relationship with the Ontario Gas utilities and our ongoing interest in this work. Figure 6-1 shows our proposed budget of $398,700.

The price quoted under this proposal is based on 1 CAD = 0.94 USD. If the exchange rate fluctuates less than five percent (5%) in either direction, there will be no change to the rates quoted under this proposal. If the exchange rate fluctuates five percent (5%) or more up to ten percent (10%), we propose to share the increase or absorb the decrease on a 50%-50% basis. In the event the exchange rate fluctuates more than ten percent (10%) either upwards or downwards, we propose to renegotiate the rates presented in the proposal.

Figure 6-1: Proposed Budget

PROPOSAL BUDGET WORKSHEET: 2014 RATES		Ontario_NTG	Project Total $398,700										Analysts Harms			
Classification to be used			Pick from Lis													
bcontractor and Expense Mark		1.100		Project Sponsor	Project Manager	Sr. Tech. Advisor	Technical Advisor	IDI Lead	CATI Lead	NTG Lead	Engineering Interviews	Engineering Interviews	Gronski Driscoll	Project Coo	Documents	
		Personnel	Last Name	Kuiken	Jones	Goldberg	Dyson	Weber	Campbell	Lamichhane	Robinson	Abreu	Tuttle	Sankey	Otto	EXPENSES
Task Description	Task #	Task Name	Task Total $	$202	$164	$372	$213	$176	$138	$113	$126	$100	$100	$81	$138	1.1
Task 1: Project Kick-off Meeting	1a	Project kickoff meeting	$12,512	12	16	12										$3,000
	1b	Initial staff interviews	$3,960					18								$792
Task 2: Develop Survey & Sampling Plan	2a	Develop survey instruments	$18,152	4	40	2	8	16	40							$0
	2b	Tracking data merge/cleaning	$15,054		16					110						$0
	2c	Develop sampling plan	$14,908		40	8	4			40						$0
	2d	Develop data collection mechanisr	$5,920		8			8					32			$0
Task 3: Data Collection	3a	Field participant CATI surveys	$52,784		16				80							$39,120
	3b	Field participant IDIs	$42,548					57	33				281			$0
	3c	Field adviser IDIs	$11,040					27	27				27			$0
	3d	Field contractor IDIs	$20,000										200			$0
	3e	Engineer follow-up interviews	$19,436								86	86	0			$0
Task 4: Data Analysis	4a	Estimation of free ridership	$24,132	4	50	6	4			80			30			$0
	4b	Estimation of spillover savings	$70,356	4	70	4	16			100	172	172	30			$0
	4c	Calculation of combined NTG ratio	$14,408	4	20	4	4			60			12			$0
Task 5: Reporting	5a	Draft report	$40,268	18	70	8	24	16		40	12		38		32	$0
	5b	Final report & presentation	$15,248	12	24	8	8								16	$2,000
Task 6: Project Management	6a	Routine project management	$15,350	12	64									30		$0
	6b	Bi-monthly status reports	$2,624		16											$0
		PROJECT TOTAL	$398,700	70	450	52	68	141	180	430	270	258		30	48	$44,912

7. Subcontractors

Opinion Search Inc.
160 Elgin Street
Ottawa, Ontario
K2P 2P7

Contact: Bruce Wilson, Project Manager

Contact: Janette Niwa, VP Client Services

Market research survey data collection services – primarily telephone data collection work for DNV KEMA.

ABOUT OPINON SEARCH INC.

Founded in 1988, Opinion Search opened our first office at 160 Elgin Street in Ottawa, Ontario and has since become one of the Canada's most established names in marketing research data collection. As demand grew we've been fortunate to expand to two of Canada's largest cities. Our Toronto office is located at 2345 Yonge Street and our Montreal office is located at 1080 Beaver Hall Hill.

For more than 25 years, Opinion Search has focused on providing high quality quantitative and qualitative data collection services to market research partners from the private, public and not-for-profit sectors.

Opinion Search offers an array of data collection solutions including but not limited to telephone interviewing, both landline and cell phone, on-site intercept interviewing, self-administered mail. We also offer extensive online data collection including invitation emailing, survey programming & hosting, data tabulation and a proprietary Canadian panel profiled for consumers and businesses. Our qualitative services include as recruiting from our database, your lists or RDD for a range of session types including one-on-one interviews, product testing and evaluation, in-office focus groups, online groups and bulletin boards. Opinion Search can also provide all the necessary qualitative logistical requirements, such as facilities – our own in Toronto, Montreal and Ottawa plus a network of associates across Canada - DVD recordings, catering and refreshments, remote location set-up, simultaneous translation services, incentive handling and more.

We've made our niche high quality data collection and a focused approach to work with our clients as a part of their research team. We conduct extensive customer satisfaction work across Canada as well as advertising and reputation/brand tracking. We bring our skills to bear on projects both large and small.

QUALITY CONTROL

OSI uses a “two-team” structure: (1) a team of supervisors who manage the project logistics, training, quotas and day-to-day issues and (2) a quality control team composed of dedicated monitors who work with the Field Managers and HR team to evaluate the interviewers and ensure high quality, accurate data collection.

Interviewers are centrally monitored by a trained team, thereby ensuring consistency and accuracy in all work conducted at Opinion Search Inc. The dedicated monitoring staff continually evaluate the quality of interviewing conducted for all projects. As a part of our standard quality control evaluation, the following measures are undertaken on a continual daily basis:

- Audio monitoring of all calls (introductions, booking of call-backs, completed interviews/recruits, refusals, terminations, etc.);
- When conducting interviewing/recruit using the CATI system, simultaneous visual monitoring of the interviewers’ work by viewing the CATI screen and responses entered while conducting the audio monitoring of all calls;
- Regular evaluation of open-ended responses;
- Feedback cycle with interviewers to evaluate their work and to acquire feedback on the survey process.

A ‘Gold Seal’ member of the Marketing Research and Intelligence Association (MRIA – l’Association de recherche et d’intelligence marking - ARIM in French), Opinion Search’s field management team monitors 5% of each interviewer's work, with 75% of the completion needing to be monitored to count towards the 5%. In addition to meeting this MRIA standard, Opinion Search also randomly monitors 10%-15% of the overall project work. We monitor newer interviewers at a higher level and drop off towards the 5% for more experienced interviewers.

8. Insurance

ACORD®

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 10/29/2013

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

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E-MAIL ADDRESS: kvandiver@charterenergy.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Federal Insurance Company	20281
INSURER B : National Union Fire Ins (Chartis)	19445
INSURER C : Chubb Indemnity Insurance	12777
INSURER D :	
INSURER E : Great Northern Insurance Company	20303
INSURER F :	

INSURED
KEMA, INC.
ONE BURLINGTON BUSINESS CENTER
67 SOUTH BEDFORD STREET
SUITE 201 EAST
BURLINGTON, MA 01803

COVERAGES **CERTIFICATE NUMBER:** 497083 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY COMMERCIAL GENERAL LIABILITY CLAIMS-MADE / OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY / PRO-JECT / LOC						EACH OCCURRENCE	$
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$
							MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
							PRODUCTS - COMP/OP AGG	$
								$
E	AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS / SCHEDULED AUTOS X HIRED AUTOS / X NON-OWNED AUTOS			7357-14-79	10/31/2013	10/31/2014	COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
								$
B	UMBRELLA LIAB / X OCCUR X EXCESS LIAB / CLAIMS-MADE DED / RETENTION $			8763089	10/31/2013	10/31/2014	EACH OCCURRENCE	$ 5,000,000
							AGGREGATE	$ 5,000,000
								$
C A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N / A		7172-58-41 7172-58-42 (HI)	10/31/2013	10/31/2014	X WC STATU-TORY LIMITS / OTH-ER	
							E.L. EACH ACCIDENT	$ 1,000,000
							E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000
A	Property/Inland Marine			3595-87-37	10/31/2013	10/31/2014	Per Schedule	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
Blanket AI and WOS are available for Auto and Excess Liability. Primary & Non-Contributory applies. Severability applies. As required in a written contract.
Blanket WOS is available for WC as required in a written contract.
30 Days notice applies for all policies.

CERTIFICATE HOLDER
MASTER CERTIFICATE Kema, Inc. FOR INFORMATION PURPOSES ONLY

CANCELLATION
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE
K Vandiver

9. Workplace Safety

DNV KEMA is committed to ensuring a safe and healthy work environment across all of its member companies. To that end, the Executive Board of DNV KEMA has issued a Health, Safety and Environmental Policy to apply to all DNV KEMA companies. Furthermore, with several offices in California, DNV KEMA has a legal obligation to provide and maintain a safe and healthful workplace for employees, according to the California Occupational Safety and Health Act of 1973. To this end, DNV KEMA has developed an Injury and Illness Prevention (IIP) Program administered by DNV KEMA's HSE Director for the Americas.

DNV KEMA believes that communicating with employees concerning workplace hazards and the methods used to control them help create the safest possible work environment. We place a great deal of importance on communicating with employees about health and safety issues. Our communications system includes:

- New employee orientation including a review of the IIP Program document
- Training programs
- Safety meetings
- An anonymous reporting system
- Learning from events

DNV KEMA also uses the following measures to ensure that all workers comply with the practices outlined in our IIP Program:

- Informing workers of the provisions of our IIP Program
- Annually evaluating the safety performance of all workers
- Providing necessary training to all employees and will provide re-training as necessary to employees needing refresher or remedial training
- Disciplining workers for failure to comply with safe and healthful work practices
- Expecting that all employees practice good safety awareness when visiting and working at DNV KEMA customer and client sites

Through these measures, DNV KEMA is committed to provide a safe and healthy workplace for employees. One gauge of how well DNV KEMA is performing related to injury and wellness is our Workers Compensation Experience Modification Rate. Rates for the last several are:

- 2011-2012: .96
- 2010-2011: .95
- 2009-2010: .92
- 2008-2009: .82
- 2007-2008: .796

WSIB eServices
As of: Oct 31, 2013

Workplace Injury Summary Report

By: FIRM

GL GARRAD HASSAN CANADA INC.
151 SLATER ST SUITE 806
OTTAWA ON K1P 5H3

Firm Number: **767722CH**
Account Number: 2343349
Firm Earliest Start Date: Nov 29, 2004

958 - TECHNICAL AND BUSINESS SERVICES

Earliest Coverage Start Date: Nov 29, 2004
Latest Coverage End Date:

Year	Fatal Diseases	Fatal Traumatics	# LTI	# NLTI	* LTI Freq.	*NLTI Freq.	*YTD Days Lost	*Inj.Yr. Days Lost	* FTE Workers	*Severity Rate	NEER Perf. Index	Rate Group LTI Freq	Rate Group NLTI Freq
YTD 2013	0	0	0	0							N/A		
2012	0	0	0	0	0.00	0.00	0.00	0.00	17.10	0.00	N/A	0.17	0.33
2011	0	0	0	0	0.00	0.00	0.00	0.00	19.20	0.00	N/A	0.18	0.32
2010	0	0	0	0	0.00	0.00	0.00	0.00	16.20	0.00	N/A	0.19	0.33
2009	0	0	0	0	0.00	0.00	72.00	0.00	21.00	342.86	N/A	0.21	0.38

FIRM TOTAL

Year	Fatal Diseases	Fatal Traumatics	# LTI	# NLTI	* LTI Freq.	*NLTI Freq.	*YTD Days Lost	*Inj.Yr. Days Lost	* FTE Workers	*Severity Rate	CAD7 Perf. Index	MAP Adj. Results
YTD 2013	0	0	0	0							N/A	5.00 % Discount
2012	0	0	0	0	0.00	0.00	0.00	0.00	17.10	0.00	N/A	5.00 % Discount
2011	0	0	0	0	0.00	0.00	0.00	0.00	19.20	0.00	N/A	10.00 % Increase
2010	0	0	0	0	0.00	0.00	0.00	0.00	16.20	0.00	N/A	10.00 % Increase
2009	0	0	0	0	0.00	0.00	72.00	0.00	21.00	342.86	N/A	N/A

Generated on: Dec 09, 2013, 16:41

N/A: Not Applicable

* Current Year Injury Frequencies, Days Lost, FTE, Severity, and Performance Index will be available at Year End

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wsib ONTARIO

WSIB eServices
As of: Oct 31, 2013

Workplace Injury Summary Report

By: FIRM

Firm Number: 767722CH **Account Number:** 2343349

GLOSSARY

Column Heading	Long Name	Definition
Fatal Diseases	Number of occupational disease fatalities for the accident year	An occupational disease that results in the death of the worker.
Fatal Traumatics	Number of traumatic fatalities for the accident year	A work-related accident that results in the death of the worker.
# LTI	Number of allowed non-fatal lost time injuries for the accident year	A "lost time" claim is created when a worker suffers a work-related injury that results in being off work past the day of accident, a loss of wages/earnings, or a permanent disability/impairment.
# NLTI	Number of allowed no lost time injuries for the accident year	A "no lost time" claim results from a work-related injury where no time is lost from work, other than on the day of the accident, but where health care is required.
LTI Freq.	Lost time injury frequency	Calculation on the number of allowed fatal and non-fatal LTI claims divided by the derived hours worked multiplied by 200,000.
NLTI Freq.	No lost time frequency	Calculation on the number of allowed No Lost Time claims divided by the derived hours worked multiplied by 200,000.
YTD Days Lost	Year-to-Date days lost for all claims in the calendar year	The number of equivalent full working days lost authorized for all claims (regardless of accidents dates) where temporary benefits have been awarded in the calendar year.
Inj. Year YTD Days Lost	Life-to-Date days lost for claims with injuries that occurred in the calendar year	The number of equivalent full working days lost authorized for all claims with injuries that occurred within the calendar year, where temporary benefits have been awarded.
FTE Workers	Full time equivalent workers	An estimated number of full time equivalent workers based on the average hourly wage for the rate group and the firm's insurable earnings for the calendar year, assuming a person works an average of 2,000 hours per year.
Severity Rate	Severity Rate	Year-To-Date Days lost regardless of the accident dates divided by the full time equivalent worker multiplied by 100.
NEER Perf. Index	NEER Performance index (available only if firm meets criteria for NEER program)	Calculated at the firm-rate level. A comparison between the firm-rate's NEER cost record and the expected costs. If the costs are higher (lower) than expected, a surcharge (refund) is calculated. i.e.: 0.00 to 0.99 = refund 1.00 = no refund or surcharge 1.01 to 4.00 = surcharge
CAD-7 Perf. Index	CAD-7 performance index (available only if firm meets criteria for CAD-7 program)	Calculated at the account level. Indicates the account overall performance based on its two-year cost and frequency records. It ranges from the best performance at 1.000 to the worst at –4.000.
MAP Adj. Results	Merit Adjusted Premium (MAP) results (available only if firm meets criteria for MAP program)	Calculated at the firm level. The MAP program applies a percentage increase/decrease to a firm's premium rate, depending on the firms average premiums and the number of claims costing more than $500 in a three year period. Employers with a better than expected performance received a premium discount and those with a worse than expected performance received a premium increase.

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A. Resumes

Edilson Abreu

Profession:	Engineer
Years of Experience:	< 1
Education:	B.S./2012/Chemical Engineering (Energy Management)/Western Michigan University/Kalamazoo, MI
Years with DNV KEMA:	< 1

Key Qualifications:

Edilson Abreu is a graduate from Western Michigan University at Kalamazoo, earning a B.S. degree in Chemical Engineering with a focus in energy management systems. Edilson has academic experience in the design and implementation of energy management systems as well as the analysis and improvement of industrial and commercial HVAC and lighting systems. He earned his Engineer in Training certificate in 2013 and plans to acquire certifications as an Energy Manager and Energy Auditor from the Association of Energy Engineers.

Selected Professional Experience:

Professional Experience:

DNV KEMA, Madison, Wisconsin: July 2013 to Present
Engineer II

- Performing on-site inspections and efficiency assessments.
- Verifying installation, operations, and performance characteristics of energy-efficient equipment.
- Installing measurement equipment and analyzing measured data, including lighting loggers, power recorders, and other data acquisition systems.
- Performing energy analyses using advanced spreadsheets and building simulation software.
- Analyzing energy performance and reporting the impacts associated with efficiency improvements.
- Interviewing energy managers, consumers, and other relevant personnel.

UBE America, Inc., Wixom, Michigan: November 2012 to January 2013
Sales Engineer

- Responsible for North American Polyamide 6 & 12 Accounts.
- Closed contract negotiations with a major buyer which doubled sales to $2.3 million.
- Designed physical property data sheets for multiple products for dissemination.
- Collaborated with the logistics staff to mitigate the Southern California Port strikes in December 2012.
- Communicated with customers and provided sales support, technical support, and contract proposals.
- Resolved customer complaints satisfactorily in cooperation with colleagues overseas.

- Used Excel analysis to determine conversion rates and reactor sizes of several equilibrium reactions.
- Co-designed a grass roots plant, complete with PFDs, P&IDs, and energy optimizations.
- Created cash flow tables and calculated various relevant measures of profitability (PP, NPV, EUAW, etc.).
- Co-authored a project report documenting the relevant assumptions, work and results.

Academic Experience:

Process Water Reclamation: January 2012 to April 2012

- Analyzed the technical feasibility of reclaiming process water for a USG paper mill.
- Discovered 198 million gallons per year of process water could be reclaimed by completing a plant mass balance.
- Calculated the cooling capacity for chillers and cooling towers to cool process water to desired temperature.
- Reviewed design of a battery limits plant addition, including PFDs and P&IDs, for accuracy.
- Produced cash flow tables and calculated payback period for a 15 year project.
- Collaborated to write a project report documenting relevant assumptions, work, and results.

Production of Methanol from Natural Gas: October 2011 to December 2011

- Assessed the technical and economic feasibility of converting natural gas to methanol.
- Completed a methanol market survey which indicated increasing market space.
- Assigned project tasks and tracked team progress.

Professional Affiliations:

American Institute of Chemical Engineers, Kalamazoo, MI: September 2008 – December 2013

Languages:

	Speaking	*Reading*	*Writing*
English:	Excellent	Excellent	Excellent
Portuguese:	Excellent	Intermediate	Beginner
Spanish:	Intermediate	Intermediate	Beginner
French:	Beginner	Beginner	Beginner

Certifications:

Engineer In Training Certification – April 2013

Skills:

Microsoft Word, Microsoft Excel, Microsoft PowerPoint, AutoCAD, Aspen Plus, HTML, CSS

Bradley W. Campbell

Profession:	Senior Analyst
Years of Experience:	7
Education:	Master of Public Affairs/2008/University of Wisconsin-Madison
	Bachelor of Arts/2002/Majors: Portuguese, History and Science; Minor: Integrated Liberal Studies/University of Wisconsin-Madison
Years with DNV KEMA:	3

Key Qualifications:

Bradley Campbell has been a Senior Analyst with DNV KEMA for 3 years where he has performed survey and interview management for state specific programs in Iowa, Wisconsin, Michigan, Massachusetts as well as national and multi-state programs. In addition to focusing on survey and interview management, Mr. Campbell has worked extensively on focused research projects; Bradley has worked in project and task management of both pilot and full scale programs in Wisconsin and Michigan where he has worked with Wisconsin Public Service Community Pilots Program, Efficiency United and Energy Optimization programs.

Bradley previously worked for the Wisconsin Department of Workforce Development as the lead Labor Market Research Analyst and Program Manager for the Current Employment Statistics and Non-Metropolitan County Industry Estimates surveys. These statistical surveys were among the timeliest leading economic indicators. Bradley brings to DNV KEMA extensive analytic experience, and also has public training with expertise in program evaluation, analysis and management. He has worked in private and public industry, and strived to continuously improve government to better serve the needs of citizens through improved data, methods, policy, transparency and responsiveness.

Professional Experience:

DNV KEMA, Madison, Wisconsin: 2011 to Present
Senior Analyst

Michigan Community Action Agency Association/Efficiency United Evaluations, Phase III/IV

- For the past two cycles, Bradley has managed the development and delivery of surveys to residential and commercial customers and non-participants. These surveys provided information for both process and impact evaluations – verifying installation, net to gross impact, and customer satisfaction. In executing this, Bradley has managed up to nine separate surveys through four separate subcontractors.

Wisconsin Public Service Community Pilot Evaluations

- Bradley let the evaluation of pilot programs in Wisconsin, requiring in-depth interviewing with numerous participants and stakeholders. These process evaluations were performed with the Low Income and another small program designed to place college interns into energy evaluator roles. Bradley managed the evaluations of these pilot programs, which included in-depth interviews with participating customers and non-participating customers (commercial, institutional and residential), program managers and staff.

Tennessee Valley Authority Commercial & Industrial and Heat Pump Evaluations

- Bradley has been actively involved with the development and execution of multiple interview panels involving utility executives, trade allies, residential and commercial participants, and program 'drop-outs' in the Tennessee Valley Authority territory. These interviews have been designed to measure the process effectiveness and satisfaction with various facets of the programs.

Wisconsin Department of Workforce Development, Madison, Wisconsin: 2008 to 2011
Current Employment Statistics Program Manager

- Management of monthly economic survey team
- Presentation of monthly analysis to Secretary and Governor's office
- Program management, planning, execution and budget
- Program communication with U.S. Labor Department, public, press and other stakeholders
- Creation of new information products in conjunction with other programs
- Analysis of Wisconsin public market gap in skills credentialing
- Management of special project teams –

Wisconsin Department of Workforce Development, Madison, Wisconsin: 2007 to 2007
Labor Market Research Analyst

- Implementation of Current Employment Statistics (CES) Survey, "Payroll Survey"
- Analyze stratified random sample (n=7000) semimonthly
- Compile monthly estimates into publishable data for web designers and end-users
- Analysis of statistical anomalies, trends and outliers

Wisconsin Department of Commerce, Madison, Wisconsin: 2006 to 2007
Housing Research Policy Specialist

- Evaluated Wisconsin Fresh Start (WFS) Program with economic impacts
- Recidivism evaluation
- Interpretation and communication of state and federal program regulation

United States Department of Housing and Urban Development, Madison, Wisconsin: 2006 to 2006
Entitlement Agency Representative Intern

Ozaukee County, Department of Administration, Port Washington, Wisconsin: 2006 to 2006
Administrative Intern

City of Delafield, Delafield, Wisconsin: 2006 to 2006

Administrative Intern

Colleen F. Driscoll

Profession:	Energy Analyst
Years of Experience:	2
Education:	B.A./2011/ Princeton University, Woodrow Wilson School of International and Public Affairs/ Certificate Programs in Environmental Studies and African Studies
	Study Abroad/Spring 2010/University of Cape Town/Cape Town, South Africa
	Continuing Education/Fall 2011-2012/Chemistry/Rutgers University
Years with DNV KEMA:	< 1

Key Qualifications:

Colleen Driscoll is an Energy Analyst with DNV KEMA. Her educational background is in public policy, with a focus on environmental policy. Her senior thesis analyzed the potential effects of climate change on the South African wine industry by incorporating qualitative case studies of vineyards in the region with a quantitative analysis of how climatic variations affect grape price. Her previous work experience is primarily in low-income energy efficiency and energy assistance program evaluation. She has managed surveys for multiple government and utility energy assistance and energy efficiency programs. In addition, she has experience in data analysis, report writing, and public policy analysis.

Professional Experience:

DNV KEMA, Fairfax, Virginia: February 2013 to Present
Energy Analyst

- **Department of Energy – State Energy Program Evaluation:** Analyst on the State Energy Program Evaluation project. Work includes creation and management of high-level progress tracking database on SharePoint, management of the Renewable Projects CATI Survey and research and implementation of solar thermal analysis tool. Also serves as lead on several individual renewable energy project evaluations, from data collection to analysis to reporting.
- **Dominion Virginia Power – Residential Heat Pump Upgrade Program Evaluation:** Manager for the CATI survey efforts for this evaluation, including drafting the survey, managing the CATI interviewers and cleaning the data. Analyst on the analysis portion of this evaluation.
- **Dominion Virginia Power – 2012 EM&V Report:** Contributed to final 2012 EM&V report. Contributions to the final report included checking all the sections for consistency, copy editing and general formatting.
- **LG&E and KU – Smart Grid:** SUS-C analyst on a MOC project on whether a business case for Smart Grid implementation exists in LG&E and KU service territories. Work includes a customer characterization of the utilities using utility customer data and data from several surveys conducted about energy use and smart grids. In addition, analysis will include comparison to

regional and national statistics using a combination of DOE's Residential Energy Consumption Survey and Census data.

- **ODEC – End-Use Consumption Analysis:** Analyst on project to generate seasonal electric end-use consumption estimates by coop. Project combined EIA datasets (2009 RECS and 2013 AEO) with ODEC specific billing, weather and appliance data to create specific end-use estimates.
- **Tennessee Valley Authority – EnerNOC Demand Response Analysis:** Analyst on a project to evaluate baseline during Demand Response events and develop predictive model for future events. Work on project included replicating baseline and settlement calculations and incorporating NOAA weather data into analysis file.

Apprise Incorporated, Princeton, New Jersey: July 2011 to February 2013
Policy Analyst

Conducted research and evaluation for energy efficiency and energy bill payment assistance programs managed by the Federal government, state governments, and utilities.

Developed memos and reports to summarize research methodology and findings.

Analyzed energy survey data and large government datasets using Stata for in-depth analysis on energy assistance and energy efficiency programs.

Managed surveys with program participants, including survey preparation, CATI testing, and interviewer training and monitoring.

Researched the monetization of non-energy benefits from the Weatherization Assistance Program.

Languages:

	Speaking	*Reading*	*Writing*
English:	Excellent	Excellent	Excellent
French:	Very Good	Excellent	Excellent

Skills:

Full mastery of Excel, PowerPoint and Word; Proficient in Stata; Beginner SAS, SharePoint, ArcGIS and R.

Christopher Dyson

Profession:	Principal Consultant
Years of Experience:	23
Education:	M.A./1996/Public Policy Analysis/University of Wisconsin–Madison, The Robert M. La Follette Institute of Public Affairs Certificate in Energy Analysis and Policy/1996/University of Wisconsin–Madison, The Institute for Environmental Studies B.A./1987/Political Science/Yale University, New Haven, CT
Years with DNV KEMA:	17

Key Qualifications:

Net-to-Gross, Impact Evaluation, Market Effects, Market Baseline Studies

- **California Public Utilities Commission:** Is key member of team that is developing net-to-gross estimates and other key inputs for estimating the energy impacts of California's 2010-2012 residential retrofit programs, especially the compact fluorescent lamp (CFL) rebate programs. Played a similar role in the impact evaluation of the 2006-2008 California programs. This work was completed in 2010. Conducted interviews with participating lighting manufacturers and retailers to obtain their net-to-gross estimates and develop understanding of California CFL market that aided in estimating the magnitude and timing of CFL gross savings impacts.
- **Massachusetts Program Administrators and Energy Efficiency Advisory Council:** From 2010-2013 managed the process evaluations and the estimation of net-to-gross ratios for two Massachusetts upstream lighting programs: the Bright Opportunities Program (targeting C&I customers) and the ENERGY STAR lighting program (targeting residential customers). These evaluations also included characterizations of the Massachusetts CFL and LED markets through interviews with lighting manufacturers, distributors, contractors, and retailers.
- **Tennessee Valley Authority (TVA):** Currently project manager for a multi-year (2012-2014) evaluation of TVA's Energy Right Solutions for Business/Industry portfolio of energy efficiency programs. This evaluation includes both a process evaluation and an impact evaluation.
- **Rochester Gas and Electric/New York State Electric and Gas:** Recently (2011-2013) managed the process and impact evaluations of the RG&E/NYSEG gas furnace rebate program. The process evaluation included an assessment of the program's influence on HVAC contractors and distributors, an analysis of the program tracking database, and measurements of participant satisfaction. The impact evaluation included a net-to-gross analysis, a billing analysis to estimate gross energy savings and an engineering analysis that critically examined the energy savings assumptions used for residential gas measures in the state's Technical Reference Manual.
- **Massachusetts/Rhode Island Program Administrators:** Currently managing a multi-year research task that is estimating net-to-gross ratios for the Massachusetts and Rhode Island Energy Star lighting programs using a supply-side self-report methodology. This task involves in-depth interviews with participating and nonparticipating lighting manufacturers and retail lighting buyers as well as CATI

surveys with retail store managers. Mr. Dyson also participated in a parallel study for the same clients that recommended ways to improve the net-to-gross methodologies for the Massachusetts C&I programs based on a study of "best practices" from other states.

- **Wisconsin Public Service Commission:** Managed a 2009-2010 project for identifying and quantifying effects from the Wisconsin Focus on Energy's Business Programs on the Wisconsin lighting and HVAC markets. This project used both quasi-experimental quantitative methods and market participant self-reports to determine which market effects can be attributed to these programs and how much energy savings were resulting from these market effects.
- **Pacific Gas and Electric:** Currently managing study of the market potential for enhanced lamp technologies currently being developed by California utilities. This study is collecting information about technological barriers for enhanced lamp technologies, barriers to consumer acceptance of current CFLs, what prices consumers would be willing to pay for advanced lighting products, and which lighting sockets are best suited for the new enhanced lamp technologies.
- **California Public Utilities Commission:** Co-authored December 2008 report on the market effects of the years of California compact fluorescent lamp (CFL) rebate programs. Wrote major section in report dealing with market effects reported by participating lighting manufacturers and retailers.
- **Wisconsin Public Service Commission:** Was the manager and primary author of an evaluation of the Wisconsin Focus on Energy's Business Programs Education and Training (E&T) program. This program provided training for both Wisconsin commercial and industrial customers and the trade allies that serve them. This 2008 evaluation included both an impact evaluation and a process evaluation of this E&T program.
- **California Public Utilities Commission, sponsor, and California Investor-Owned Utilities:** Developed net-to-gross methodology for evaluation of California's statewide Multifamily Rebate Program. Evaluation was completed in 2007.
- **Wisconsin Department of Administration, Division of Energy:** Wrote study on the market for high-volume low speed (HVLS) fans in the Wisconsin dairy industry. Study was completed in 2006.
- **Wisconsin Energy Conservation Corporation:** Wrote analyses of commercial and agricultural sectors for market baseline study of energy efficiency practices in Wisconsin. Baseline study was completed in 2005.
- **Wisconsin Department of Administration, Division of Energy:** Wrote analyses of commercial and industrial sectors for market baseline study of energy efficiency practices in Wisconsin. Baseline study was completed in 2001.

Process Evaluations – Residential and Nonresidential Energy Efficiency Programs

- **Massachusetts Program Administrators and Energy Efficiency Advisory Council:**
  - C&I: Currently managing a statewide process evaluation of the Massachusetts large C&I energy efficiency programs. This evaluation, which began in 2010 and which will continue through 2015, is focusing on ways to increase program participation, acquire "deeper" energy savings from participating projects, and improve the integration of large C&I program across utilities and across fuel types. It is also evaluating the effectiveness of various new construction programs for large C&I customers.

- Residential: Currently serving as project manager for DNV KEMA's evaluation of Massachusetts' residential energy efficiency programs. DNV KEMA is a member of a consulting team that is evaluating these programs. The evaluation effort started in 2013 and while the full evaluation scope is yet to be determined, but it will include process evaluations, impact evaluations, and market characterization studies.

- **Michigan Community Action Agency Association (MCAAA) and Efficiency United (EU):** Currently managing a multi-year (2010-2014) process evaluation of the EU portfolio of energy efficiency programs, which is administered by MCAAA. This portfolio includes C&I, HVAC, Energy Star CFLs/appliances, online audit and weatherization, appliance recycling, multifamily, and low-income programs, among others.
- **Tennessee Valley Authority (TVA):** Currently project manager for a multi-year (2012-2014) evaluation of TVA's Energy Right Solutions for Business/Industry portfolio of energy efficiency programs. This evaluation includes both a process evaluation and an impact evaluation.
- **California Public Utilities Commission (CPUC):** From 2011-2012 served as an advisory consultant for the CPUC in monitoring and reviewing the process evaluations of the Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) Home Energy Efficiency Rebate (HEER) and Multifamily Energy Efficiency Rebate (MFEER) programs.
- **Rochester Gas and Electric/New York State Electric and Gas:** Recently (2011-2013) managed the process and impact evaluations of the RG&E/NYSEG gas furnace rebate program. The process evaluation included an assessment of the program's influence on HVAC contractors and distributors, an analysis of the program tracking database, and measurements of participant satisfaction. The impact evaluation included both a billing analysis to estimate gross energy savings and an engineering analysis that critically examines the energy savings assumptions used for residential gas measure in the state's Technical Reference Manual.
- **Con Edison:** Recently (2011-2013) managed the process evaluations of Con Edison Multifamily Low-Income and Multifamily Electric and Gas programs.
- **Michigan Electric Cooperative Association (MECA) and Energy Optimization (EO):** Managed a multi-year (2010-2012) process evaluation of MECA's EO portfolio of energy efficiency programs. This portfolio included C&I, HVAC, Energy Star CFLs/appliances, online audit and weatherization, appliance recycling, multifamily, and low-income programs, among others.
- **Pacific Gas and Electric (PG&E):** Managed the process evaluation of PG&E's $400 million 2006-2008 Mass Markets program, which promotes energy efficiency in the residential and small business sectors. This evaluation was completed in 2009.
- **Southern California Edison (SCE):** Managed the process evaluations of SCE's Upstream Lighting, Home Energy Efficiency Rebate (HEER), and Multifamily Energy Efficiency Rebate (MFEER) programs. This evaluation was completed in 2009.
- **Alliant Energy:** In 2007-2008 managed the evaluation of Alliant Energy's E-Communities program in Iowa. Was project manager for the process and impact evaluations of Alliant Energy's 2005 Iowa residential and nonresidential energy efficiency programs. This evaluation was completed in 2006.
- **California Public Utilities Commission (CPUC), sponsor, and California Investor-Owned Utilities:** Managed the process evaluation of California's statewide Multifamily Rebate Program. This evaluation was completed in 2006.

- **California Public Utilities Commission, sponsor, and Heschong Mahone Group:** Managed the process evaluation of California's statewide "Designed for Comfort: Efficient Affordable Housing (EAH) Program." This evaluation was completed in 2006.
- **Alliant Energy:** Managed the process and impact evaluation of Alliant Energy's Iowa residential Direct Load Control (DLC) program. The evaluation was completed in late 2005. Also was primary author and analyst for process evaluation of four Alliant Energy residential energy-efficiency programs including prescriptive rebates, home audits, new construction, and appliance recycling.
- **California Public Utilities Commission, sponsor, and California Investor-Owned Utilities:** Was key contributor to process evaluation of California energy-efficiency education and training centers. Was sole author of process evaluation and case study of Title 24 training class offered by Pacific Gas and Electric's Energy Training Center in Sacramento. Evaluation was completed in 2005.
- **California Public Utilities Commission, sponsor, and California Investor-Owned Utilities:** Was primary author and analyst of a study of contractors who were involved in California's statewide Single-Family Rebate Program. Study evaluated program processes, program attribution, and market potential. Evaluation was completed in December 2004.
- **California Public Utilities Commission, sponsor, and California Investor-Owned Utilities:** Conducted analysis of the effect of upstream incentives on manufacturers of compact fluorescent lamps. Analysis was part of evaluation of the 2002 California Statewide Residential Lighting Program. Evaluation was completed in the fall of 2003.

Best Practices Evaluations

- **San Diego Gas and Electric:** Was the manager and primary author of a 2009-2010 benchmarking/ comparison study involving three California Direct Load Control (DLC) programs: the PG&E SmartAC Program, the SCE Summer Discount Program, and SDG&E Summer Saver Program. This study examined similarities and differences among the programs in a number of different areas including marketing, incentive levels and structures, program implementation structures, frequency of control events, comfort during control events, and satisfaction with program processes. In 2008 he also managed a best practices study of DLC programs for SDG&E that was part of a large evaluation of their Summer Saver DLC program.
- **California Public Utilities Commission, sponsor, and California Investor-Owned Utilities:** In 2007 was key contributor to national survey of new best practices for energy efficiency program design and evaluation.
- **City Public Service, San Antonio:** Conducted best practices assessment of residential direct load control programs. Assessment was part of broader study of best practices for program types offered by City Public Service (CPS), San Antonio. Study will help CPS develop an integrated roadmap for DSM implementation. Best practices assessment was completed in 2005.
- **Wisconsin Department of Administration, Division of Energy:** Co-authored study of best practices for energy efficiency programs. Study was designed to guide the Wisconsin Focus on Energy program in improving its rebate design and program delivery methods. Analysis was completed in 2003.

Demand Response and Smart Devices; Metering Analysis and Evaluation; and Load Profiling

- **Hawaiian Electric Company:** In 2010 managed the process evaluation of four HECO Direct Load Control (DLC) programs. These include programs for residential direct load control of water heating (RDLC-WH), residential direct load control of central air conditioning (RDLC-CAC), a small business direct load control (SBDLC) program, and direct load control program (CIDLC), for larger C&I customers. This evaluation includes in-depth interviews with program managers and contractors; reviews of marketing materials, program organizational structures, data exchange protocols; and surveys of program participants, non-participants, and participants who dropped out of the program.
- **Progress Energy Carolinas:** In 2010 managed the multi-year process evaluation of the EnergyWise DLC program. The evaluation examined the comfort levels and behaviors of program participants during control events for both the summer and winter periods. In addition to surveys of program participants, the evaluation also surveyed customers who dropped out of the program as well as program non-participants. It also conducted in-depth interviews with program staff and contractors. The evaluation provided the utility with information on the effectiveness of program marketing efforts, load-control device installation, incentive payments, and other program processes.
- **Ontario Power Authority:** In 2010 completed the process evaluation of the 2009 Ontario-wide peaksaver Direct Load Control (DLC) program. The evaluation examined the comfort levels and behaviors of program participants during control events. It also provided the agency with information on the effectiveness of program marketing efforts, load-control device installation, incentive payments, and other program processes.
- **San Diego Gas and Electric:** Was the manager and primary author of a 2009-2010 benchmarking/comparison study involving three California Direct Load Control (DLC) programs: the PG&E Summer Saver Program, the SCE Summer Discount Program, and SDG&E Summer Saver Program. This study examined similarities and differences among the programs in a number of different areas including marketing, incentive levels and structures, program implementation structures, frequency of control events, comfort during control events, and satisfaction with program processes.
- **San Diego Gas and Electric:** Was the manager and primary author of the 2008-2009 process evaluations of SDG&E's Summer Saver and Smart Thermostat programs. The Summer Saver program uses switches and the Smart Thermostat program uses "smart" thermostats to control air-conditioning load during critical peak periods.
  - The process evaluation of the Summer Saver program helped guide SDG&E on ways to increase participation in this program both through recruiting new participants and reducing drop-out rates among current participants. It also helped determine SDG&E customer interest in new program features such as a 100% duty cycle option for residential customers, a 30% duty cycle option for commercial customers, and new weekend cycling options. KEMA based its recommendations on the findings from interviews with Summer Saver program managers and implementation staff, an external best practices study, a survey of participating customer, a survey of nonparticipating eligible customers, and a survey of customers who recently dropped out of the program.
  - The Smart Thermostat process evaluation examined whether customers were satisfied with their smart thermostats, whether they used these thermostats to "override" SDG&E control events, and the extent to which people were using web portals to control their thermostat settings remotely. It also provided the utility with information on the incidence and character of participating customers overriding the utility's control of their thermostats. The evaluation

also examined the comfort levels and behaviors of program participants during control events. Finally the evaluation also provided the utility with information on the effectiveness of program marketing efforts, load-control device installation, incentive payments, and other program processes.

- **Pacific Gas and Electric:** Was the manager and primary author of the 2008 and 2009 process evaluations of PG&E's Smart AC program. This Direct Load Control (DLC) program, which uses both "smart" thermostats and pager-controlled switches to control air-conditioning load during critical peak periods, is a brand new program. This process evaluation examined customer satisfaction with their smart thermostats, technical problems with these thermostats, and the extent to which people used web portals to control their thermostat settings remotely. The evaluation also examined the comfort levels and behaviors of program participants during control events. Finally the evaluation also provided the utility with information on the effectiveness of program marketing efforts, load-control device installation, incentive payments, and other program processes.
- **Alliant Energy:** Managed the process and impact evaluation of Alliant Energy's Iowa residential DLC program. The evaluation was completed in late 2005. The analysis evaluated the performance of the programs control system, the estimated system energy savings and peak load curtailment, and the efficiency of program processes and level of customer satisfaction. The analysis combined information from surveys of participating customers and DLC switch installers with system performance information gathered from the field. The field operations included testing the success of the control system from signal transmittal to switch relay operation. It also included interval metering a sample of houses. The customer surveys were used not only to evaluate program processes and measure participant satisfaction but also to gather information about typical air conditioner use and experiences with DLC periods. These customer self-reports were used to inform the field measurements.
- **City Public Service, San Antonio:** Conducted best practices assessment of residential direct load control programs. Assessment was part of broader study of best practices for program types offered by City Public Service (CPS), San Antonio. Study will help CPS develop an integrated roadmap for DSM implementation. Best practices assessment was completed in 2005.
- **Multi-Client Subscription Study of Retail Energy Markets:** Directed annual study of market dynamics and market rules of all states undergoing retail electric competition from 2002 to 2007. The studies identified the most promising retail electric markets and analyzed market structure, rate structure, metering and billing practices, generation credits, customer switching rates, and other key indicators for these markets.
- **Multi-Client Subscription Study of Retail Energy Markets:** Directed study of competitive metering and billing in the electric utility industry. Key topics addressed included market rules and the regulatory framework, competitive activity, emerging products and services, and market barriers. The study also conducted a number of interviews with regulators, utility officials, and representatives of metering and billing companies to capture best practices and lessons learned. Other information reviewed included state utility commission filings, decisions, and staff reports; Security and Exchange Commission (SEC) filings; utility tariffs; white papers and conference presentations from representatives of energy companies, consulting firms, and think tanks; and trade press articles.

- **Back Room Operations Companion Study – Syndicated Research:** Co-authored the KEMA Back Room Operations study, a companion to KEMA's multi-million dollar Retail Energy Markets syndicated research project, examined the functions and systems development required to support the new competitive market. KEMA researchers studied the experiences of 24 distribution companies (LDCs) and 11 retail suppliers (ESPs) with back room functions such as customer interface, billing, metering, load profiling, and settlement. KEMA detailed organizational structures, new business processes, and information flow from the perspective of distribution companies and suppliers. Special attention was paid to the information systems and data exchange (EDI) systems that are the foundation of the new back room.
- **Electric and Gas Mass Market Business and Financial Plan – Vectren Retail:** Was key contributor to development of detailed business and financial plan for a Midwestern utility seeking to become a retail energy supplier and provider of energy-related products and services in the region. We analyzed energy tariffs and regulatory rules in detail for about a dozen Midwestern states, researched and evaluated a wide range of value-added products and services – including metering-related services, and designed appropriate products and services based on this analysis. We conducted detailed gas and electric tariff analyses to identify the most profitable customer segments to serve based on shopping credits offered, customer size categories and load factors. From this and other information, we estimated likely sales volumes, gross revenues and profitability. We then prepared a set of pro-forma financial statements and analyzed the profitability of each product or service considered, both individually and in total.
- **Electric Retail Business Planning Support – Louisville Gas and Electric:** Was key contributor to KEMA creation of plausible electric retail business cases that characterized the specific business initiatives and market scenarios identified by our utility client. Each business case reflected unique combinations of factors that cause active or desirable markets, including shopping credits, default tariffs, wholesale power costs, market size, retail business rules, metering and data management considerations, and degree of competition expected. Conducted detailed tariff analyses to determine the most attractive markets and market segments. For each of these cases, developed pro-forma financial statements and analyzed likely cash flows and profitability. From this information, constructed a recommended business strategy for the client.
- **Development of Accuracy Standards for Load Profile Generation Methods – Four Alberta Electric Utilities:** Under joint contract to four of the participants in Alberta's Settlement Specification Group, KEMA developed accuracy standards for load profile generation for retail load settlement. The standards address sample design and implementation, and frame adequacy, as well as statistical measures of sampling and modeling error. The standards are intended to apply to both dynamic estimation using load research data from the day of interest, and any method that relies on estimation from historic load research data. Analysis was also done on the benefits and costs of load profiling vs. interval metering for various customer classes.
- **Load Profiling Forum – Electric Power Research Institute:** Was key contributor to the *Load Profiling Forum*, a monthly technical briefing on current issues related to retail market settlement. Briefings were detailed discussions of issues, analytic methods, applications, and current practices. Wrote two technical briefs on tradeoffs between interval metering and load profiling.
- **Preparation of Papers on Load Profiling, Interval Metering Development and Application – The Marketplace Company, Ltd (M-Co):** Was key contributor to a set of papers that KEMA prepared on load profile development for New Zealand's electric power pool. One paper

developed proposed rules under which new load profiles could be developed, validated, and used for settlement. These rules addressed the basis for defining the groups eligible for new profiles; the relationship between the sampling frame and the group to which the profile would be applied; and special procedures to protect existing direct load control rates for customers who do not have metering in place to reflect the effects of those rates. A second paper addressed the size level at which interval metering should be required. This issue was addressed in terms of meter affordability; the likely deterrent effects on retail competition of imposing metering requirements; and a societal cost-benefit analysis; valuing the benefits of interval metering in terms of the reduced deadweight loss when on- and off-peak price signals are improved.

- **Load Profiling Methods Study – EPRI and Salt River Project:** Was key contributor to KEMA's technical assessment of a proposed load profiling method for the Salt River Project. The methods assessment examines the volatility and bias of the settlement estimates based on this method for a set of simulated suppliers and hourly market clearing prices. As part of this project, KEMA reviewed the effects of alternate size cut-offs for requiring 100 percent interval metering for retail access customers. This review was based on a cost-benefit analysis that translates settlement errors into social costs. The findings from the study have substantial implications for shaping the rules that may govern direct access in Arizona.

Professional Experience:

DNV KEMA, Madison, Wisconsin: June 1996 to Present
Principal Consultant

- Experience includes evaluating energy efficiency and demand response programs as well as analyzing retail competition in U.S. electric markets. Evaluation project experience includes process evaluations, impact evaluations, market assessments, market baseline studies, best practice studies, and gap analyses. Experience analyzing U.S. retail electric competition includes identifying and rating promising retail electric markets, analyzing retail market structures and rules, tracking and explaining trends in customer switching data, studying the effects of competition on utility metering and billing practices, studying the performance of independent system operators (ISOs), Performance-Based Ratemaking, and utility back office operations.

Public Citizen, Inc., Washington, DC, Critical Mass Energy Division: 1993 to 1994
Energy & Environmental Policy Analyst

- Wrote reports and articles on environmentally friendly automobiles and global warming.

Public Citizen, Inc., Washington, DC, Buyers Up Heating Oil Division: 1987 to 1993
Energy & Environmental Policy Analyst

- Wrote reports and articles on supplies of heating oil and gasoline and related consumer issues.

Professional Papers:

Dyson, Christopher, Wendy Todd, "Bright Opportunities: A New Way of Getting LEDs into the Commercial and Industrial Market." Presented at the proceedings of the International Energy Program Evaluation Conference, Chicago, Illinois in August 2013.

Dyson, Christopher, Bing Tso, Arlis Reynolds, Chad Telarico, Aaiysha Kursheed, "A Comprehensive Look at Comprehensive Design Programs." Presented at the proceedings of the International Energy Program Evaluation Conference, Boston, Massachusetts in August 2011.

Dyson, Christopher, Caroline Chen, Shahana Samiullah, "The Split Incentive Barrier: Theory or Practice in the Multifamily Sector?," Paper presented at American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings in August 2010.

Dyson, Christopher and Richard Aslin, "Breaking Down Barriers to Using AMI Data for Load Research." Paper presented at Autovation conference in Denver, Colorado in September 2009.

Dyson, Christopher and Susan Norris, "AMI & Improved Direct Load Control Programs." Paper presented at Autovation conference in Atlanta, Georgia in September 2008.

Dyson, Christopher, Jenna Canseco, Julie Blackwell, "Best Practices in Community Energy-Efficiency and Renewable Energy Partnership Programs." Paper presented at American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings in Pacific Grove, CA in August 2008.

Dyson, Christopher, Miriam Goldberg, "The Gift That Keeps Giving: A Model Approach for Measuring Participant Spillover" Paper presented at the proceedings of the International Energy Program Evaluation Conference, Chicago, Illinois, August 2007.

Dyson, Christopher, LeAndra MacDonald, "Multiple Solutions to a Complex Problem: Effective Strategies for Reaching the Multi-Family Sector" Paper presented at American Council for an Energy-Efficient Economy Summer Study on Energy Efficiency in Buildings in August 2006.

Dyson, Christopher, Tami Rasmussen, Shahana Samiullah, John Cavalli, "Can Programmable Thermostats Be Part of a Cost-Effective Residential Program Portfolio?" Paper presented at International Energy Program Evaluation Conference, New York, New York, August 2005.

Goepfrich, Valy, Christopher Dyson, and Miriam L. Goldberg, KEMA Inc.; Jeff Erickson, PA Consulting Group; Oscar Bloch, Wisconsin Dept of Admin, Div of Energy. "Getting the Best Evaluation for the Buck." Paper presented at International Energy Program Evaluation Conference, Seattle, Washington, August 2003.

Miriam L. Goldberg

Profession:	Senior Vice President
	Business Line Director, Sustainable Use Consulting, Americas
Years of Experience:	38
Education:	Ph.D./1982/Statistics/Princeton University
	M.S.E./1980/Mechanical and Aerospace Engineering/Princeton University
	B.A./1975/Mathematics/magna cum laude/Harvard University
Years with DNV KEMA:	21

Key Qualifications:

Miriam Goldberg, Ph.D., is DNV KEMA's director of Sustainable Use Consulting for the Americas. She oversees a team of 120 professionals including econometricians, survey specialists, and building engineers for DNV KEMA's consulting services on the "customer side" of the meter. This work spans demand-side planning and evaluation, and customer research for general operational support.

Dr. Goldberg is a leading expert in energy efficiency program evaluation and received the *2009 International Energy Program Evaluation Conference (IEPEC) Lifetime Achievement Award* in recognition for her leadership in and contributions to and demand response programs evaluation. With over 35 years of experience, she has directed studies of a wide range of programs, including commercial/industrial, low-income, general residential, and load management programs. She is an expert in the application of statistical methods to program evaluation, including sample design, surveys, and data analysis. Her expertise covers sampling and estimation, load research, billing data analysis, discrete choice modeling, end-use studies, pricing analysis, and segmentation.

Much of Dr. Goldberg's work has contributed to improving methods of measuring savings, to make demand-side resources more credible and reliable. In addition to directing many Demand Response evaluations, Dr. Goldberg has overseen several assessments of demand response baseline methodology, and served as chair of the Working Group on Measurement and Verification for the National Action Plan on Demand Response. She is currently helping to develop Measurement and Verification Protocols for the Superior Energy Performance program for Industrial facilities. She co-authored the Uniform Methods Protocol for Wholehouse Retrofit based on billing analysis. She has conducted methodological assessments for impact evaluation, and load profiling for market settlement. She was an author of an early California Framework for Assessing the Benefits and Costs of Publicly Funded Energy Efficiency Programs, including the public policy rationale for intervention in energy efficiency markets. She authored multiple chapters of the EPRI Guidebook on Nonresidential Program Evaluation. She has a Ph.D. in Statistics and an M.S. in Mechanical and Aerospace Engineering from Princeton University, as well as a B.A. in Mathematics from Harvard University.

Selected Professional Experience:

- **Developed Guidance documents on M&V**

- Co-authored the Uniform Methods Protocol for Wholehouse Retrofit based on billing analysis.
- Chair of the Working Group on Measurement and Verification for the National Action Plan on Demand Response, and primary author of guidelines
- Drafted measurement and verification protocols for the Superior Energy Performance program, based on ISO50001
- Member of the Smart Grid Investment Grant customer behavior studies Technical Advisory Group
- Co-authored A Framework for Assessing Costs and Benefits of Publicly Funded Energy Efficiency Programs, a widely read methodological study sponsored by Pacific Gas and Electric Company. The study provides a coherent framework for planning, designing, and evaluating market transformation and other energy efficiency programs.

- **Directed market studies:**
  - Oversaw the California Public Utilities Commission Upstream Lighting Program evaluation, including the most comprehensive residential lighting metering study conducted to date, and development of new approaches to net-to-gross estimation for upstream programs.
  - Directed California's statewide Low-Income Needs Assessment, involving 1,500 onsite inspections and household interviews.
  - Directed residential market research for a major utility, including a residential appliance saturation study, technical potential assessment, and end-use load shape development.
  - Contributed to the design of the Energy Information Administration's 2005 Residential Energy Consumption Survey (RECS).
  - Directed a study to estimate lighting technology saturations and energy use by sector, using statistical leveraging techniques and multinomial choice modeling (Department of Energy).
  - Directed development of lighting technology sales shares by state using statistical leveraging techniques and multinomial choice modeling (large manufacturer).
  - Designed a nationally representative onsite study of manufacturing motor use (Department of Energy).
  - Directed a pilot study of alternative frame development and sampling methods for the Commercial Buildings Energy Consumption Survey.
  - Managed the baseline market effects study for the Wisconsin Focus on Energy. This study has supported both program design and program evaluation.
  - Contributed to development of demand-side forecasts for supply procurement filings (Southern California Edison, San Diego Gas and Electric).
  - Managed the development of a research plan for commercial data collection by audit and end-use metering for Entergy. The research plan included a nested sample design, sample selection, and an integrated analysis plan.
- **Directed major methodological studies:**
  - Assessed baseline calculation protocols for demand response programs (ISO NE, California Energy Commission).
  - Directed performance assessment of alternative load profiling methods (EPRI).

- Conducted simulation studies of alternate methods of estimating net-to-gross savings ratios, including discrete choice and self-selection correction methods.
- Developed integration methods for end-use metering and billing analysis for an EPRI tailored collaborative evaluating commercial rebate programs.

- **Managed or directed impact evaluations:**
  - Puget Sound Home Energy Reports program
  - Wisconsin Public Service Company's customer pilots
  - Progress Energy Carolina's Residential Direct Load Control Programs.
  - Focus on Energy Business Programs and Renewable programs.
  - Ontario Power Authority's Residential and Small Commercial Direct Load Control Program.
  - Pacific Gas and Electric Company's Residential Direct Load Control Program.
  - California Public Utilities Commission Upstream Lighting Program.
  - San Diego Gas and Electric's Smart Thermostat and Summer Saver Programs.
  - Alliant Energy's DSM programs.
  - Pacific Gas and Electric Company's residential programs.
  - California's statewide Appliance Recycling Program.
- **Managed persistence studies:**
  - Pacific Gas and Electric Company's Residential Appliance Rebate Program.
  - Southern California Edison's Appliance Recycling Program.
- **Directed load research, load profiling, and load forecasting studies:**
  - Reviewed load forecast methods of five network companies for Australia's National Electricity Market Management Company (NEMMCO).
  - Directed the development of load profiling procedures and pilot load research studies for the Russian Federation (World Bank).
- Provided advice, methodological assessments, and drafted rules for load profiling for retail market settlement.
- Advised utilities and retail suppliers on procedures and positions related to retail electric market settlement systems.
- Developed methods to assess the hedge value of energy-efficiency programs in the context of supply procurement.
- Provided rate case support through review and critique of load and revenue forecasts and class load data analysis.

Professional Experience:

DNV KEMA, Madison, Wisconsin: 1992 to Present
Senior Vice President, Sustainable Market Strategies (2003 to present)
Vice President (1998–2003)
Director of Consulting, Central Region (1995–1998)
Principal Consultant (1993–1995)
Senior Manager of Statistical Research (1992–1993)

U.S. Energy Information Administration (EIA), Energy End-Use and Integrated Statistics Division, Washington, DC: 1986 to 1992

Team Leader, Analytic Databases (1990–1992)

- Designed and directed innovative analytic projects to address crucial gaps in EIA consumption data sets. Developed methodology and supervised staff. Advised other teams on sample design, data analysis, and interpretation of statistical results. Worked toward unified approaches across surveys for different sectors. Served on the National Energy Strategy development team, and contributed to specification of key forecasting parameters for the National Energy Model.

Mathematical Statistician (1986–1990)

- Developed and implemented improved methods for design, data collection, and analysis of EIA energy consumption surveys, especially the Commercial Buildings Energy Consumption Survey (CBECS). Served as end-use expert for EIA's commercial and residential demand forecasting models, reviewing details of model formulation and suggesting new approaches.

U.S. Environmental Protection Agency, Office of Water, Washington, DC: 1985 to 1986

Statistician

- Served as statistical consultant with respect to data interpretation and principles for establishing regulatory criteria and guidelines. Developed improved methodological approaches, with explication of issues for nonstatisticians.

University of Wisconsin–Madison, Wisconsin: 1982 to 1985

Principal Investigator, Statistical Laboratory (1984–1985)

- Conducted evaluations of Low-Income Weatherization programs in Wisconsin. Also consulted on various projects at the University and outside.

Lecturer, Department of Statistics (1983–1985)

- Taught introductory statistics motivating understanding of, and interest in, statistical issues for humanities and social science majors, and for older students in extension school classes.

Research Associate, Mathematics Research Center (1982 – 1984)

- Unrestricted postdoctoral fellowship. Conducted independent statistical research on appropriate accuracy measures for nonlinear models.

Professional Affiliations:

AESP International

Gregory D. Gronski

Profession:	Analyst
Years of Experience:	1
Education:	Master of Public Affairs/December 2012/Concentration: Energy/Indiana University, School of Public and Environmental Affairs (SPEA), Bloomington, IN B.S./May 2011/Biological Sciences/Minor: Environmental Studies/Concentrations: Ecology and Evolution/University at Buffalo, the State University of New York Buffalo, NY
Years with DNV KEMA:	1

Key Qualifications:

Gregory Gronski, Analyst, brings in research, economic and cost benefit, and data and statistical analysis skills specifically related to the energy industry. Before joining DNV KEMA, Greg interned at the Chemung County Executive's Advisory Commission on Natural Energy Solutions where he was responsible for researching the feasibility of residential renewable energy systems in the County as part of a NYSERDA grant, including both the resource availability and economic concerns. Prior to that, Greg served as a Research Assistant for Dr. Ken Richards at Indiana University where he researched instances where local level impacts and policies influenced state and federal energy policies and regulations. Greg has his Masters of Public Affairs (MPA) degree from Indiana University's School of Public and Environmental Affairs (SPEA), and a B.S. in Biological Sciences with a minor in Environmental Studies from SUNY at Buffalo.

Professional Experience:

DNV KEMA, Burlington, Massachusetts: January 2013 to Present
Analyst

- **National SEP Evaluation-GA**
  - Focused on the State of Georgia, tasked with performing background research into the Governor's Energy Challenge of 2008
  - Created interview guides, and interviewed Program Managers for the Pilot Communities
  - Evaluated the results of the pilot programs to determine attribution results
- **National SEP Evaluation- MA Legal**
  - Researched the natural gas and electricity savings from energy efficiency based on the Green Communities Act, on a pre and post basis
  - Forecasted expected savings because of the GCA out to 2015
  - Extrapolated the predicted gas savings if the GCA didn't occur
- **National SEP Evaluation-Savings Calculation Tool (SCT)**
  - Researched the historical federal standards of appliances trying to go back as far as 1989

- Called PM's and National Associations to find federal standards for years not listed on the internet.

- **EPA CCAP/E-CAST**
  - Worked on updating the Unit Energy Consumption (UEC) values and the shipping documentation for the ENERGY STAR program products.
  - Created Excel tables to display product specification data
  - Performed background research on the ENERGY STAR products to understand the products better, and to track specification changes.
  - Manipulated Excel code to populate summary tables.
  - Edited the Measure Files to allow them to be incorporated into the DSM ASSYST model.
- **MA Residential Products Evaluation**
  - Transferred interview notes from Microsoft Word to Excel
  - Aided in the recording of interview responses
- **MA Project 23**
  - Performed background research on the New Jersey Pay for Performance Program (P4P), and the Consolidated Edison's Commercial & Industrial Energy Efficiency Custom Program (Custom Program)
  - Looked up potential stakeholders, and any barriers to program participation
  - Created interview guides and interviewed the program managers, program implementers, and Engineering firms.
  - Drafted memos of each interview to provide the PM with an accurate description of each project.

Chemung County Executive's Advisory Commission on Natural Energy Solutions, Elmira, New York: Summer 2012
Alternative Energy Research Assistant

- Created resource documents that were displayed on the county website for wind, solar, geothermal, and biomass including cost figures for residential systems.
- Researched potential of the area for resources in conjunction with a NYSERDA grant to create a regional sustainability plan that will aid in the distribution of funds to specific areas.
- Performed cost benefit analysis and cost feasibility studies for clients looking to install solar, wind, and biomass systems. Using improved data collection methodology and economic analysis provided the client with a more accurate representation of the project cost.

Corning Incorporated, Corning, New York: Summer 2012
Summer Intern

- Served as the database manager to update and populate the SharePoint site, which is a file sharing site that allows for team members to reference data and information more quickly.
- Conducted experiments with applications for future patent potential.

Corning Incorporated, Corning, New York: Summer 2011

Summer Intern

- Worked in the building, testing, and shipping of Corning's LCD measurement equipment including running qualifications tests and data analysis. Reports were then issued to managers to ensure the equipment was performing up to company specifications.
- Managed the group's installation and machine status report chart for the manager.

Languages:

	Speaking	***Reading***	***Writing***
English:	Excellent	Excellent	Excellent
Spanish:	Good	Good	Good

Skills:

Microsoft Office, SAS, SharePoint, ArcGIS

SAS Knowledge: Basic Proc commands, including some knowledge on doing replaces and using IF statements.

Samuel Harms

Profession:	Analyst
Years of Experience:	< 1
Education:	M.P.A./University of Wisconsin-Madison/2013
	Certificate in Energy Analysis & Policy
	B.S./2010/Geology & Geophysics/University of Wisconsin-Madison
	Certificate in Environmental Studies
Years with DNV KEMA:	< 1

Key Qualifications:

Samuel Harms is a graduate from the University of Wisconsin-Madison, earning a B.S. degree in Geology & Geophysics and a Master of Public Affairs degree with a certificate in Energy Analysis & Policy. Samuel specializes in qualitative and quantitative analysis, including data collection, analysis of results, and reporting of results.

Selected Professional Experience:

- Complete projects on varied topics for diverse clients such as WI PSC and WI DOR.
- Conduct extensive literature reviews and compose technical briefings and factsheets.
- Statistical analysis includes experience with t-tests, multiple regression, and STATA.

Professional Experience:

DNV KEMA, Madison, Wisconsin: June 2013 to Present
Analyst

Michigan Community Action Agency Association/Efficiency United

- Conducted in-depth interviews with diverse program stakeholders, including utility and community action agency representatives, contractors, and retailers
- Managed development and delivery of surveys to residential customers and non-participants for process and impact evaluations
- Analyzed and reported on survey and interview results

Dominion Virginia Power

- Analyzed and reported on survey results for Dynamic Pricing Pilot program

Massachusetts Program Administrators and Energy Efficiency Advisory Council

- Researched and compiled detailed summaries of previous DNV KEMA projects in the suite of MA programs

University of Wisconsin, Madison, Wisconsin: September 2012 to May 2013
Project Assistant

- Conducted literature reviews and performed calculations in Excel to model the future costs of carbon capture and storage technology for coal plants based on varying policy assumptions.
- Created a poster for presentation of project research at a national science conference

Clean Wisconsin, Madison, Wisconsin: June 2012 to August 2012
Science and Policy Intern

- Performed extensive independent research and composed technical briefings and factsheets for use in legislative campaigns.
- Topics included local and state energy efficiency policies for buildings and street lighting, linking electricity rate structures and consumption, and concerns regarding smart meters.
- Connected with industry professionals, local government officials, and organization leaders to acquire information and gain support for campaigns.

RENEW Wisconsin, Madison, Wisconsin: May 2010 to December 2010
Research/Communications Intern

- Researched energy-related topics, compiling news articles and data for profiles of wind, solar, and biomass projects in Wisconsin.
- Reported on public hearings and legislative meetings on wind energy siting.
- Wrote and edited press releases on project and policy developments in renewable energy.
- Assisted in soliciting memberships and maintaining membership database.

Languages:

	Speaking	*Reading*	*Writing*
English:	Excellent	Excellent	Excellent
Spanish:	Basic	Basic	Basic

Awards:

- 2013 La Follette School of Public Affairs Piore Prize for Best Paper in Science and Public Policy
  Paper entitled "Reallocating Distribution Upgrade Costs for Farm Digester Projects"
- 2012 Startup America Policy Challenge, National Winner in Energy Policy
  Competed with a proposal to incentivize electric utility solar leasing programs
  Presented to a panel of expert judges from government, industry, and academia
- 2011-12 and 2012-13 Robert M. La Follette Fellowships
  1 of 9 students selected for competitive award to attract and retain top academic talent
- 2009-10 Department of Geoscience Mack C. Lake Scholarship
- 2009 Department of Geoscience L.R. Laudon Outstanding Junior Scholarship
- 2008 Department of Geoscience Outstanding Sophomore Award

Skills:

MS Word, Excel, PowerPoint, and proficiency in STATA statistical analysis software.

Benjamin L. Jones

Profession:	Consultant
Years of Experience:	6
Education:	M.A./2008/International Public Affairs/La Follette School of Public Affairs: University of Wisconsin Masters Certificate/2008/Energy Analysis and Policy/Nelson Institute for Environmental Studies: University of Wisconsin B.A./2001/Political Science/Near Eastern Studies: Ancient Civilizations and Biblical Studies/University of Michigan
Years with DNV KEMA:	6

Key Qualifications:

Ben Jones, Consultant, leads the development of DNV KEMA's BC Calculator tool used to conduct benefit-cost analyses of energy efficiency and renewable energy programs. Mr. Jones has led quantitative analysis on several evaluations of energy efficiency and renewable energy programs, including Wisconsin's statewide Focus on Energy Business and Renewable Programs and Alliant Energy's programs in both Iowa and Wisconsin. Fluent in Mandarin Chinese, he lived, worked and studied in Chongqing, China from 2001 to 2006.

Mr. Jones has a B.A. in Political Science and Near Eastern Studies from the University of Michigan. He received a Masters in International Public Affairs from the La Follette School of Public Affairs and a Masters Certificate in Energy Analysis and Policy from the Nelson Institute of Environmental Studies at the University of Wisconsin-Madison in 2008.

Professional Experience:

DNV KEMA, Madison, Wisconsin: Spring 2007 to Present
Consultant

Mr. Jones manages and provides data analysis support on a wide variety of DSM applications. His project tasks have included developing benefit cost models for assessing the cost effectiveness of energy efficiency and renewable energy programs, developing complex sample design for impact and process evaluations of DSM and renewable energy programs; developing, conducting and evaluating surveys; conducting research into DSM industry best practices; and helping develop impact estimates of DSM programs for clients.

Specific Project Experience:

- **Michigan Multi-client (21 utilities):** Manages the impact analysis for the multi-year evaluations of six of the Efficiency UNITED program. He manages a team of engineers, analysts and market researchers responsible for calculating verified gross and net savings and program free-ridership based on participant surveys.
- **National State Energy Programs (SEP):** Leads net impact analysis and cost effectiveness testing for DNV KEMA's evaluation of the National SEP programs. Mr. Jones manages a team of

analysts in estimating verified gross and net savings based on participant surveys and interviews. He also is responsible for performing the cost effectiveness testing on the programs.

- **National Energy Efficiency Community Block Grants (EECBG):** Leads net impact analysis and cost effectiveness testing for DNV KEMA's evaluation of the US Federal EECBG programs. Mr. Jones manages a team of analysts in estimating verified gross and net savings based on participant surveys and interviews. He also is responsible for performing the cost effectiveness testing on the programs.
- **Massachusetts Program Administrators:** Mr. Jones led the analysis team for the 2012 Commercial and Industrial Non-Energy Impacts Study. In this role, he developed four separate complex sample designs, using DNV KEMA's LRS Software, managed a team of analysis performing quality control on the quantitative data collected through over 800 in-depth interviews, developed the final NEI to Savings ratios and evaluated the relationship between non-energy impacts and program attribution.
- **Wisconsin Focus on Energy:** Mr. Jones developed and maintained the model used for conducting the multi-year benefit-cost analysis (simple and expanded societal TRC tests) of the programs. As the lead analyst for the impact evaluations of both the Business Program and the Renewable Energy Program for the past four years, Mr. Jones was responsible for developing complex sample designs using DNV KEMA's LRS software, and managed a team of analysts in calculating verified gross and net savings and program free-ridership based on participant surveys.
- **Alliant Energy, Wisconsin:** Mr. Jones led the cost effectiveness testing (TRC, and Utility Cost Tests) for Wisconsin Power and Light's programs. He was also the project manager for DNV KEMA's comprehensive evaluation (impact, process and cost effectiveness) of Wisconsin Power and Light's Renewable Energy Program. He worked as the lead analyst for both years of DNV KEMA's impact evaluation of Shared Savings Program. For the impact evaluations, Mr. Jones managed a team of analysts in estimating engineer verified gross and net savings and program free-ridership based on program tracking data and participant surveys.
- **Alliant Energy, Iowa:** Led the impact analysis for DNV KEMA's evaluation of Interstate Power and Light's 14 energy efficiency and renewable energy programs. Mr. Jones manages a team of analysts in designing sample using DNV KEMA's LRS software and estimating engineer verified gross savings based on program tracking data and participant surveys.
- **City Public Service (CPS) Energy:** Estimated free-ridership in DSM programs from survey data and wrote report detailing the customer satisfaction and level of free-ridership in active DSM programs. Administered measurement and verification survey to participants in CPS Energy's Commercial and Industrial energy efficiency rebate program. Calculated program savings for both the CPS Compact Florescent Light (CFL) rebate program and Home Efficiency Rebate Program. Conducted benefit-cost analysis on a potential new rebate program.

Languages:

	Speaking	*Reading*	*Writing*
English:	Excellent	Excellent	Excellent
Chinese:	Excellent	Good	Good
French:	Good	Good	Good

Tamara Kuiken, P.E.

Profession:	Principal Consultant
Years of Experience:	14
Education:	M.S./2002/Mechanical Engineering/Iowa State University
	B.S./1999/Mechanical Engineering/Iowa State University
Years with DNV KEMA:	10

Key Qualifications:

Tamara Kuiken, P.E, is a Principal Consultant providing support for DNV KEMA's Policy Advisory and Research projects focusing primarily on impact evaluations. Ms. Kuiken has contributed to and directed studies in all sectors, including the commercial/industrial, residential, low income, agriculture, and institutional sectors. She has evaluated programs that address energy efficiency, load control, and renewable projects. Her engineering background provides a strong foundation for the evaluation of large commercial and industrial programs with complex custom installations.

Much of Ms. Kuiken's work has contributed to improving the methods of measuring program attributable savings, including free-ridership and spillover. Ms. Kuiken has measured attributable savings for programs in many regulatory jurisdictions and currently has a large role in the impact evaluations of the United States Department of Energy's State Energy Program and Energy Efficiency Community Block Grant program. She played a critical role in developing life-cycle attribution methods for the state of Wisconsin's commercial and industrial programs and helped pioneer a dual baseline calculation in that state.

Program Evaluation:

- **Oak Ridge National Laboratory, Energy Efficiency Community Block Grant:** Ms. Kuiken is currently managing the impact evaluation of the Energy Efficiency Community Block Grant for the US Department of Energy, under contract to Oak Ridge National Laboratory. Ms. Kuiken is managing the verified savings calculations of 350 grants offered across the country and contributing to the attribution analysis methodology.
- **Oak Ridge National Laboratory, State Energy Program:** Ms. Kuiken is currently managing the DNV KEMA portion of the Nonresidential Retrofit State Energy Program evaluation for the US Department of Energy, under contract to Oak Ridge National Laboratory. Ms. Kuiken is directing the documentation requests, telephone and on-site data collection, analysis, and reporting for 13 programs offered in states across the country and contributing to the attribution analysis methodology.
- **Con Edison:** Ms. Kuiken is currently managing the impact evaluation of the Small Business Direct Install program for Con Edison and Orange and Rockland utilities in New York. The study calls for a billing analysis of participating businesses and a number of site visits to verify installation. Ms. Kuiken will also oversee the development of attribution adjustment factors and net savings estimates for the program.
- **MECA/MCAAA:** Ms. Kuiken is currently managing the fourth round of impact evaluation of the Energy Optimization Programs for a consortium of utilities in Michigan. Programs include residential new construction, ENERGY STAR products, residential HVAC, appliance recycling, home energy

audits, and commercial and industrial prescriptive and custom measures. In previous years, Ms. Kuiken coordinated with the process evaluation of the same programs and monitored data collection, site visits, engineering reviews, and net-to-gross analyses to produce life cycle net savings. In the current year, Ms. Kuiken directs the audit and certification of the program tracking database and savings reports.

- **Alliant Energy-IPL:** Ms. Kuiken managed the process and impact evaluations of the 2009 – 2013 Energy Efficiency Plan and directed the evaluation of the PowerHouse television program for Alliant Energy in Iowa. The Energy Efficiency Plan programs included residential, nonresidential, and agriculture prescriptive; appliance recycling; direct load control; nonresidential custom; low income; home energy audits; renewable; and various educational and other programs. Ms. Kuiken managed study design, oversaw sample design and data collection, coordinated impact analyses, and incorporated process and impact evaluation results into a program-level report. She organized and managed the simultaneous evaluation of 20 distinct programs and oversaw client presentations, final report production, and additional scope and study requests. For the PowerHouse evaluation, Ms. Kuiken directed study design, oversaw sample design and data collection, and directed and reviewed the modeling results. Ms. Kuiken also participated in the 2005-2006 evaluation of the Alliant Energy efficiency and direct load control programs in Iowa and evaluated the energy savings estimates and algorithms used for the Agricultural Prescriptive Program in 2007.
- **MECA/MCAAA:** Ms. Kuiken managed the evaluation of the Efficiency United statewide energy efficiency program in Michigan for 3 years before turning responsibility over to a KEMA colleague. Programs included ENERGY STAR products, residential HVAC, appliance recycling, home energy audits, and commercial and industrial prescriptive and custom measures. Ms. Kuiken coordinated with the process evaluation of the same programs and monitored data collection, site visits, engineering reviews, and net-to-gross analyses to produce life cycle net savings.
- **Public Service Commission of Wisconsin:** Ms. Kuiken managed the evaluation of the Focus on Energy Business Programs statewide public benefits program in Wisconsin in 2010. The evaluation included an impact evaluation and a study of the savings resulting from the Education and Training program. She also participated in past evaluations of this program (since 2003), which included deemed savings review, a lighting supply-side study, a measure life study, an incremental cost study, and research into net-to-gross approaches and analysis methods.
- **Alliant Energy-WPL:** Ms. Kuiken managed the impact evaluation of the Alliant Energy Shared Savings Program in Wisconsin in 2009 and 2010. She oversaw telephone and on-site data collection for energy efficiency measures installed in the commercial and industrial sectors and monitored data analysis to determine net program savings. She also coordinated study efforts with the evaluation of the Focus on Energy Program.
- **Public Service Commission of Wisconsin:** Ms. Kuiken managed the impact evaluation of the Focus on Energy Renewables Program statewide public benefits program from 2003-2008. She oversaw sample design, collected data from program participants, estimated gross energy savings resulting from implemented projects, and analyzed survey data to determine net savings.
- **Vectren Natural Gas, Indiana:** Ms. Kuiken was the project manager for DNV KEMA's 2009 evaluation of the Indiana prescriptive and custom natural gas programs in the Vectren service territory. She oversaw data acquisition and sample design, developed survey instruments, and managed data collection and survey delivery. She also directed data analysis and the development of adjustment factors to determine net program savings.

- **San Diego Gas and Electric:** Ms. Kuiken was the project manager for DNV KEMA's 2009 evaluation of a commercial load control program in Southern California. She developed a system to recruit 400 participants for evaluation, developed onsite protocols, specified measurement equipment, trained field staff, and implemented quality control. She oversaw the installation and removal of meters on commercial air conditioning equipment.
- **New Jersey Board of Public Utilities:** Ms. Kuiken was a task manager for DNV KEMA's 2007 to 2009 evaluation of the Smart Start commercial and industrial energy efficiency program in New Jersey. She oversaw assembly of data from 7 different utilities, assisted with sample design, oversaw verification of energy savings, and managed the review and update of statewide deemed savings protocols.
- **Hydro Quebec:** Ms. Kuiken managed DNV KEMA's 2007/2008 impact evaluation of the Novoclimat Program, a multifamily new construction program in Quebec. She managed the completion of 20 site visits, reviewed existing paperwork, and performed detailed simulations of 15 participant sites in eQuest to verify energy savings.
- **Pacific Gas & Electric:** Ms. Kuiken was the task manager for DNV KEMA's 2007/2008 evaluation of a pilot load control program in Northern California. She developed a system to recruit 550 participants for evaluation, produced onsite protocols, hired temporary employees, trained field staff, and implemented quality control. She oversaw the installation of nearly 670 meters on residential air conditioners within a 6 week period and monitored the removal of all meters in a 2 week period.
- **City Public Service, San Antonio, Texas:** Ms. Kuiken was the task manager for DNV KEMA's 2006 through 2008 impact evaluations of the prescriptive and custom commercial and industrial energy efficiency programs in Texas. She also evaluated the residential and commercial prescriptive cooling program. She determined data collection details, wrote surveys for participants, managed completion of surveys, and calculated verified gross energy savings.
- **California Public Utilities Commission, San Diego Gas and Electric:** Ms. Kuiken assisted with DNV KEMA's 2006 evaluation of the California Statewide Multifamily Program. She assisted with the sample design for 120 site visits across the state of California, created survey forms and audit protocols, managed a team of 5 surveyors to complete field data collection, and analyzed survey data and applied results to program tracking data.
- **California Public Utilities Commission, (under subcontract to Heschong Mahone Group):** Ms. Kuiken managed DNV KEMA's 2006 impact evaluation of the Design for Comfort Program, a whole-building custom program targeted to low-income multifamily properties in Southern California. She developed data collection requirements for each site, managed and performed site audits at ~15 sites, used collected data to verify energy efficiency simulations provided by the program, and determined program verified gross energy savings.
- **Pacific Gas & Electric Company (under subcontract to ICF Consulting):** Ms. Kuiken participated in DNV KEMA's 2004 evaluation of the Partnership for Energy Affordability in Multi-Family Housing. She conducted participant surveys, analyzed and reported quantitative and qualitative results. In 2005 and 2006, she managed the impact evaluation. She oversaw and managed auditors who completed 35 onsite audits and used audit results to calculated verified energy savings.
- **New Hampshire Electric Utilities:** Ms. Kuiken was the task manager for DNV KEMA's 2005/2006 impact evaluation of the New Hampshire Large Commercial and Industrial Retrofit Program. She identified, scheduled, and managed onsite visits with participants in the program, developed an onsite plan that included estimation, direct measurement, and data logging, and managed onsite personnel. She also conducted phone interviews and analyzed onsite data and developed estimates of energy

savings for a wide variety of projects, including variable speed air compressors, lighting, EMS systems, high efficiency HVAC, custom process measures, and more.

- **U.S. Environmental Protection Agency (under subcontract to the Cadmus Group):** Ms. Kuiken aided in designing a survey sample for the 5th and 6th national household survey of customer awareness of ENERGY STAR□ in 2004 and 2005. She analyzed results from a nationwide Internet survey and compared data across survey years.
- **California Public Utilities Commission, Southern California Gas Company (under subcontract to ICF Consulting):** Ms. Kuiken assisted with the 2004 evaluation of the Demand Control Ventilation Pilot Program in Southern California. She conducted participant surveys with contractors and distributors and analyzed and reported results.

Technical Potential Studies:

- **Xcel Energy Services:** Ms. Kuiken participated in DNV KEMA's 2005 demand-side management market potential study in Denver, Colorado and surrounding areas. She conducted site visits of medium-sized commercial end-users to determine the saturation of specific technologies and the potential for increasing that saturation. She used face-to-face interviews and facility tours to evaluate energy-using equipment and their control strategies.
- **City Public Service:** Ms. Kuiken participated in DNV KEMA's 2004 energy efficiency potential study in San Antonio, Texas. She reviewed existing database structure for design and content, analyzed client billing data, used information from RECS, CBECS, and a recent residential appliance saturation study to estimate energy end use, researched energy efficiency measures for incremental cost, savings, and saturation, and reviewed existing tracking (database) information to verify efficient design and data integrity.
- **NSTAR:** Ms. Kuiken participated in DNV KEMA's 2004 energy efficiency potential study in Massachusetts. She used information from RECS and a recent residential appliance saturation study to estimate energy end use for residential customers, researched energy efficiency measures for incremental cost, savings, and applicability, and simulated data and analyzed and reported results.

Professional Experience:

DNV KEMA, Madison, Wisconsin: July 2003 to Present
Energy Engineer/Analyst – Research and Evaluation Division

Nexant, Inc., Madison, Wisconsin: May 2002 to July 2003
Engineer – Energy Delivery and Management Division

Industrial Assessment Center, Iowa State University, Ames, Iowa: May 1999 to May 2003
Lead Graduate Assistant

Iowa Energy Center Grant, Iowa State University, Ames, Iowa: May 1999 to May 2002
Research Assistant

Professional Affiliations:

Member, Association of Energy Services Professionals (AESP)

Certifications:

State of Wisconsin Licensed Professional Engineer

Professional Publications:

Kuiken, T. 2012. "Evaluation Broad and Deep: Getting the Most Out of Nonresidential Portfolio Evaluations." *Proceedings of the ACEEE 2012 Summer Study on Energy Efficiency in Buildings*. Washington, D.C.: American Council for an Energy-Efficient Economy.

Kuiken, T. 2002. "Energy savings in a commercial building with daylighting controls: empirical study and DOE-2 validation." M.S. thesis, Iowa State University.

Santosh Lamichhane

Profession:	Analyst
Years of Experience:	6
Education:	Master of International Public Affairs (Public Policy Analysis)/2011/Lafollette School of Public Affairs, University of Wisconsin-Madison Energy Analysis and Policy Certificate/2011/Lafollette School of Public Affairs, University of Wisconsin-Madison B.S./2007/Electrical Engineering/Magna Cum Laude/The University of Texas at Arlington (UT Arlington)
Years with DNV KEMA:	2.5

Key Qualifications:

Santosh Lamichhane has a Master's degree in Public Affairs with a focus in energy analysis and policy. In addition, he has an Engineer-in-Training certification with a Bachelor's degree in electrical engineering. He has worked on the impact evaluation of many energy efficiency programs and has performed and managed analytical tasks such as model-based statistical sample designs, calculating net-to-gross ratios, and producing estimates of net energy savings for both C&I and residential projects. In addition, he has performed engineering analysis and calculations, reviewed tracking databases, prepared samples for surveys, and used SAS program to write and modify codes to do analysis and automate tasks in a reproducible way. Mr. Lamichhane has also worked as a design engineer.

Selected Professional Experience:

- Program evaluation, cost-benefit analysis, policy analysis
- Energy analysis, engineering analysis, project management
- Statistical and econometric analysis, database management, computer programming

Project Specific Experience

- **Michigan (MECA/MCAA):** Performed sample design, survey data preparation, survey data analysis, and report writing tasks for impact evaluation of several programs of both MECA and MCAAA. Programs include Energy Star, HVAC, Online Audit, Onsite Audit, and Commercial and Industrial program. Analysis included calculation of net-to-gross ratios and producing estimates of net energy savings for both C&I and residential projects. He also performed tracking database reviews, verified that savings are calculated using correct engineering formula and assumptions, and verified that savings assignment match with the MEMD database.
- **NGRID Prescriptive Gas Program Evaluation:** Helped in sample design and survey data preparation.
- **NGRID Small Business Program Evaluation:** Helped in estimation of net-to-gross analysis.

- **MA Bright Opportunities Program (Project 17):** Helped in estimation of net-to-gross ratios for the program net of free-ridership and in estimation of spillover from the program focusing on participant spillover. Wrote sections of report related to free ridership and spillover.
- **Massachusetts Program Administrators, Commercial and Industrial Non-Energy Impacts Study:** Helped in database management, coding, mathematical calculations, literature review, and analysis to estimate non energy impacts from the range of C&I retrofit programs offered by the Massachusetts electric and gas Pas.
- **Con Edison Residential Direct Installation Program**: Helped in process evaluation, analyzed survey data, and converted data into charts and tables to help complete report writing.
- **Alliant Energy, Iowa:** Helped in comparing and evaluating Interstate Power and Light's renewable energy programs. Conducted in-depth interviews and research to compare the program with similar programs in other states.
- **Wisconsin Public Service Community Pilot Evaluations:** Helped in evaluation of pilot programs in Wisconsin, conducting in-depth interviews with participating customers and non-participating customers, report writing, database management, and research.

Professional Experience:

DNV KEMA, Madison, Wisconsin: June 2011 to Present
Senior Analyst

- Provide assistance in program evaluation, cost-benefit analysis, SAS programming, surveying.
- Help in converting data into information, perform qualitative and quantitative analysis.
- Use policy analysis, energy analysis, statistics, economics, econometrics and project management skills.

University of Wisconsin Madison: August 2010 to May 2011
Project Assistant (with Professor Greg Nemet on exploring options for public policy mechanisms to address climate change)

- Help identify policy interventions to lower costs and increase demand of carbon capture in the long run.
- Help build models to calculate the cost of carbon capture.

Pacific Economics Group, Madison, Wisconsin: June, 2010 to August, 2010
Intern Economist

- Successfully gathered data and processed them using statistical software (SST) to calculate performance indexes, cost details, and trends of utility industry companies.
- Analyzed trends to provide performance based economic and management consulting.

Department of Workforce Development, Labor Market Information Section, Madison, Wisconsin: September 2009 to May 2010
Project Assistant

- Performed statistical analysis of skills to change career of unemployed individuals.
- Carried out quantitative and qualitative analysis; linked green jobs to occupational information.

Versacom LLC, Dallas, Texas: July 2007 to September 2008
Design Engineer

- Designed, Priced, and Managed AT&T construction projects, studied city permits and policies.
- Got experienced in cable conditioning, cable splicing layout design, outside plant engineering, cost reports.

Wave Scattering Research Center, UT Arlington: March 2006 to December 2006
Research Assistant

- Completed jobs related to antenna fabrication, data analysis, troubleshooting, applied mathematics.

Languages:

	Speaking	*Reading*	*Writing*
English:	Excellent	Excellent	Excellent
Nepali:	Excellent	Excellent	Excellent
Hindi:	Excellent	Excellent	Excellent
Spanish:	Basic	Basic	Basic

Certifications:

Engineer in Training, State of Texas, Fundamentals of Engineering, May 2007

College Reading and Learning Association (CRLA) certified Level I Tutor

Awards:

Lafollette School of Public Affairs Fellowship, University of Wisconsin-Madison, 2009

Recipient, Stephen F. Crumb Memorial Award in Engineering, UT Arlington spring 2007

Recipient, Igor Fraiberg Endowed Scholarship in Engineering, UT Arlington fall 2006

Skills:

SAS, STATA, SST, C, MATLAB, Windows, Web Design, MS Word, Excel, PowerPoint, HTML, AutoCAD, Integrated Environmental Control Model (IECM), InDesign

Jeremiah Robinson, PE

Profession:	Engineer
Years of Experience:	6
Education:	B.S./2002/Engineering-Electrical Emphasis/Messiah College, Grantham, PA
Years with DNV KEMA:	3

Key Qualifications:

Jeremiah Robinson has three years of experience at DNV KEMA, where he works as an energy engineer and analyst. He performs engineering reviews for energy savings protocols and impact evaluations, field data collection, expert surveying, and data analysis using Excel and Access. With expertise in writing, editing, and spreadsheet development, he often assists in producing reports. Prior to joining DNV KEMA, Mr. Robinson worked for three years in electrical engineering building design and construction administration, with specializations in energy efficiency, lighting, and communications. He works well with building owners and contractors, and knows his way around mechanical rooms and jobsites.

Professional Experience:

DNV KEMA, Madison, Wisconsin: April 2008 to Present
Engineer

- Performed extensive cross-referencing analysis of participant motivations for solar PV installation and sizing based on billing, telephone survey, and on-site inspection data for the California Solar Initiative. Helped write report presenting findings.
- Served as an expert electrical engineering advisor for the California Public Utilities Commission's Super Lamp program, helping develop specifications for advanced CFL bulbs sold in California.
- Installed monitoring equipment on air conditioners for customers in California. Performed extensive psychometric data analysis to determine efficiency gains from system tune-ups.
- Played a primary role in creating and adjusting energy savings protocols for deemed and prescriptive savings programs in Wisconsin, New Jersey, Michigan, and Iowa.
- Conducted surveys and engineering reviews of custom commercial and industrial projects for impact evaluations of Wisconsin's Focus on Energy, New Jersey's Smart Start, and Alliant Iowa's Custom Non-Residential programs. Performed analysis of survey results, and helped write reports presenting findings.
- Performed engineering reviews and created basic residential building simulation models for multi-family residential buildings for Hydro Quebec, all based on data provided in French.
- Researched industry standards and made recommendations for typical measure life values for the Wisconsin Focus on Energy commercial and industrial programs.
- Performed complex on-site data collection for Xcel Energy residential, Alliant Energy commercial and industrial programs, and the Maryland utilities commercial program.

Mead & Hunt, Madison, Wisconsin: January 2005 to March 2008
Electrical Engineer

- Designed electrical power distribution, lighting, fire alarm, video surveillance, access control, and motor control systems for airport terminals and other airport buildings, university buildings, industrial buildings, prisons, and water pumping stations.
- Designed airfield lighting and roadway lighting.
- Surveyed and cataloged the power and communications systems for a large hospital facility.
- Managed conflicts between clients, contractors, and vendors, in person and over the phone.
- Estimated costs and performed construction administration for projects of all types and sizes.
- Considered a go-to person for sustainable design, fire alarms, video surveillance, architectural lighting, code expertise, new product research, well-written prose, and unusual projects requiring a unique skill set and outside-the-box thinking.

Self-Employed, Madison, Wisconsin: October 2003 to January 2005
Website and Database Developer

- Designed and built database-driven websites and content management systems for various non-profit and for-profit organizations.

Harza Engineering, Milwaukee, Wisconsin: June 2001 to August 2001
Electrical Engineering Intern

- Collaborated with teams of engineers on power plant electrical and instrumentation / controls system designs

Professional Affiliations:

Professional Engineer Certification

LEED Accredited Professional

Skills:

Experience with computer programs: AutoCAD; Revit; AGI32; DAPPER (power distribution); Microsoft Access, Word, Excel, Outlook, and Power Point; Adobe PhotoShop and Acrobat; Macromedia Dreamweaver and ColdFusion

Sarah E. Tuttle

Profession:	Analyst
Years of Experience:	< 1
Education:	M.S./December 2012/Resource Economics/University of Massachusetts Amherst, Amherst, MA
	B.S./2010/ Economics/Graduated magna cum laude/Minor in Mathematics/University of North Texas, Denton, TX
Years with DNV KEMA:	< 1

Key Qualifications:

Sarah Tuttle is currently an Analyst for Sustainable Use Consulting Group. She has experience with econometric modeling and is familiar with data analysis using SAS and Stata software. Prior to joining DNV KEMA, Ms. Tuttle worked as a research assistant at the University of Massachusetts Amherst. As a research assistant she recruited 60 people to participate in a health research longitudinal study funded by the USDA. Ms. Tuttle led the telephone interviews with the recruits and helped develop the interview protocols and all other related materials sent to each participant.

Professional Experience:

DNV KEMA, Burlington, Massachusetts: January 2012 to Present
Analyst

Department of Resource Economics, University of Massachusetts Amherst: August 2011 to December 2012
Research Assistant (January 2012-December 2012)

- Conducted research assessing the comparative advantages of different communication methods when delivering health information to rural families with limited income.
- Collaborated remotely with a team made up of professionals located throughout the United States.
- Developed interview protocols, recruited study subjects, and led telephone interviews.
- Collected and managed confidential data, coded qualitative data, and developed a quantitative basebook.

Teaching Assistant (August 2011-Decmber 2011)

- Led two sections of an introductory statistics course.
- Graded assignments on time for 120 students.
- Tutored individual students outside of class.

Department of Economics, University of North Texas: October 2009 to May 2011
Teaching Assistant

- Assisted professor in an "International Trade" economics class.
- Helped create weekly lesson plans and conducted lessons in front of a large audience.

Additional Education:

Fields of Study: Applied Econometrics and Industrial Organization

Field Essay: Determinants of Physician Supply in Massachusetts After the Passage of Universal Health Care

Centro per la Formazione in Economia e Politica dello Sviluppo Rurale (CENTRO) Portici, Italy – Participated in a four week Microeconometrics course. Awarded a stipend from CENTRO to attend.

Awards:

George Benx Memorial Scholarship in Economics

Catherine and Virgil Rogers Scholarship in Economics

Board of Regents Scholarship

Skills:

Stata and SAS software

Microsoft Office Suite and other applications

Econometric modeling

Susan Weber

Profession:	Senior Consultant
Years of Experience:	20
Education:	M.S./Information Science/ Simmons College
	B.A./ University of Wisconsin-Madison
Years with DNV KEMA:	14

Program Evaluation and Survey Design

- **C&I Program Evaluation**, **Massachusetts Program Administrators (2012).** Led in-depth interviews and focus groups for C&I customers for the 2011-2012 Process Evaluation of the Large Commercial and Industrial Energy Efficiency Programs in Massachusetts.
- **Commercial and Industrial Non-Energy Impacts Study, Massachusetts Program Administrators (2012):** Led the in-depth interview team to collect non-energy impacts data from over 500 commercial and industrial program participants. Developed multi-step interview process and set of formulas to translate qualitative interview responses into a set of quantitative NEI estimates; and trained interviewers how to elicit this information.
- **Industrial Sector Market Research, Pacific Gas & Electric and Southern California Edison (2008 – 2011).** Led in-depth telephone interviews with sector-specific industrial customers; and developed profiles of key industrial manufacturing sectors to help utilities better understand their customers and increase adoption of industrial energy efficiency. For primary research efforts, developed in-depth interview guide and conducted one-on-one telephone interviews; and participated in webinar forums. Secondary research included developing key business factors and report outline; conducted secondary research on business factors that differentiate priorities for industrial decision makers.
- **Program Evaluation, Hydro-Quebec (2012-2013).** Managed in-depth interviews, CATI surveys and Delphi Process to conduct market effects/market transformation evaluation for residential appliance rebate program.
- **Program Evaluation, U.S. Department of Energy (2010-2011).** Developed methodology to evaluate programs; trained staff to effectively categorize state program activities; and conducted primary interviews with Program Officers.
- **Program Evaluation, Hydro Quebec (2010).** Conducted process evaluation for Hydro Quebec's 2008-2009 Mieux Consommer (PPMC) electrical appliance program that provided rebates for eligible Energy Star appliances.
- **Program Evaluation, Connecticut Clean Energy Fund (2008-2009).** Managed process evaluation and conducted policy research and analysis to assess CCEF's solar photovoltaic and distributed generation incentive programs. Conducted process interviews on CCEF's installed capacity program among policymakers, and CCEF board members and executives; and developed policy and economic analysis including comparisons to similar incentive programs; analyzed Feed-in-Tariff models in Canada and Europe as possible program alternative.

- **Program Evaluation, Alliant Energy (2008):** Project Manager on process evaluation for Alliant Energy's Performance Contracting program, delivered to Iowa territory business customers. Developed an interview protocol, identified participants and conducted interviews with program actors such as program administrator, project developers, and the third-party verifiers.
- **Evaluation of Renewable Portfolio Standard (RPS), NYSERDA (2009)**: Managed analysis of the economic impacts, costs and benefits of NYSERDA's central procurement program to support the statewide Renewable Portfolio Standard.

Policy Analysis & Sustainability:

- **Corporate Sustainability Initiative, DNV KEMA (2008-2012).** Project Manager; lead six member team focused on planning, researching, and incorporating sustainable business practices into corporate processes and culture. Focus areas include: calculating DNV KEMA's global CO2 footprint; setting corporate CO2 reduction goals; developing an Innovation Fund invest in sustainable projects; and oversaw internal employee communications.
- **Sustainable Solar Strategy, Connecticut Clean Energy Fund (2009).** Co-developed a long-term, sustainable solar strategy for Connecticut intended to grow solar energy development and reduce barriers through a set of programs and initiatives. These recommendations were presented to state policymakers on behalf of the Connecticut Clean Energy Fund.
- **Policy Analysis for Transmission Upgrade, State of New Hampshire (2010).** Researcher on action plan to develop a transmission cost allocation methodology to facilitate wind and biomass generation development in northern New Hampshire. Research tasks: evaluated series of transmission cost allocation policies and approaches used in the U.S.
- **Smart Grid Development Plan, Vectren (2009):** Contributor to implement a Smart Grid plan to enable Distribution Automation (DA) and Advanced Metering Infrastructure (AMI) technology to the utility's 150,000 electric and 88,000 gas customers. As contributing Project Management member, developed, wrote and edited Request for Proposals to solicit then evaluate and select Smart Grid vendors. This project's goal is to extend coverage of automated transmission processing and monitoring capability and includes HAN communications capability in each smart meter and enables demand response (DR) services.
- **International Battery, Market Research (2009).** Worked with International Battery staff to identify key characteristics of lithium-ion storage device and mapped against potential end-user applications. The market analysis study focused on three key market areas – Generation, Transmission & Distribution, and End-Users. Results showed that despite higher costs, energy storage for end-uses offers a potential emissions benefit when competing against more cost-effective existing back-up generation options.
- **Competitive Intelligence Analysis, Multi Client Service (2000-2008).** Led research and analysis of electricity suppliers operating in restructured electric markets. Primary author of *The Retailer Yearbook*, an annual publication that captures electric supplier financial metrics including gross margin, customer acquisition costs and provides profiles on all electric supplier active in U.S. retail energy markets. Developed robust biannual market share data for residential and non-residential U.S. retail electric and gas suppliers.
- **Market Research, Constellation NewEnergy (2008):** Project manager to develop market analysis and market shares for demand response and voluntary renewable energy markets.

Developed and fielded surveys; organized, cleaned and compiled data; managed junior researcher; and developed insight into company's competitive position.

Professional Experience:

DNV KEMA, Burlington, Massachusetts: 1999 to Present
Senior Consultant

Senior Consultant (2007-Present)
Senior Energy Analyst (2003-2007)
Energy Analyst (1999-2003)

InterGen Energy, Boston, Massachusetts: 1997 to 1999
Research Manager

- Supported worldwide power plant development using primary and secondary research, and trained employees in research methods.

Graduate Student, Simmons College, Master of Information Science: 1994 to 1997

Laughlin & Constable, Milwaukee, Wisconsin: 1990 to 1993
Public Relations Account Manager

- Managed non-profit and consumer public relations accounts; handled media relations and planned and coordinated special events.

Professional Papers:

Freeman, Luisa and Susan Weber, DNV KEMA Energy & Sustainability. "Evaluation Challenges for Generation and Transmission Companies and Electric Cooperatives." Paper presented at International Energy Program Evaluation Conference, Chicago, Illinois, August 2013.

Stevens, Noel and Susan Weber, DNV KEMA; Lindsay Foley, National Grid; Pam Rathbun, TetraTech. "Using In-Depth Interviews to Estimate Non-Energy Impacts Resulting from C&I Energy Efficiency Measures." Paper presented at International Energy Program Evaluation Conference, Chicago, Illinois, August 2013.

Weber, Susan and Julia Vetromile, DNV KEMA; Rafael Friedmann, PG&E. "Driving Business Decisions: A Look at the Business Drivers of Industrial Energy Efficiency Programs." Paper presented at ACEEE Conference, Niagara Falls, New York, July 2011.

B. Standard Consulting Agreement

CONSULTING AGREEMENT

This AGREEMENT is made and entered into as of ____________________ 201 (the “effective date”) by and between KEMA Consulting Canada Ltd., with a principal place of business at 1059 Edgewood Road, North Vancouver, BC V7R 1Y8, CANADA (“KEMA”), and ____with a principal place of business at____("Client").

WITNESSETH

WHEREAS, KEMA is engaged in the business of providing consulting services;

WHEREAS, Client and KEMA intend to set forth in this Agreement the terms and conditions under which KEMA shall make available, and Client shall obtain from KEMA, such services;

NOW, THEREFORE, in consideration of the promises, the mutual covenants and agreements herein contained, and other valuable consideration, the receipt, adequacy and sufficiency of which are hereby acknowledged, and in consideration of Client proceeding with this Agreement, the parties do hereby covenant and agree as follows:

1. SERVICES TO BE PERFORMED - TASK ORDERS

KEMA shall provide consulting services to Client as more specifically authorized in Task Orders to be attached to and made a part of this Agreement. Each Task Order shall be sequentially numbered and shall contain information such as:

i). A description of the scope of work;

ii). Period of performance of the Task Order;

iii). Total dollar value of the Task Order;

iv). Type of contract and payment terms including applicable rates;

v). Client point of contact for the Task Order;

vi). Any other terms and conditions applicable to that particular Task Order.

Each Task Order shall be dated and signed by both parties, and shall be governed by the terms of this Agreement. In the event of any conflict between the terms of this Agreement and the terms contained in any Task Order, the terms of the Task Order shall take precedence.

2. INDEPENDENT CONTRACTOR

KEMA shall at all times be deemed to be an independent contractor. Nothing contained in this Agreement shall be construed as creating the relation of employer and employee, agent or joint venturer between KEMA and Client. KEMA shall have the right in its sole discretion to determine which of its staff shall be assigned to perform services for Client under this Agreement, and shall have the sole right to re-assign or replace any staff person. KEMA is a U.S. company operating within a global network of affiliated companies. In the course of providing the services hereunder, KEMA may, in its discretion, utilize the staffing or other resources of any of its other affiliates. Client agrees that KEMA may provide any Information it receives in connection with this Agreement to such other affiliates for the purpose of providing the services hereunder. However, unless another affiliated company is separately contracted, provision of the services under this Agreement remains the responsibility of KEMA.

3. PERIOD OF PERFORMANCE

This Agreement shall have a period of performance commencing with the effective date as set forth above and continue in full force and effect until the later of i). one (1) year, or ii). until the completion of all Task Orders entered into in accordance with this Agreement, unless earlier terminated in accordance with Article 8. below. This period of performance may be extended by the mutual written agreement of the parties.

4. PAYMENT

The method of payment for services to be performed under this Agreement shall be specified on each Task Order. Unless otherwise set forth in the Task Order, KEMA shall submit invoices for each Task Order at the end of each month for services performed during that month. Client shall pay KEMA the undisputed portion of each invoice within thirty (30) days of receipt.

5. ASSIGNMENT

Neither party shall assign, transfer or otherwise delegate its obligations under this Agreement or any interest, or right or claim thereunder, nor subcontract any portion of the work to be performed, without the prior written consent of the other party, which consent shall not be unreasonably withheld.

6. STANDARDS OF PERFORMANCE

KEMA shall perform its services with care, skill and diligence in accordance with the applicable professional standards currently recognized by such profession, and shall be responsible for the professional quality and completeness of all deliverables or other items and services which may be required under this Agreement. Within sixty (60) days from the date of providing any service or item hereunder, should such service or item provided by KEMA be found to be defective by Client, Client shall identify the nature of such deficiency in writing and KEMA shall within thirty (30) days from the date of receipt of such notice attempt to correct, re-perform or replace the defective services or item.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES AND CONDITIONS EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

7. CHANGES

Any changes in, modifications of, or amendments to this Agreement or any Task Order shall be in writing and signed by both parties.

8. TERMINATION

Either party shall have the right, with or without cause, to terminate this Agreement and/or any Task Order by providing the other party with thirty (30) days prior written notice. Unless such notice also provides for termination of all outstanding Task Orders, this Agreement shall remain in effect until final payment is received by KEMA for all work performed under any Task Orders issued hereunder.

Either party shall have the right to terminate this Agreement and/or any Task Order should the other party default in its obligations under this Agreement or any Task Order, and either fail to correct such default within ten (10) days after receipt of written notice specifying same, or, if the default is not curable within such time, fail to take the reasonable and necessary steps to begin to cure the default.

In full discharge of its obligations to KEMA with respect to this Agreement and/or any Task Order and any termination in accordance with this Article, Client shall pay an amount to KEMA which includes: i). payment in accordance with the payment terms of the Agreement and/or Task Order for services performed and items delivered up to the effective date of termination; and ii). costs and related overhead and profit for services and items in progress up to the date of termination; and iii). costs and related overhead incurred as a result of the termination. KEMA shall not be entitled to loss of anticipated profit under this provision.

9. CONFIDENTIALITY

During the term of this Agreement, either party (the "Disclosing Party") may disclose confidential information (the "Information"), to the other party (the "Receiving Party"). Information shall mean any information that is owned or controlled by Disclosing Party and not generally available to the public, including but not limited to performance, sales, financial, contractual and marketing information, and ideas, technical data and concepts. It also includes information of third parties in possession of Disclosing Party that Disclosing Party is obligated to maintain in confidence. Information may be in intangible form, such as unrecorded knowledge, ideas or concepts or information communicated orally or by visual observation, or may be embodied in tangible form, such as a document. The term "document" includes written memoranda, drawings, training materials, specifications, notebook entries, photographs, graphic representations, firmware, computer information or software, information communicated by other electronic or magnetic media, or models. All such Information disclosed in written or tangible form shall be marked in a prominent location to indicate that it is the confidential information of the Disclosing Party. Information which is disclosed verbally or visually shall be followed within ten (10) days by a written description of the Information disclosed and sent to the Receiving Party at the address and in accordance with the terms established in Article 19.

The Receiving Party shall hold the Disclosing Party's Information in confidence and shall take all reasonable steps to prevent any unauthorized possession, use, copying, transfer or disclosure of such Information. The Receiving Party shall give such Information at least such protection as the Receiving Party gives its own information and data of the same general type, but in no event less than reasonable protection. The Receiving Party shall not use or make copies of the Disclosing Party's Information for any purpose other than as contemplated by the terms of this Agreement and/or Task Order. The Receiving Party shall not disclose the Disclosing Party's Information to any person other than those of the Receiving Party's employees, agents, consultants, contractors and subcontractors who have a need to know in connection with this Agreement. The Receiving Party shall, by written agreement, require each person to whom, or entity to which, it discloses the Disclosing Party's Information to give such Information at least such protection as the Receiving Party itself is required to give such Information under this Agreement. The Receiving Party's confidentiality obligations hereunder shall not apply to any portion of the Disclosing Party's Information which:

(a) has become a matter of public knowledge other than through an act or omission of the Receiving Party;

(b) has been made known to the Receiving Party by a third party in accordance with such third party's legal rights without any restriction on disclosure;

(c) was in the possession of the Receiving Party prior to the disclosure of such Information by the Disclosing Party and was not acquired directly or indirectly from the other party or any person or entity in a relationship of trust and confidence with the other party with respect to such Information;

(d) the Receiving Party is required by law to disclose; or

(e) has been independently developed by the Receiving Party from information not defined as "Information" in this Agreement.

The Receiving Party shall return the Disclosing Party's Information (including all copies thereof) to the Disclosing Party promptly upon the earliest of any termination of this Agreement or the Disclosing Party's written request. Notwithstanding the foregoing, the Receiving Party may retain one copy of such Information solely for archival purposes, subject to the confidentiality provisions of this Agreement.

This Agreement shall not be deemed to grant any rights with respect to either party's Information other than those expressly set forth herein and shall not be deemed to grant any license whatsoever with respect to any patents, inventions, copyrights, trademarks or trade secrets contained in such Information.

This Article shall survive the termination of this Agreement and continue to apply to all Information exchanged by the parties during the period of performance of this Agreement.

10. INDEMNIFICATION

KEMA hereby agrees to indemnify Client from third party claims for damages for bodily injury or death of any person or damage to or destruction of tangible property, to the extent directly resulting from the negligent acts or omissions of KEMA in the performance of the work covered by this Agreement, provided, however, that KEMA shall not be obligated to indemnify Client for the portion of any such claims, liabilities, obligations, damages or causes of action which are the result of the negligent acts or omissions of Client.

Client hereby agrees to indemnify KEMA from third party claims for damages for bodily injury or death of any person or damage to or destruction of tangible property, to the extent directly resulting from the negligent acts or omissions of Client in connection with the performance of the work covered by this Agreement, provided, however, that Client shall not be obligated to indemnify KEMA for the portion of any such claims, liabilities, obligations, damages or causes of action which are the result of the negligent acts or omissions of KEMA.

11. LIMITATION OF LIABILITY

The liability of KEMA for any claim whatsoever related to this Agreement, including any cause of action in contract, tort or strict liability, and including any obligations to indemnify Client as set forth in Article 10 above, shall not exceed the total amount of payments previously made to KEMA hereunder. KEMA shall have no responsibility or liability whatsoever for the services, work, errors or omissions of any other party, including any EPC contractor, including for any delays or damages caused by any such third party. In no event shall KEMA be liable for any consequential, exemplary, special, incidental or punitive damages including, without limitation, lost profits, even if such damages are foreseeable or the damaged party has been advised of the possibility of such damages and regardless of whether any such damages are deemed to result from the failure or inadequacy of any exclusive or other remedy.

12. RIGHTS IN DATA

The work product, and all right, title and interest thereto, (the "Data") developed, created, or produced by KEMA and required to be delivered to Client pursuant to this Agreement shall remain the property of KEMA and shall be provided to Client with a non-exclusive, internal use license upon the later of: (a) delivery of such Data to Client or, (b) receipt of full payment by KEMA for the Data. Client may use the Data for its internal business purposes only, and may not provide the Data to any third parties without first receiving KEMA's written consent. In addition, Client acknowledges and agrees that KEMA retains and may use the general knowledge acquired as a result of its creation of the Data or the performance of services hereunder for its general reference and enhancement of its technical capabilities and that KEMA retains unlimited rights in such general knowledge, which shall include the right to use in any manner and for any purpose. All information and material which is owned by KEMA and used by KEMA in the performance of this Agreement shall remain the exclusive property of KEMA whether or not such information or material was incorporated in, adapted for use in, or used to produce any Data delivered under this Agreement, unless otherwise specified in an individual Task Order.

13. NON-SOLICITATION

Client agrees that during the period of performance of this Agreement and for one (1) year thereafter, it will neither directly or indirectly solicit for employment, engage as a contractor, hire, or otherwise induce any employee or contractor of KEMA to leave the employ of KEMA.

14. TAXES

KEMA's prices do not include any local, state or federal sales or use taxes. Should any such taxes be found to be applicable to this transaction, KEMA will invoice Client separately for these taxes, and Client will remit these taxes to KEMA, unless Client provides KEMA written evidence that Client is exempt from such taxes or that Client has remitted these taxes directly to the appropriate taxing authority.

15. EQUITABLE RELIEF

The parties hereto agree that irreparable damage would occur in the event that any of the provisions of this Agreement were not performed in accordance with their specific terms or were otherwise breached. Accordingly, it is agreed that the parties shall be entitled to an injunction or injunctions to prevent breaches of this Agreement and to enforce specifically the terms and provisions hereof in any court of the United States or any state having jurisdiction, this being in addition to any other remedy to which they are entitled at law or in equity.

16. ENTIRE AGREEMENT

This Agreement and all Task Orders issued hereunder contain the entire Agreement between the parties with respect to the matters covered herein. This Agreement cannot be modified except in writing signed by both parties.

17. SEVERABILITY

If any term or provision of this Agreement shall be found by a court of competent jurisdiction to be illegal or otherwise unenforceable, that finding shall not invalidate the whole of this Agreement, but only such term or provision shall be deemed modified to the extent necessary in the court' s opinion to render such term or provision enforceable, and the rights and obligations of the parties shall be construed and enforced accordingly, preserving to the fullest permissible extent the intent and agreement of the parties herein set forth.

18. WAIVER

The failure of any party to insist upon strict adherence to any term of this Agreement on any occasion shall not be considered a waiver or deprive that party of the right thereafter to insist upon strict adherence to that term or any other term of this Agreement. To be in force and enforceable, any waiver must be in writing and must be signed by both parties.

19. NOTICES

All notices and other communications hereunder shall be in writing and shall be deemed to be given if delivered personally or by facsimile transmission, telexed or mailed by registered or certified mail (return receipt requested), postage prepaid, or deposited for overnight delivery with a reputable overnight delivery service, such as Federal Express, to the parties at the following addresses (or at such other address for the party as shall be specified by like notices; provided that notices of a change of address shall be effective only upon receipt thereof):

To KEMA	To Client
KEMA Consulting Canada, Ltd.	______________________________
1059 Edgewood Road	______________________________
North Vancouver, BC V7R1Y8	______________________________
CANADA	______________________________
Attn: Legal Department	

20. APPLICABLE LAW

This Agreement shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts, exclusive of its conflict of law rules.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement by their duly authorized representatives as of the day and year indicated below.

KEMA Consulting Canada, Ltd.	Client
Signature: ______________________	Signature: ____________________
Name: _________________________ (Type or Print)	Name: _______________________ (Type or Print)
Title: __________________________	Title: ________________________
Date: __________________________	Date: ________________________

C. Free Ridership Methodology

This appendix provides a detailed explanation of the program attribution methodology used in this impact evaluation.[6]

Overview of Approach

The attribution analysis uses data collected from the engineering review, on-site visits, participant surveys, and supplier surveys. These data are used to calculate the following adjustment factors:

- **Installation rate.** This factor corresponds to the fraction of measures that were installed. Each measure is assigned a binary factor that identifies whether it was installed or not installed. Adjustments to the number of units installed for a particular measure are included in the engineering verification factor, not in the installation rate.
- **Engineering verification factor.** This is the ratio of the verified gross savings to the tracking estimate of gross savings for installed measures. The engineering verification factor includes corrections to the numbers of units installed, changes in operating hours, changes in operating levels, etc. Starting with this round, the correction is determined both for measures in the engineering sample and measures in the CATI sample and is applied to measures that were installed by participants in both groups, both custom and deemed. Measures in the CATI sample receive the deemed energy savings and adjustments based on the parameters used to calculate total measure savings, such as unit quantity or operating hours.
- **Attribution factors.** These factors are used to determine the proportion of the verified gross savings attributable to the Focus on Energy Business Programs. For non-CFL measures,[7] the attribution factors are determined from the participant's responses to a battery of survey questions designed to determine how influential Focus on Energy Business Programs was in the decision to install a particular measure. For CFL measures, the final attribution is assigned based on market research done to measure the balance between attribution and spillover in the entire state and across sectors.

The three attribution factors that affect the final net savings are timing, efficiency, and quantity attribution. All three attribution factors are based on responses to the attribution questions in the impact evaluation survey. The following is a brief description of each factor:

- **Timing attribution, A_T**: This measures the effect the program had on *when* the equipment was installed. The timing attribution is a linear function of the **Acceleration Period, m_a**, which corresponds to the number of months between when the equipment was actually installed and when it would have been installed in the absence of the program. For respondents who say they would have installed at the same time or earlier without the program, $m_a = 0$. For those who say

[6] KEMA has developed an alternative attribution analysis methodology (life cycle net savings, or LCNS) that uses the same survey instruments. The results using the LCNS method are provided for comparison only in Appendix H.

[7] For purposes of this discussion, "CFLs" includes small CFLs only; for example, measures described in the program tracking databases as "CFL <= 32W". The standard evaluation attribution battery is used for larger CFL installations (> 32W).

they would have installed later, m_a is the number of months later they say they would have installed, up to a maximum of 48.

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

The complement of attribution is free-ridership. Attribution measures the portion of the savings that result because of the actions of the program. Free-ridership measures the portion of the savings that would have happened in the absence of the program. The free-ridership equivalents of the attribution factors are used to determine program net savings. They are:

- **Timing free-ridership, f_T:** The timing free-ridership is also a linear function of the Acceleration Period, m_a, defined under Timing Attribution above.
- **Efficiency free-ridership, f_E:** This is the fraction of verified gross installed (VGI) savings per unit that would have occurred without the program (free rider efficiency increment). This value is also equivalent to the factor E used in previous attribution analysis reports.
- **Quantity free-ridership, f_Q:** This is the fraction of installed units that would have been installed without the program (free rider quantity factor). This value is also equivalent to the factor Q used in previous attribution analysis reports.

The free-ridership values are easily calculated from the attribution factors.

- $f_T = 1 - A_T$
- $f_E = 1 – A_E$
- $f_Q = 1 – A_Q$

Attribution Analysis

The impact evaluation starts with the program-reported gross savings for a measure. This is the savings value reported by the program in the program tracking database. The verified gross savings are determined by multiplying the tracking savings by the installation rate and the engineering verification factor. The combined installation rate and engineering verification factor is also called the gross savings adjustment factor. These equations are illustrated in Figures E-1 and E-2.

Figure 0E-1. Gross Savings Adjustment Factor Calculation

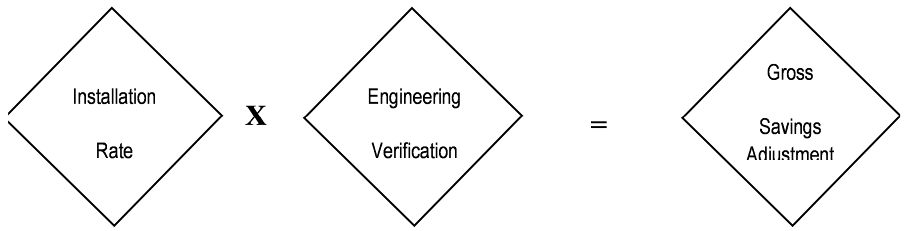
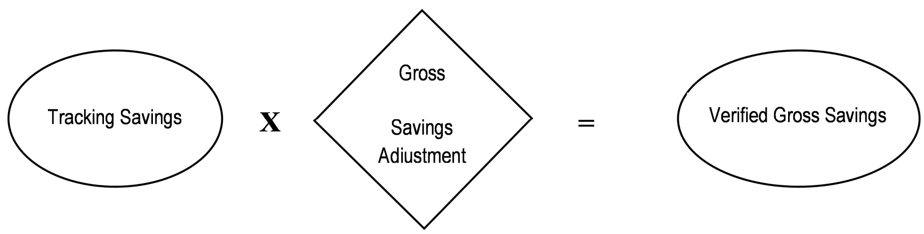
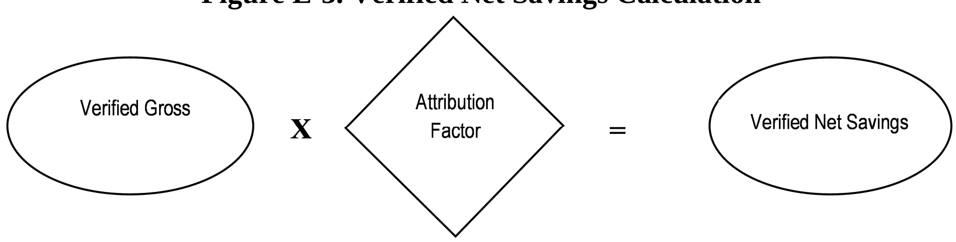


Figure E-2. Verified Gross Savings Calculation



As shown in Figure E-3, the verified net savings for each measure are equal to the VGI savings multiplied by the overall Attribution Factor, A.

Figure E-3. Verified Net Savings Calculation



The overall attribution factor is a function of the Simple Program Attribution (SPA) and the timing free-ridership. The SPA is the fraction of VGI savings that are attributable to the program and is a function of the efficiency free-ridership and the quantity free-ridership.

The fraction of VGI savings that would have occurred *without* the program is the product of the fraction of units that would have been installed without the program, f_Q, and the fractional unit savings that these units would have had without the program, $f_{E.}$

$$f_{QE} = f_Q \, f_E$$

For example, if two-thirds as many units would have been installed without the program ($f_Q = 2/3$), and the savings per unit would have been only half as much ($f_E = 1/2$), the portion of the savings that would have occurred without the program would be

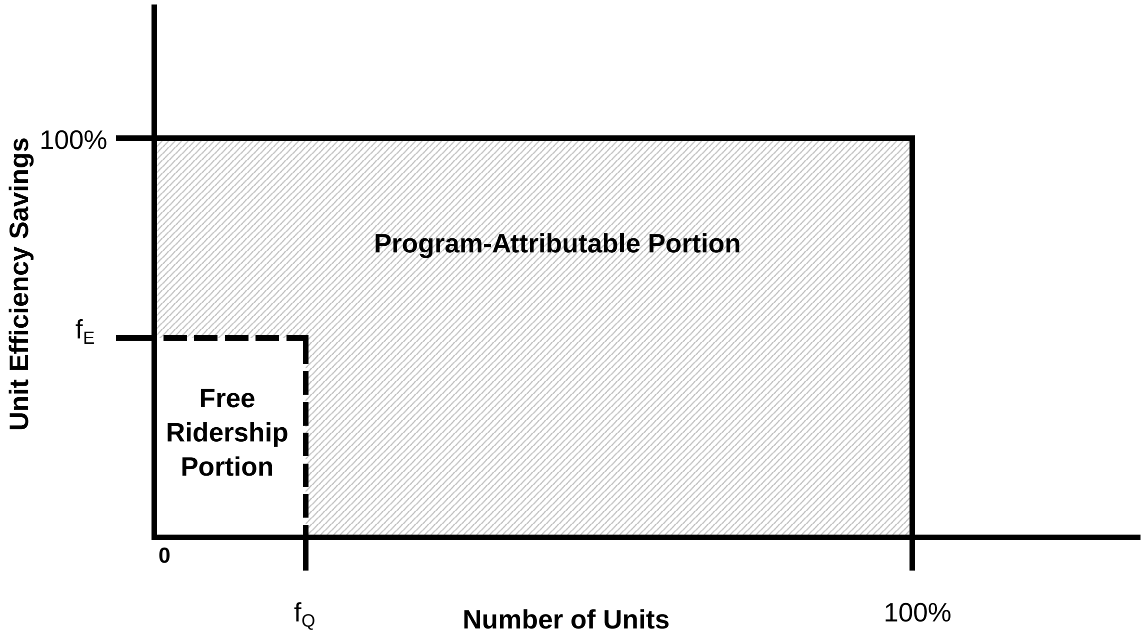
$$f_{QE} = (2/3) \text{ x } (1/2) = 1/3.$$

The SPA is the complement of this free rider portion.

$$SPA = 1\text{-}f_{QE} = 1\text{-}\ f_Q\ f_E$$

The relationship is illustrated in Figure E-4.

Figure 0E-4. Graphical Derivation of the SPA Equation



The timing free-ridership is calculated from the acceleration period using

$$f_T = 1 - m_a/48.$$

The overall attribution factor is

$$A = 1 - f_Q f_E f_T$$

Thus, if the measure was accelerated by more than 48 months, the no-program timing factor f_T is 0 and the attribution is 1, regardless of f_Q and f_E. If the measure was not accelerated at all, f_T = 1, and the simple attribution is the final attribution, A = SPA.

The net savings can be calculated

First-year net savings = VGI Savings * A

Determining Attribution Parameters

The attribution factors defined in the previous section are determined from the participant responses gathered during the survey. This section provides an overview of the survey data and how it is used to determine each attribution factor. It also includes more detailed sections for each factor that show exactly how all survey responses are handled.

General procedure

This section provides an overview of the attribution factors and how they are determined.

- **Timing attribution, A_T:** The timing attribution is determined directly from the acceleration period, m_a, which is in turn provided directly by the respondent. The timing attribution is equal to $A_T = m_a/48$ for values of m_a less than or equal to 48. There is no timing attribution effect for values of m_a greater than 48; in those instances we assume that the measure would never have been installed without the influence of the program.

- **Efficiency attribution, A_E:** The efficiency attribution is based on the answers to questions DAT2a and DAT2b as shown in Table E-1. Respondents who indicate that they would have installed a lesser-efficient piece of equipment in the absence of the program are asked what efficiency they would have installed instead. An efficiency attribution value is assigned based on the response.

Table 0-1. Efficiency Attribution Assignments

Efficiency That Would Have Been Installed without Focus		
Coarse Cut (DAT2a)	**Finer Cut (DAT2b)**	**Efficiency Attribution**
Same	NA	0%
Lower	Standard efficiency or according to code	100%
	Slightly higher than standard efficiency	70%
	Between standard efficiency and the efficiency that was installed	50%
	Slightly lower than the high efficiency that was installed	30%
	Don't know/refused	Average of above cases for measure group
Higher	NA	0%
Don't know/refused	NA	Average of all respondents for measure group

- **Quantity attribution, A_Q:** The quantity attribution is based on the percentage change in quantity caused by the program, **Inc**, which is in turn provided directly by the respondent. If the respondent would have installed a smaller measure without the program then the quantity attribution is equal to A_Q = Inc / (Inc + 100%). If the respondent would have installed a larger measure without the program then the quantity attribution is equal to A_Q = Inc.

The next few sections deal with determining the timing, efficiency, and quantity attributions on a more detailed level.

Detailed assignments

This section gives a detailed accounting of how the attribution factors are determined from the survey responses.

Timing

The timing attribution, A_T, is determined from the first set of attribution survey questions. These questions are used to determine whether or not Focus accelerated implementation of a measure or caused it to be implemented before it would have been without the program. The two relevant questions are DAT1a and DAT1b.

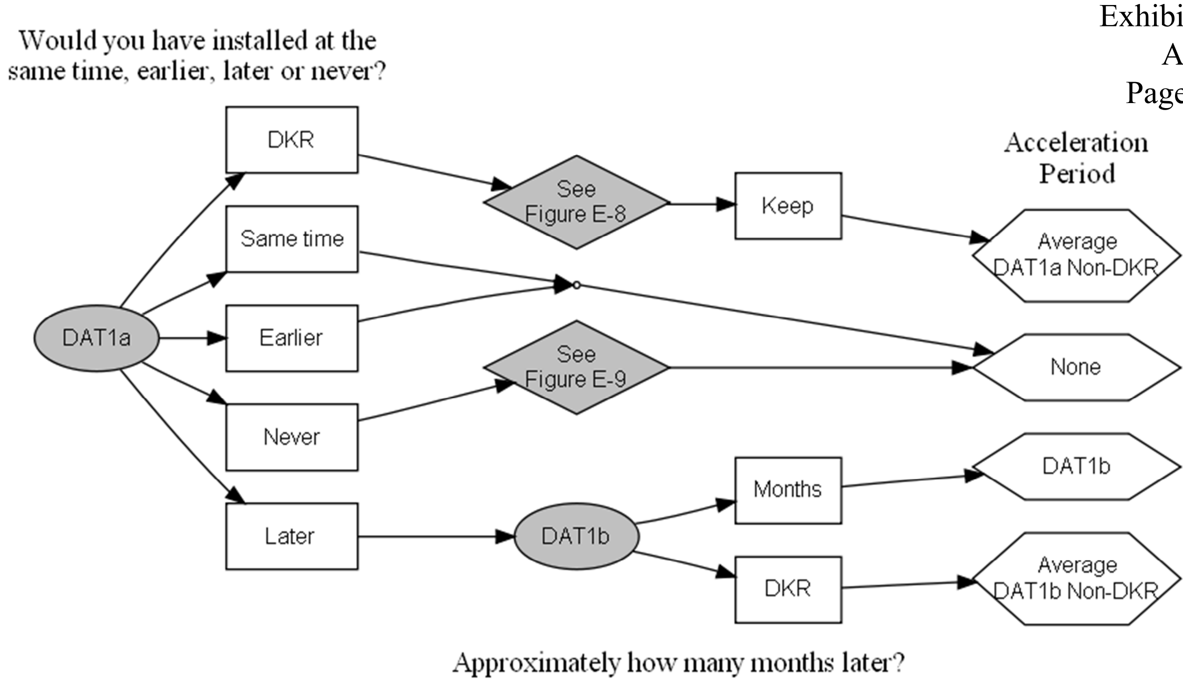
DAT1a: "Without Focus on Energy, would you have installed <measure> at the same time, earlier, later, or never?"
DAT1b: "Approximately how many months later?" (DAT1b is only asked if DAT1a is "Later.")

Note that these questions ask about the timing of installing equipment, not installation of efficient equipment in particular. For example, if the measure was replacement of a high-efficiency boiler, the question asks when the boiler would have been replaced without Focus. Engineers conducting the interviews are trained to ensure clarity for these questions. Future refinements of the questionnaire will explore further improvements to the accuracy of the timing reports.

Determination of the Acceleration Period

Figure E-5 shows a decision tree for DAT1a and DAT1b. In the decision tree, "DKR" refers to "Don't Know" and "Refused."

Figure E-5. Decision Tree for the Acceleration Period



The measure is considered accelerated if the respondent indicates that the measure would have been installed less than four years later without the influence of Focus. The acceleration period is determined based on the answer to DAT1b. If the respondent is unable to answer DAT1b, the measure is assigned the average acceleration period across all accelerated measures in the same measure group.

If the respondent answers DAT1a with Earlier or Same Time then there is no acceleration period. If the respondent answers DAT1a with Never and the Quantity and Efficiency sections apply to the measure then the survey skips to the next section and there is no acceleration period. If the respondent answers DAT1a with Don't Know or Refused but does provide answers to inform the Quantity and Efficiency Attributions then the measure is assigned the average Acceleration Attribution for all measures in the same measure group.

Efficiency

Efficiency Attribution, A_E, gives the program credit for increasing the efficiency of a measure above what would have been installed in the absence of the program. The two relevant questions are DAT2a and DAT2b.

> DAT2a: "Without Focus on Energy, would you have installed <measure> of the same efficiency as what you installed, lower efficiency, or higher efficiency?"

DAT2b: "Without Focus on Energy, would you have installed <measure> that was "standard efficiency on the market at that time," "slightly higher than standard efficiency," "between standard efficiency and the efficiency that you installed," or "slightly lower than the high efficiency that was installed?" (DAT2b is only asked if DAT2a is "Lesser.")

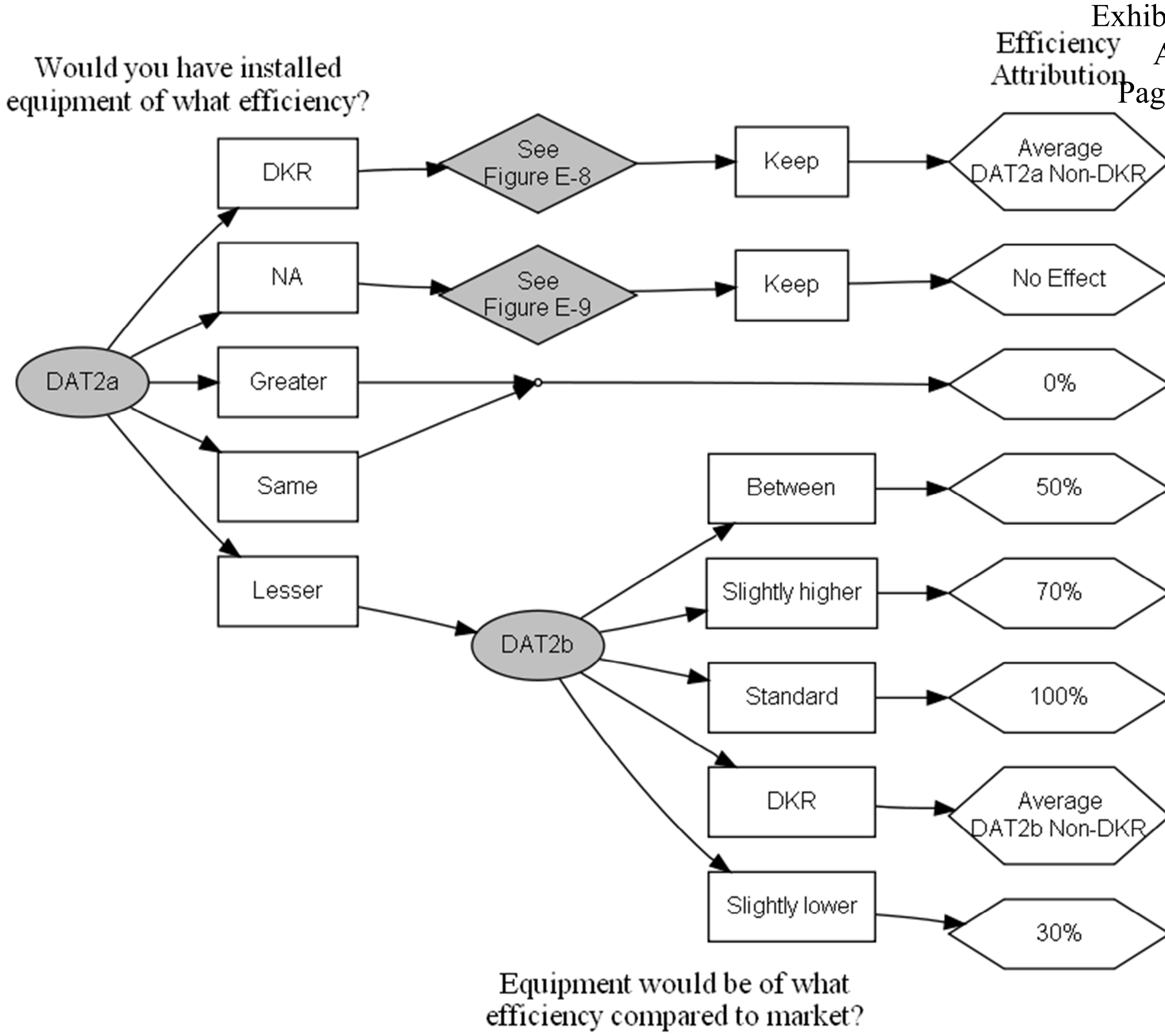
The program receives nonzero Efficiency Attribution if the respondent indicates that they would have installed a less efficient measure without the influence of Focus. The magnitude of the Efficiency Attribution is determined based on the answer to DAT2b, as shown in Table E-2. Figure E-6 shows the corresponding decision tree for DAT2a and DAT2b.

Table 0E-2. Efficiency Attribution Assignments

Efficiency That Would Have Been Installed without Focus		
Coarse Cut (DAT2a)	**Finer Cut (DAT2b)**	**Efficiency Attribution**
Same	NA	0%
Lower	Standard efficiency or according to code	100%
	Slightly higher than standard efficiency	70%
	Between standard efficiency and the efficiency that was installed	50%
	Slightly lower than the high efficiency that was installed	30%
	Don't know/refused	Average of above cases for measure group
Higher	NA	0%
Don't know/refused	NA	Average of all respondents for measure group

If the respondent answers DAT2a with Greater or Same then the survey skips to the next section and there is zero Efficiency Attribution. If efficiency is not applicable to this measure but quantity is applicable and the measure would have been installed anyway then the survey skips to the next section and the Efficiency Attribution will not affect the Simple Program Attribution. If the respondent answers DAT2a with Don't Know or Refused but does provide answers to inform the Quantity Attribution and Acceleration Period then the measure is assigned the average Efficiency Attribution for all measures in the same measure group.

Figure 0E-6. Decision Tree for Efficiency Attribution



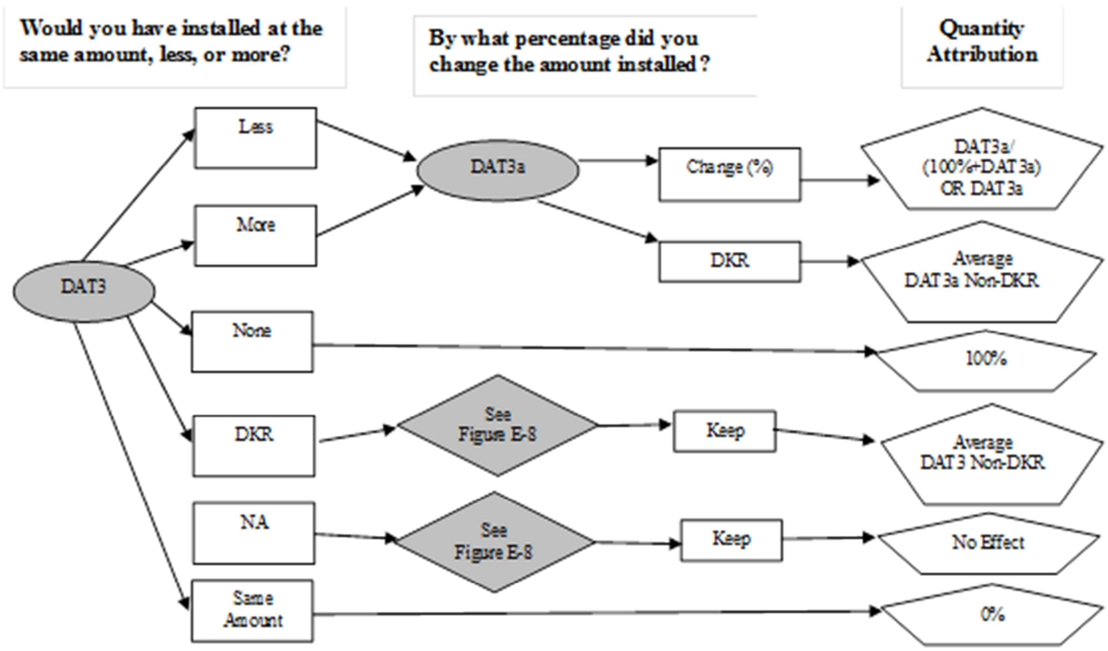
Quantity

Quantity Attribution, A_Q, gives the program credit for increasing the quantity of a measure above what would have been installed in the absence of the program. The two relevant questions are DAT3 and DAT3a.

> DAT3: “Without Focus on Energy, how different would the <number/size> of the <equipment type> have been? Would you say you would have installed the same amount, less, more, or not have installed anything?”
>
> DAT3a: “By what percentage did you change the amount of <equipment type> installed because of the Focus on Energy Program?” (DAT3a is only asked if DAT3 is “Less” or “More.”)

Figure E-7 shows a decision tree for DAT3 and DAT3a.

Figure 0-7. Decision Tree for Quantity Attribution



The program receives Quantity Attribution if the respondent indicates that they would have installed a smaller measure without the influence of Focus. The program also receives Quantity Attribution if the respondent indicates that they would have installed a larger measure without the influence of Focus. In these situations, we assume that the program was able to “right-size” the system resulting in greater and attributable energy savings. If the respondent would have installed a smaller measure without Focus then the Quantity Attribution is

$$A_Q = \text{Inc} / (\text{Inc} + 100\%)$$

where

Inc = percentage change in quantity because of Focus.

If the respondent would have installed a larger measure without Focus, then the Quantity Attribution is

$$A_Q = \text{Inc}.$$

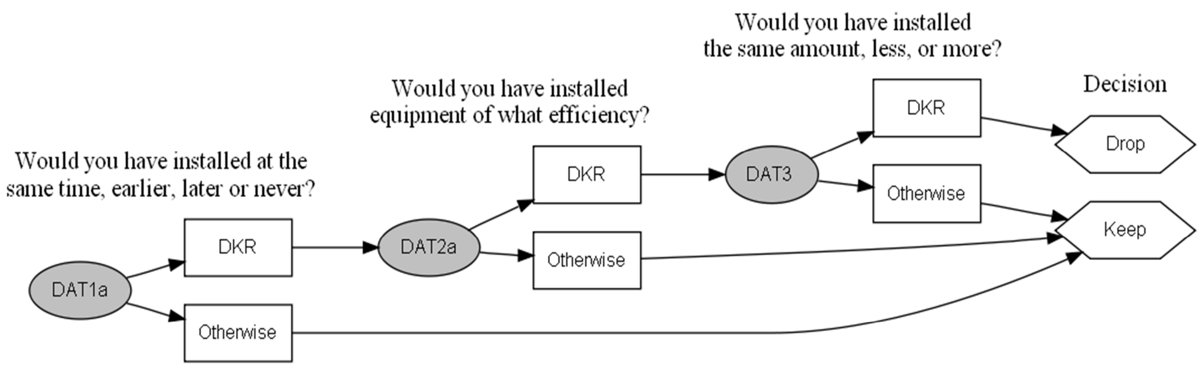
If the respondent answers DAT3 with Same Amount or None then the survey skips to the next section and there is zero Quantity Attribution. If quantity is not applicable to this measure but efficiency is applicable and the measure would have been installed anyway then the survey skips to the next section and the Quantity Attribution will not affect the Simple Program Attribution. If the respondent answers DAT3 or DAT3a with Don’t Know or Refused but does provide answers to inform the Efficiency Attribution and

Acceleration Period then the measure is assigned the average Quantity Effect for all measures in the same measure group.

What if they Don't Know or Refuse?

Some respondents are unable or unwilling to answer the relevant questions in the survey attribution sequence. If a participant is unable or unwilling to answer any of the attribution questions then the participant is dropped from the attribution analysis. However, the respondent information will still be included as part of the installation rate and the VGI. Figure E-8 shows a decision tree that indicates the relationship between the question responses and how they affect the attribution. If a measure goes to the "Keep" decision then the ultimate resolution of each effect is shown in Figures E-5, E-6, and E-7.

Figure 0E-8. NTG Case Retention Decision Tree for Don't Know/Refused

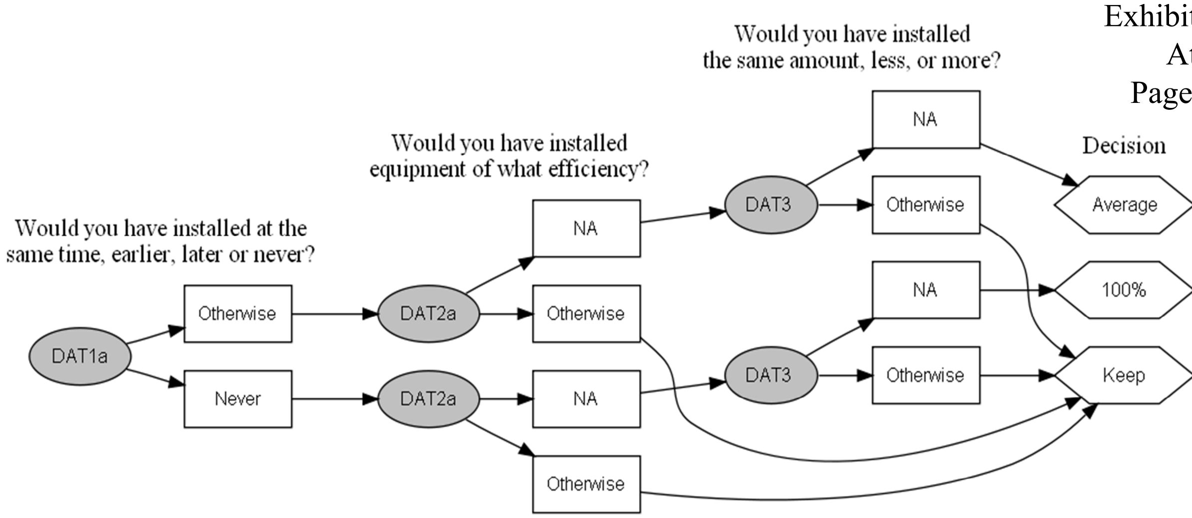


When Efficiency and Quantity Don't Apply

Quantity and efficiency questions do not apply to all measures. Efficiency questions do not apply if the equipment type is inherently an efficiency improvement; that is, the "standard efficiency" baseline would be not to install anything. Variable frequency drives (VFDs) or heat recovery systems are examples. Quantity questions do not apply when varying quantity or size do not make sense in the context of the measure.

Figure E-9 shows a decision tree that indicates the relationship between the question responses and how they affect attribution. If a respondent indicates that a measure would never have been installed without the program and the DAT2a and DAT3 questions do not apply then the attribution is 100%. If the respondent would have installed the project at the same time, earlier, or later and the DAT2a and DAT3 questions do not apply then the measure is assigned the average savings-weighted attribution across all measures in that measure group.

Figure 0E-9. Decision Tree for Not Applicable



Incorporating Supplier Effect

KEMA currently has two methods for determining when a supplier survey is necessary to supplement the participant survey. They are:

- **Program attribution assignment.** At the beginning of each impact evaluation, we send the Focus on Energy sectors a spreadsheet listing each participant in our CATI and engineering samples. We ask them to categorize each measure into one of four bins. If the sector indicates that there was no energy advisor involvement with a particular measure then we complete a survey with both the supplier and participant for those particular measures.
- **Post-participant engineering survey analysis.** Each survey completed with a participant in our engineering sample is reviewed to determine the effect the supplier had on the participant's decision to install a given measure relative to the program's effect. If a participant indicates that the program did not have an effect on their decision to install high efficiency equipment but the supplier had substantial influence then we will complete a survey with the supplier.

For measures with both participant surveys and supplier surveys, the analysis will produce two separate attribution values. The first reflects the influence that Focus on Energy had on the participant's decision to install the measure. The second reflects the influence that Focus on Energy had on the vendor's business practices and therefore their ability to sell the measure. We choose the higher of the two values as the final program attribution for that measure. That is, if either the supplier or the customer indicates that Focus influenced the decision to install the measure, we conclude that Focus influenced the decision.

Ratio Expansion—Sample to Population Results

This appendix provides the ratio estimation computation KEMA employed to develop estimates of evaluation verified gross and net impacts.

Ratio Estimation

KEMA used the statistical procedure of ratio estimation to develop estimates of evaluation verified gross and net impacts. There are two basic steps in the process. The first step is to verify energy savings in a sample of measures. KEMA accomplished this first step via engineering reviews, customer interviews, supplier interviews, and on-site visits. The second step is to expand the sample results to the population of measures. This is accomplished by calculating the ratios of verified-to-reported and attributable-to-verified for the sample[8]. The ratios are also referred to in this analysis as adjustment factors. The adjustment factors estimated from the data collection and analysis include:

- **Gross savings adjustment factor.** This factor combines the installation rate and the engineering verification factor. It corresponds to the ratio of the verified gross savings to the tracking estimate of savings.
- **Attribution factors.** This factor adjusts verified gross savings for program attribution. It is the estimated proportion of verified gross savings attributable to the Focus Business Programs. It corresponds to the ratio of net savings to verified gross savings.
- **Realization rate.** This factor combines the gross savings adjustment factor and the attribution factor. It corresponds to the ratio of the net savings to the tracking estimate of savings.

Expansion of sample results to the population via ratio analysis

The calculation of the adjustment factors for tracking system gross and net savings uses appropriate weights corresponding to the sampling rate. The three primary adjustment factors are the installation rate, the engineering verification factor, and the attribution factor. Each of these is calculated as a ratio estimator over the sample of interest (Cochran, 1977, p.165). The formulas for these factors are given below.

Notation: The following terms are used in calculating the adjustment factors:

G_{Tj} = tracking estimate of gross savings for measure j
G_{Ij} = tracking estimate of gross savings for measure j, adjusted for non-installation
G_{Vj} = verified gross savings for measure j

[8] The results of the *Participant Spillover Savings Study* (December 22, 2005) are added to the ratios prior to application to the population. Untracked attributable savings resulting from the Impact Evaluation of the Education and Training program and the CY09 Supply-side Study are then added to the population net savings. Unlike the added spillover savings, the untracked attributable savings are not included in the adjustment factors.

N_{Vj} = net savings determined from the engineering and CATI surveys.
w_{Aj} = weighting factor for measure j used to expand the combined engineering and CATI sample to the full population

Installation rate

The installation rate R_I is calculated using the combined engineering and CATI samples as

$$R_I = \frac{\sum_{j\varepsilon A} G_{Ij} w_{Aj}}{\sum_{j\varepsilon A} G_{Tj} w_{Aj}}.$$

Engineering verification factor

The engineering verification factor R_V is calculated from the engineering and CATI samples as

$$R_v = \frac{\sum_{j\varepsilon A} G_{Vj} w_{Aj}}{\sum_{j\varepsilon A} G_{Ij} w_{Aj}}.$$

Attribution factor

The attribution factor R_{FR} uses data from both the engineering and CATI samples:

$$R_{FR} = \frac{\sum_{j\varepsilon A} N_{Vj} w_{Aj}}{\sum_{j\varepsilon A} G_{Vj} w_{Aj}}.$$

Standard errors

The ratio estimator is calculated using a SAS® macro provided by SAS for ratio estimation by domains. The procedure also returns the standard error of the estimate. The standard error is calculated using two methods.

The first method recognizes the sample as drawn from a finite population: the measures completed within the analysis period with associated energy impacts in the program-tracking database. This calculation uses the Finite Population Correction (FPC) factor. This factor is a reduction to the calculated variance that accounts for the fact that a relatively large fraction of the population of interest has been observed directly and is not subject to uncertainty. It is appropriate to apply precision statistics, such as confidence intervals, based on the standard error calculated in this manner when quantifying the results of the program during the study period only.

The second calculation treats the population of interest as essentially infinite. Thus, the measures completed to date and the sample selected from them is regarded as random instances of a virtually infinite number of measures that could have been completed under the program. In this case, the FPC is not included. It is appropriate to apply standard errors calculated in this manner when applying the verification factors developed from this study to tracked savings from other years to estimate verified savings in those years.

Gross verification factor and overall realization rate

The gross verification factor is the ratio of verified gross to tracking estimate of gross savings. This factor is calculated by chaining together the installation rate and the engineering verification factor:

$$R_G = R_I R_V \qquad = \left[\frac{\sum_{j\varepsilon A} G_{Ij} w_{Aj}}{\sum_{j\varepsilon A} G_{Tj} w_{Aj}}\right]\left[\frac{\sum_{j\varepsilon A} N_{Vj} w_{Aj}}{\sum_{j\varepsilon A} G_{Vj} w_{Aj}}\right].$$

This is an example of a chained ratio estimator using a nested sample. The standard error for the chained ratio is approximated by the formula

$$\mathrm{SE}(\mathrm{AB}) \simeq \mathrm{AB}\sqrt{\left[\left(\frac{\mathrm{SE(A)}}{\mathrm{A}}\right)^2 + \left(\frac{\mathrm{SE(B)}}{\mathrm{B}}\right)^2\right]}.$$

(This formula overstates the standard error, because it ignores the correlation between the numerator of R_I and the denominator of R_V, which reduces the variance of the product.)

Likewise, the overall realization rate is calculated by chaining together the gross verification factor with the attribution factor. The same approximation formula allows (an over-estimate of) the standard error of the realization rate to be calculated from the two separate standard errors.

Measurement of NTG Factors for Ontario's Natural Gas Custom C&I DSM Programs

Kickoff Meeting

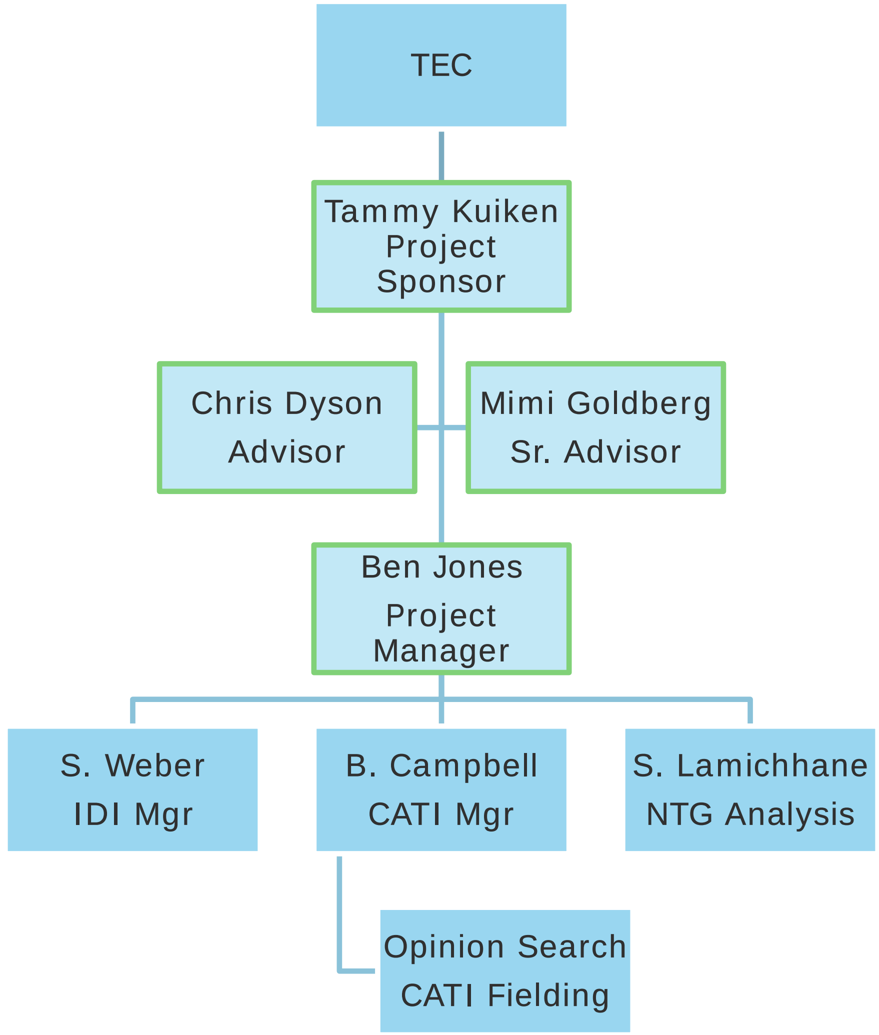
March 20, 2014

Agenda

- Introductions
- Review evaluation plan
- TEC stakeholder perspectives
  - Concerns
  - Defining success
- Project logistics and protocols
- Next steps
- Contract administration

Project Organization

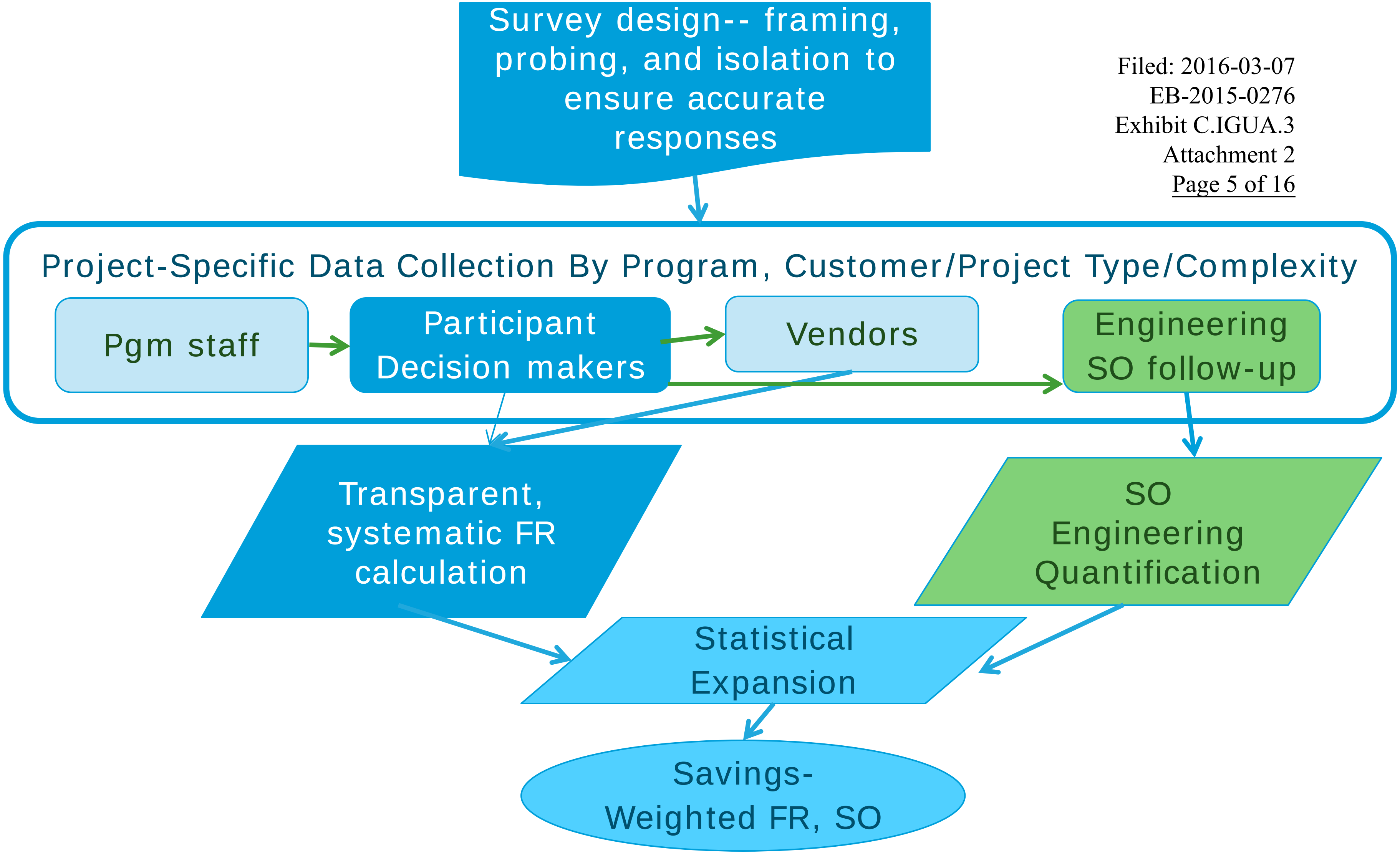
Filed: 2016-03-07
EB-2015-0276
Exhibit C.IGUA.3
Attachment 2
Page 3 of 16



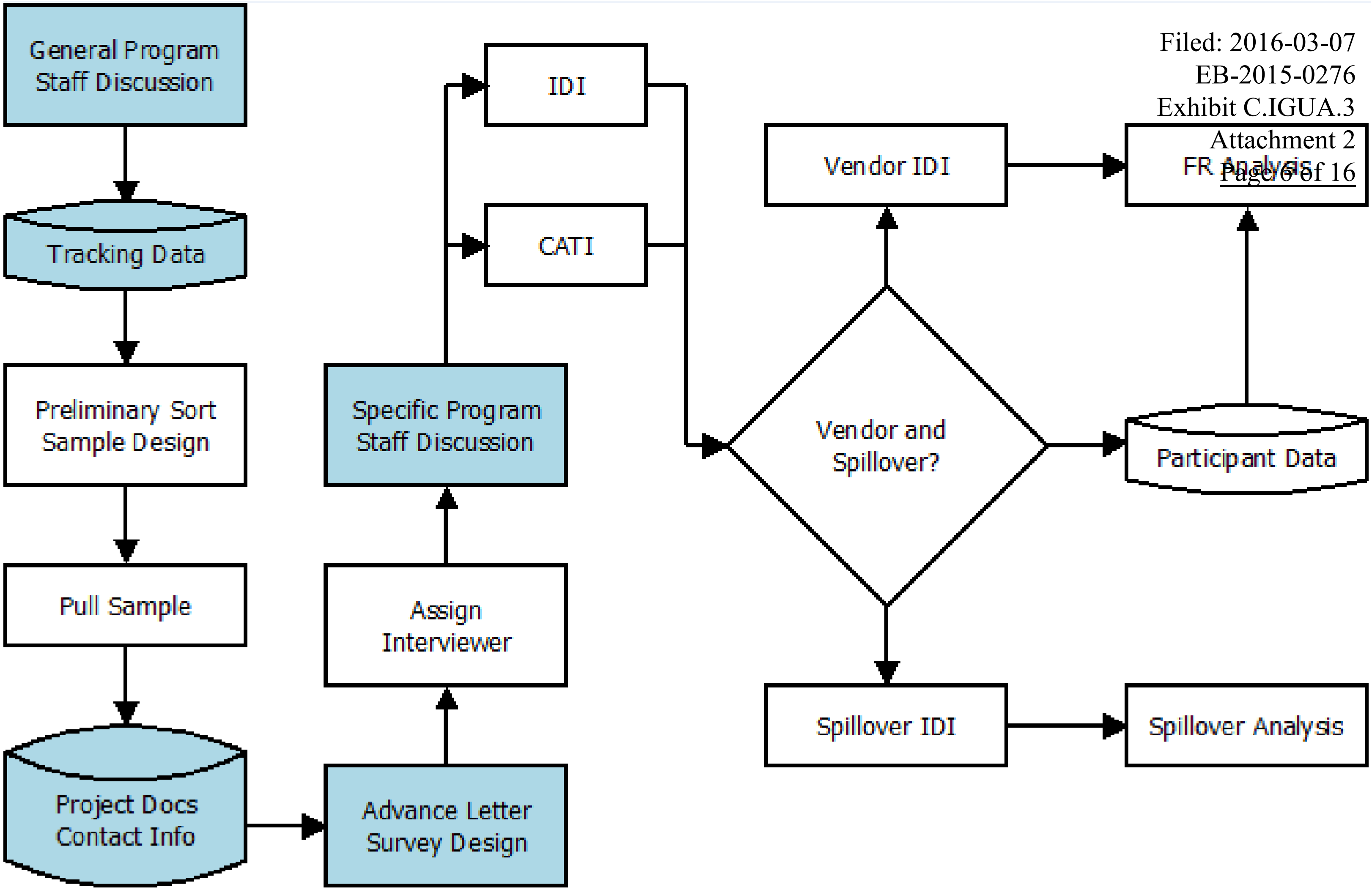
Review of Evaluation Plan

- Goal:
  - Net-to-Gross ratios for future program impacts based on past program participant experiences
- Primary Methods
  - Self-report surveys/interviews with samples of program participants and vendors
  - Statistical technique of ratio estimation to expand to population
- Unique Challenges
  - Multiple perspectives on TEC
  - Multiple utilities (2) and programs (11)
  - Spillover is difficult to detect and quantify
  - Applicability of results to new 2013 programs
  - Capturing efficiency attribution appropriate to baselines used for gross savings

Approach Overview: Self-Reported Actions without Program



Survey Logistics and Schedule



Data Collection Staging

Net-to-Gross Modules	2011 Participants	2012 Participants	2013 Participants
Free Ridership	√* (too long ago)	√	√ (Lg Indl Starts)
Spillover	√	√	(too soon)

*used to inform the spillover analysis only, not for core free ridership

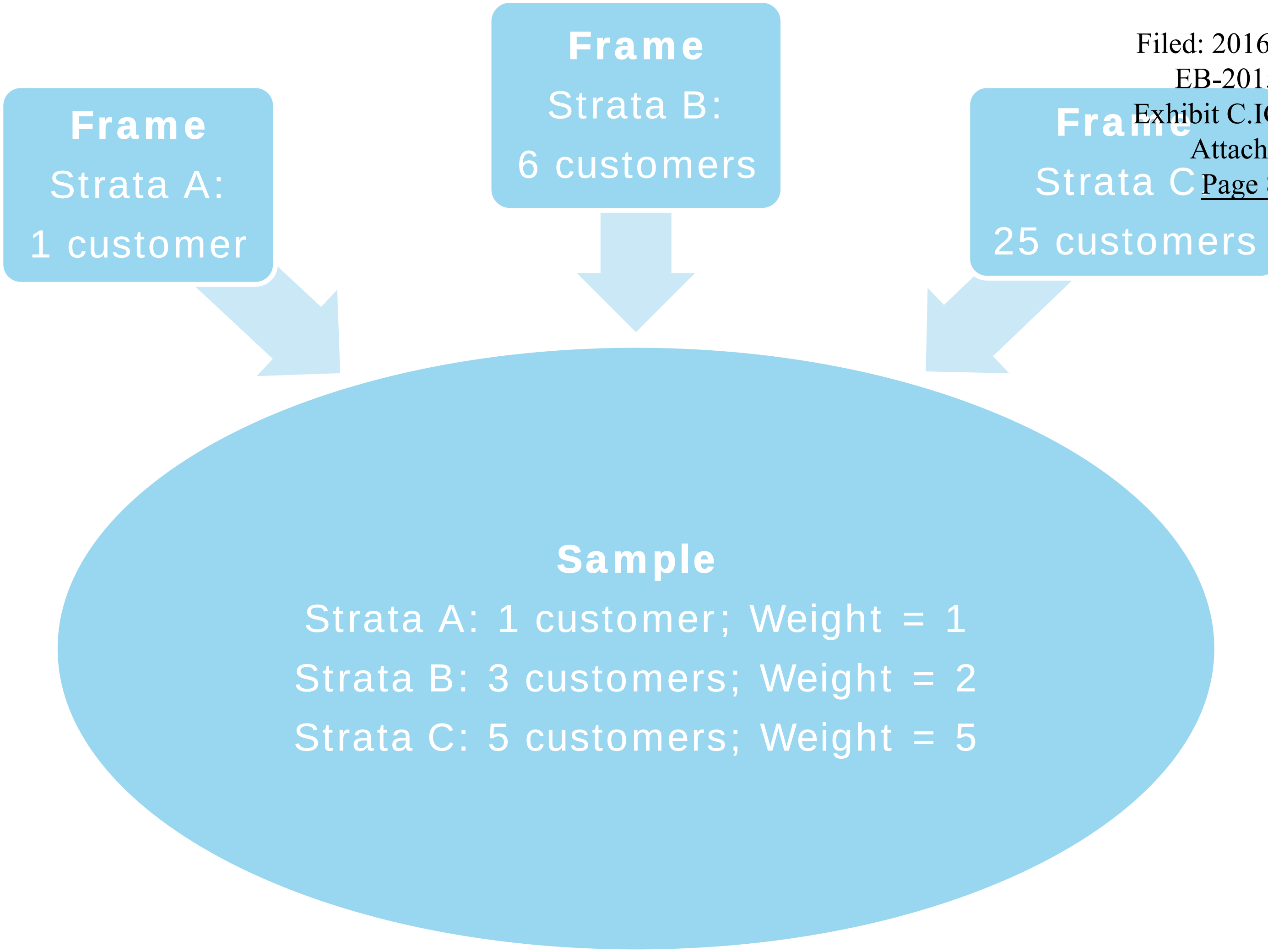
New Large Industrial Rate:

SO from 2011-12 for 2013-program-eligible customers applies to the new program IF

New program has similar controls & management to general custom program.

Otherwise need direct SO study for this program in 2014-15.

Free Ridership Analysis – Sample Weight



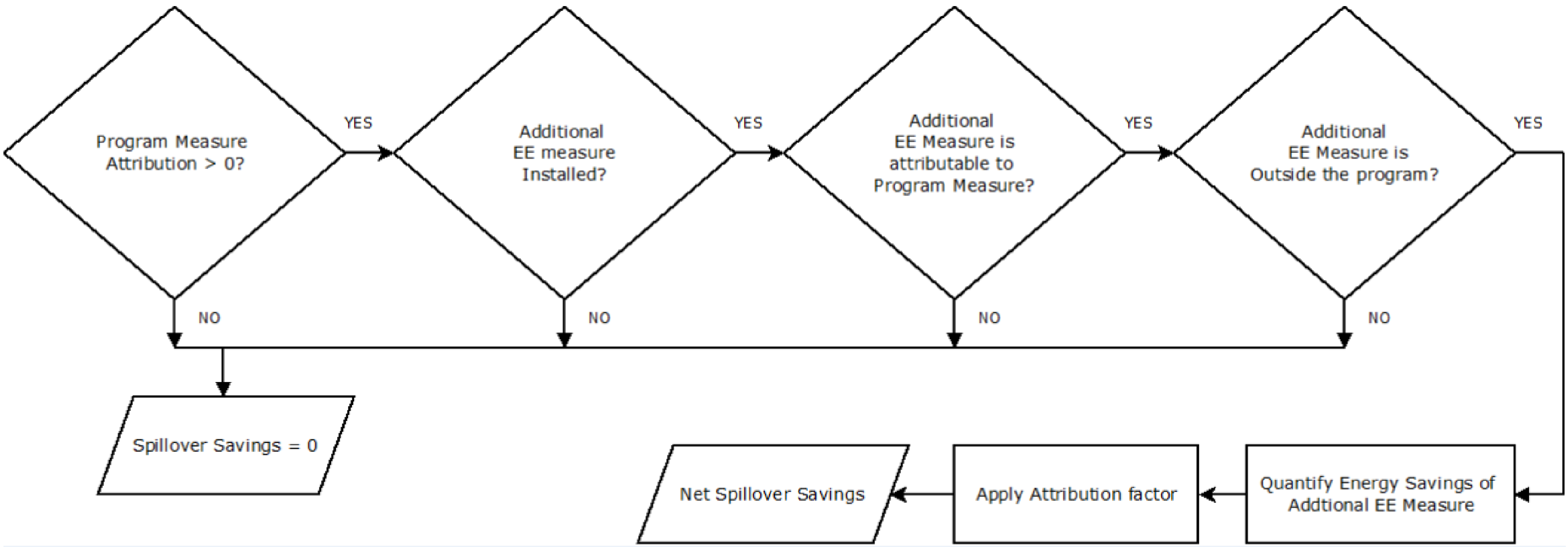
Free Ridership Analysis – Savings Weight

Strata	Cust	Wgt	Trk Svgs	Wgt Trk Svgs	NTG	Net Svgs	Wtd Net Svgs
A	a	1	580,367	580,367	95%	551,349	551,349
B	b	2	56,738	113,476	62%	35,178	70,355
B	c	2	30,632	61,264	15%	4,595	9,190
B	d	2	75,196	150,392	26%	19,551	39,102
C	e	5	4,792	23,960	9%	431	2,155
C	f	5	9,592	47,960	57%	5,467	27,335
C	g	5	3,687	18,435	0%	0	0
C	h	5	2,759	13,795	43%	1,186	5,930
C	i	5	974	4,870	32%	312	1,560
SUM				1,014,519			706,979
RATIO							70%

Participant Spillover Analysis

- Spillover types
  - Inside vs. outside
  - Like vs. unlike
  - Gas savings vs. other fuels

- Expansion similar to free ridership expansion.
  - 3 year backward looking
  - Details to be proposed in work plan.



DNV·GL

TEC Stakeholder Perspectives

- Please introduce yourself
- Who do you represent?
- What are the key issues, concerns and objectives for you and those you represent?
- What does success look like to you?

Project Logistics and Protocols

- Project points of contact
- Customer contact protocols
  - Advance letters
  - Surveys/interviews
- Review process and timelines
- Data security and handling
- Regular communication
  - Monthly status report
  - Teleconference every other month
- Final products

Survey Logistics and Schedule

Month	Task	TEC / Staff Task
March	General program staff interviews	Interviews
March	Request tracking data	Data
Apr-May	Sample stratification and pull	Review Plan
May	Program documentation/Contact Info	Data, verify contacts
Apr-May	Write survey, advance letter & send	Review guides
May	Assign collection method and interviewer	
May	Project-specific utility staff interviews	Interviews
June	Participant CATI and IDI	
July	Vendor and SO IDI (where neccessary)	
August	FR and SO analysis	Review memo
Sept	Draft report	Review
October	Final report and presentation	

Proposed Review Approach

- Major deliverables
  - 2 weeks for TEC/Program review of report or plan
  - Discussion as needed
  - 2 weeks for DNV GL response
    - Response matrix
    - Final document
- Instruments/Letters
  - 1 week for TEC/Program review
  - 1 week for DNV GL response
    - No response matrix
    - Final instrument

Next Steps

- Resolution process for parking lot items
- Review action items
- Contract(s)
- Summary memo
- Scheduling program staff interviews
- Data request(s)
- Next meeting

Thank you for your time.

Ben Jones
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SAFER, SMARTER, GREENER

Memo to: **Date:** July 2, 2014

Bob Wirtshafter, Independent Member
Ted Kesik, Independent Member
Chris Neme, Green Energy Coalition
Jay Shepherd, School Energy Coalition
Julie Girvan, Consumers Council of Canada
Ravi Sigurdson, Enbridge Gas
Marc Hull-Jacquin, Enbridge Gas
Tina Nicholson, Union Gas
Meredith Lamb, Union Gas

Copy: **Prep. by:** Ben Jones, DNV GL

Mimi Goldberg, DNV GL
Tammy Kuiken, DNV GL

1 INTRODUCTION

This memo explains the difference between the two DNV GL proposed calculation methodologies for the upcoming Ontario NTG study. The first method, referred to as "Year One Net Savings" (Y1NS) has been employed for over a decade in NTG studies across the United States, including CA and WI. The second method referred to as "Lifecycle Net Savings" (LCNS) is a 2008 update to the Y1NS method. The LCNS has been used in Net to Gross evaluations in both WI (2 years) and MI (5 years). The LCNS more accurately reflects the net to gross over the lifetime of the measure and program by taking into account both how long the measure would be in use as well as the greater savings that result in early years from measures that were accelerated by the program; however more data is required to execute the LCNS than the Y1NS.

The foundation of both the Y1NS and the LCNS methodologies is that energy savings attributable to the program is a function of three changes the program may have made to what was implemented:

- Change to the efficiency of equipment installed, Δ efficiency
- Change to the quantity or size of equipment installed, Δ size
- Change to the timing of when the equipment was installed, Δ timing

It is due to this shared foundation that both methodologies can use the same survey question sequence and start from the same basic scoring approach. The survey asks the program participant about the three aspects of the decision to install the equipment: how the program affected the timing, efficiency and size or quantity of the equipment installed.

First, we consider the "simple program attribution," ignoring the timing factor. From the survey information we determine

FR_e = "efficiency-only free ridership"
= the fraction of the gross savings per unit that would have happened without the program
FR_q = "quantity-only free ridership"
= the fraction of the quantity installed that would have been installed without the program.

The savings that would have occurred without the program is the product of these two.

FR_s = "simple free ridership" = $FR_e\ FR_q$.

The simple program attribution is the complement, or

$$SPA = 1- FR_e\ FR_q$$

For example, suppose that a particular customer on their own would have installed

- only 2/3 the number of units that they did through the program, and
- equipment with unit energy consumption half way between that of the high-efficiency program-rebated equipment and that of the baseline efficiency used for the gross savings.

Then FR_q = 2/3 and FR_e = ½. Thus, the fraction of the savings that would have happened without the program would be

$$FR_s = FR_e\ FR_q = (1/2)\ (2/3) = 1/3 \text{ or } 33\%.$$

$$SPA = 1-FR_s = 2/3$$

That is, the program gets full credit for the 1/3 of units they wouldn't have installed at all. For the other 2/3 of units, the program gets half credit, because the program got them to go to a higher efficiency level. Combining these gives a total of 2/3 credit. The only portion of savings the program doesn't get credit for is the portion for which the program affected neither the quantity nor the efficiency.

Both the LCNS and the Y1NS methods use this Simple Program Attribution (SPA) calculation.

Where the two differ is in how they treat the timing information. That difference in turn requires

1) additional data for the LCNS calculation
2) two different efficiency baselines in savings estimates for accelerated measures in the LCNS calculation.
3) LCNS weights results together based on lifetime savings, while the Y1NS method has typically used first year savings only.

2 DATA REQUIREMENTS

In terms of data needed, the LCNS method requires two pieces of data that the Y1NS method does not:

1) estimated useful life for all of the measures installed, and
2) two energy savings estimates for accelerated measures: the energy savings of the measure using a “versus existing equipment” baseline as well as a “versus standard efficiency on the market” baseline

Measure lives are available through secondary sources if they are not already integrated into program tracking databases.

Energy savings estimates using a “versus existing equipment” baseline specific to a sampled measure are usually only available if gross savings verification is conducted with the LCNS in mind. Estimation of dual baselines can be done based on previous studies, but there are not many applicable sources.

3 DURATION OF ENERGY SAVINGS

The Y1NS method uses an annual savings or “first-year” savings value to weight the measure level attribution to the population.

The LCNS method uses the measure lifetime savings to weight the measure level attribution to the population.

What this means for the results is that the LCNS method increases the relative weight for long life measures in the expanded results versus the Y1NS method.

As discussed in the TEC meeting, measures can be weighted by lifetime savings using either method. The lifetime savings calculation is somewhat more complex with the LCNS method.

4 ESTIMATION OF TIMING[1]

The timing component of attribution is sometimes referred to as acceleration, or advancement. For measures that were not “replace on burnout” or “replace on failure,” the program may induce the participant to install a measure earlier than they would have otherwise.

The estimation of how much credit the program gets for this acceleration is derived directly from survey responses that the participant gives indicating how much earlier they installed the measure than they would have in the absence of the program.

[1] The question of timing credit for service measures (such as tune ups) is outside the scope of this memo.

In our usual analysis framework, four years is the time horizon beyond which we assume the respondent cannot answer with certainty. Anything beyond four years is treated as a “never would have installed” response, rather than an accelerated measure.

In the Y1NS method the participant responses are divided by four years to give a proportional timing credit to the program. Thus, for the portion determined as attributable from the SPA calculation, acceleration by four years (or more) gives full credit to the program; acceleration by 1 year gives 25% credit to the program. This treatment is equivalent to using the reported timing as an indicator of the probability the measure would have been installed without the program.

The LCNS method interprets the reported acceleration (up to four years) as the literal estimate of how much sooner the measure was installed because of the program. The program is given 100% attribution for the duration of the acceleration period because nothing would have been done without the program during this period. For the remainder of the measure life, the SPA factor says how much of the gross annual savings is attributable to the program.

5 DUAL BASELINES[2]

Gross energy savings for a measure are estimated by subtracting the energy usage of the efficient equipment from the energy usage of a “baseline” piece of equipment (Δ efficiency). There is, and has been much discussion in the industry over which baseline to use when, but resolving this discussion is beyond the scope of this study, which focuses only on net to gross.

For the Y1NS method, a single savings estimate is used for each measure, typically using a “versus standard efficiency on the market” baseline (however that is defined in a given jurisdiction).

For the LCNS method two energy savings values are used, the same “versus standard efficiency on the market” baseline as is used in the Y1Ns and, a “versus existing equipment” baseline which typically has greater savings and is only used during the acceleration period. For example, a participant may replace a 40 year old boiler 2 years prior to the planned replacement due to program incentives. For the first two years, the savings realized by the participant should be estimated based on the efficiency of the old equipment that would have been there otherwise. After two years, the participant would have bought a boiler anyway, so the appropriate baseline is the “standard efficiency on the market.”

6 RECOMMENDATION

The LCNS method theoretically provides a more accurate estimate of the net effects of the program, but for this study, without measure specific dual baseline estimates, LCNS is not necessarily any more accurate than the more commonly used Y1NS method. For this reason, DNV GL recommends that the TEC use the Y1NS method for the current study and consider the LCNS method as an option in future studies.

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[2] How the “standard efficiency on the market” is determined is beyond the scope of this study. The NTG approach will adapt to the definition used by the programs.

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit A, Tab 2, page 5.

The free ridership rate of 54% applied to Union's commercial and industrial and large volume programs is based on the *Custom Projects Attribution* study performed by Summit Blue Consulting in 2008.

a) Please file a copy of the 2008 Summit Blue study.

Response:

a) Please see Attachment 1.

Custom Projects Attribution Study

Final

Submitted To:

DSM Evaluation
Union Gas Limited – A Spectra Energy Co.
Enbridge Gas Distribution

October 31, 2008

Submitted to:

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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.

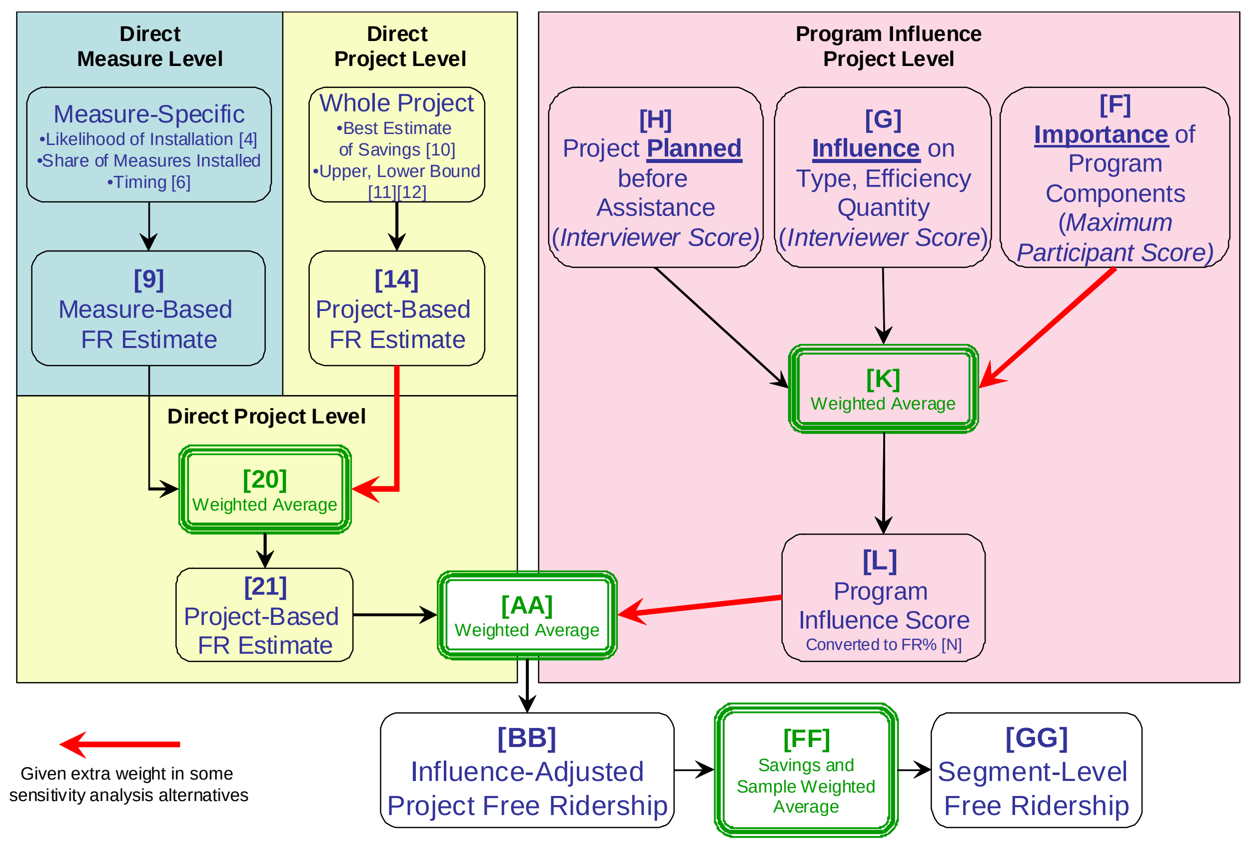
Figure 2-1 presents an overview of the survey and analysis approach. Key points in the diagram are labeled with numbers and letters in square brackets, which we will refer to below. Free ridership was discussed with each respondent in both **direct questions** aimed at obtaining respondent estimates 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.

[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.

[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.

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[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:

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[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

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[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

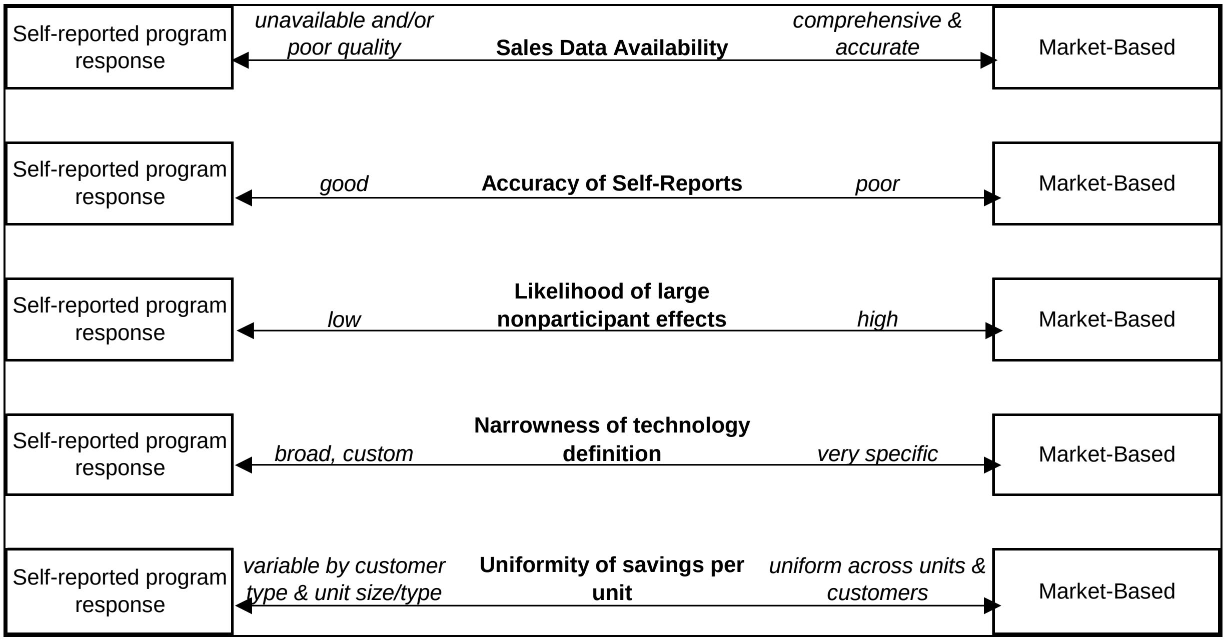
Screening Criteria	Example Screening Questions
Sales Data Availability: The availability of current and baseline market sales data enables estimating free ridership based on such data.	Are current and baseline data readily available? Are the data comprehensive and complete? Able to supplement/overcome 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.

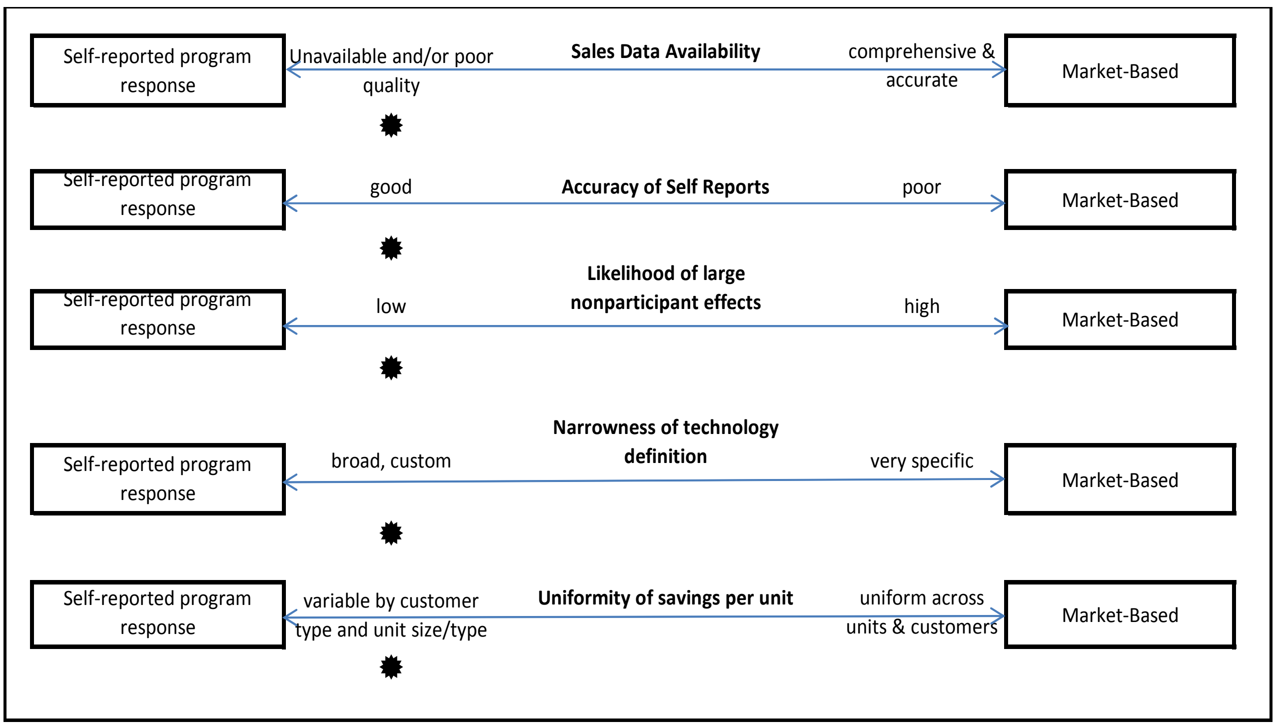
3.3 Best Method to Assess Union-Enbridge Custom Projects Free Riders and Spillover

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

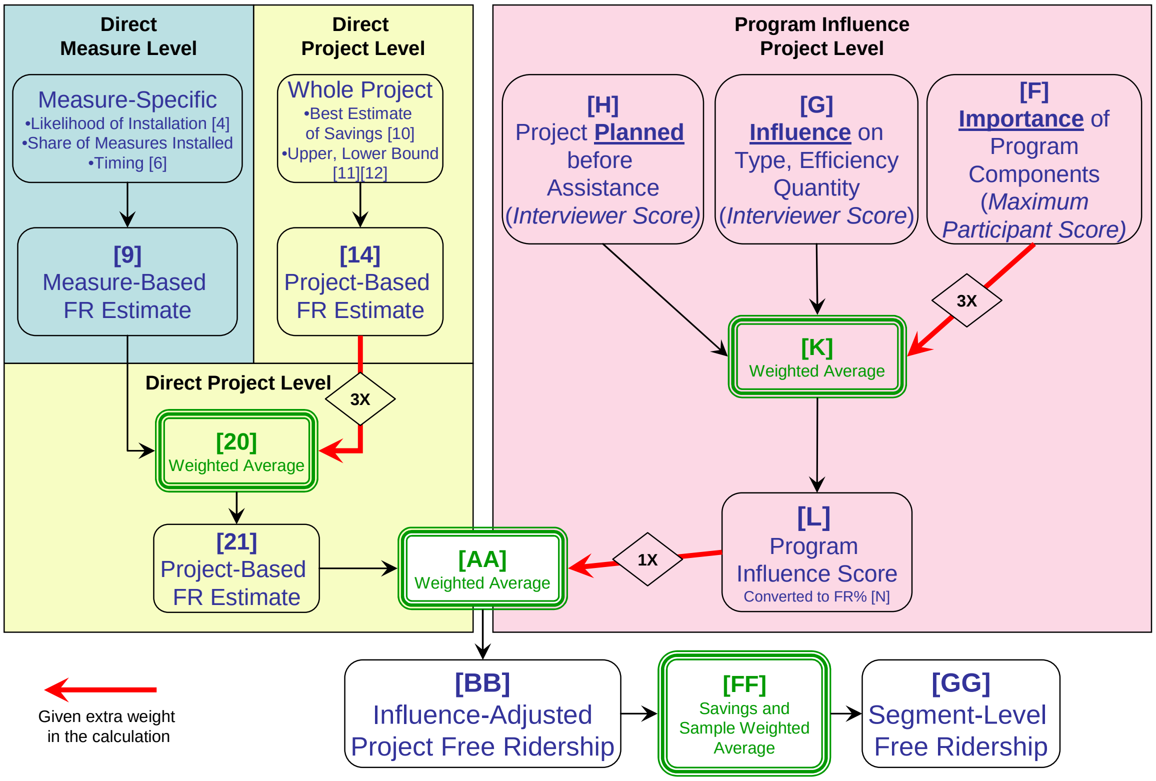
As discussed in the methodology chapter (and in the analysis plan), the calculation of free ridership requires combining answers from several different questions to come up with a single free ridership number for each measure. At several points in the calculation assumptions have to be made about how 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%

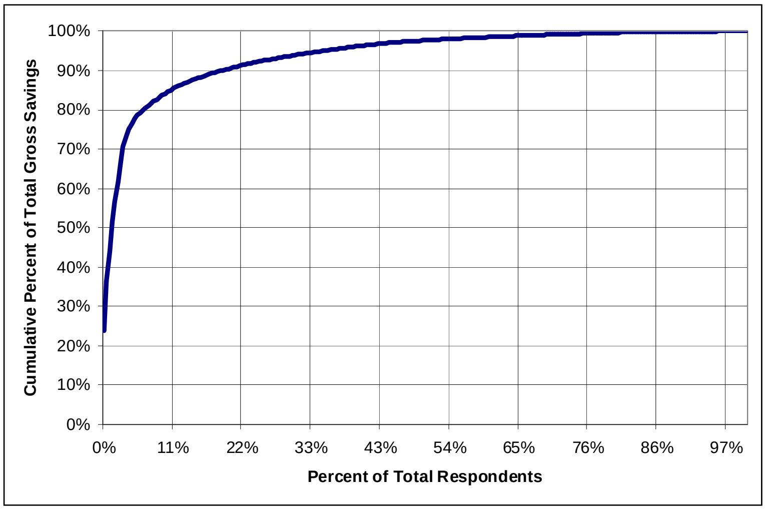
Assumptions (See Figure 2.1 for the interpretation of these assumptions):

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.”

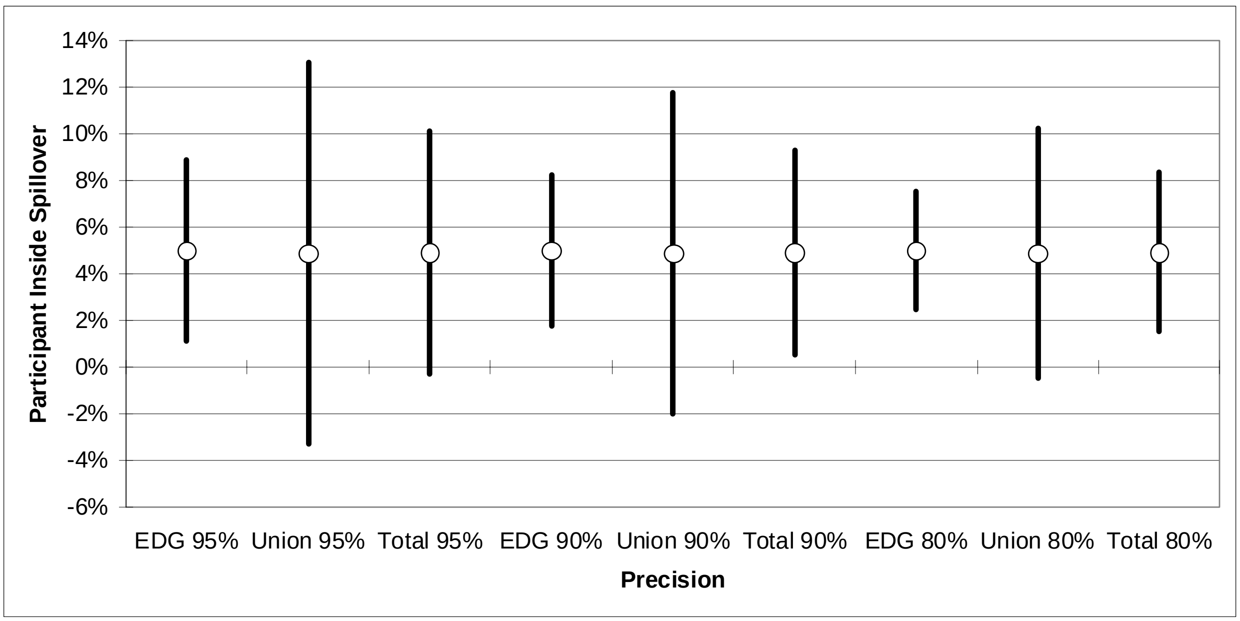
5.2 Spillover Results

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.

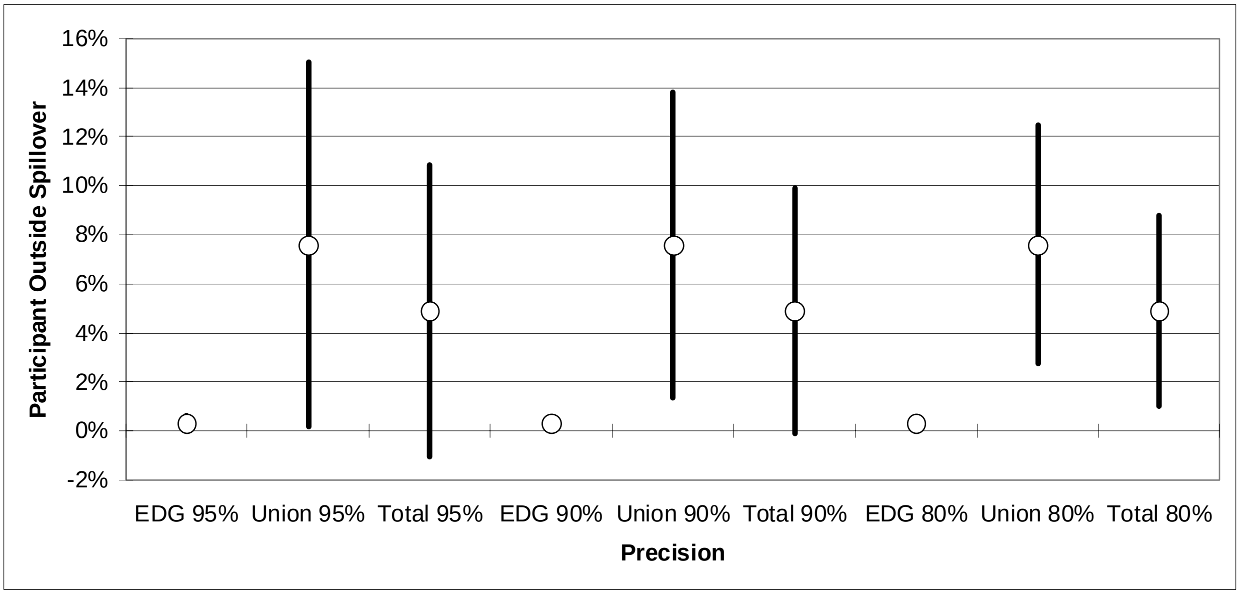
Figure 5-3. Participant Inside Spillover



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?

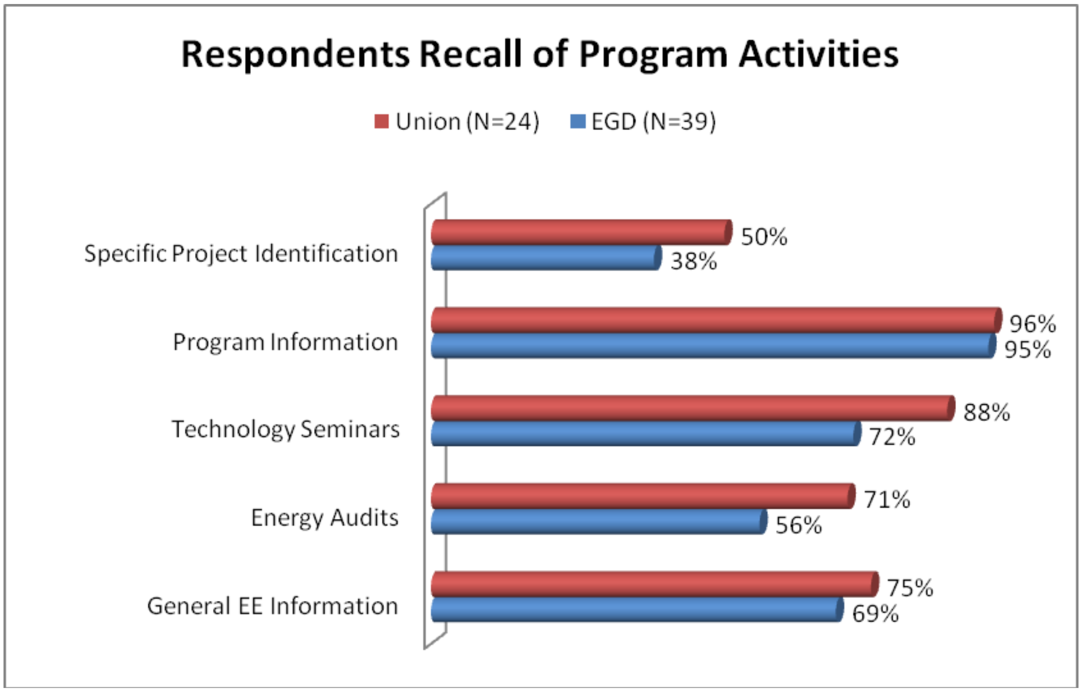
	EGD	Union	Total
EE is now part of their business plan, with a target reduction of 5% annually	0	1	1
Energy wise program has raised awareness of energy efficiency	0	1	1
Greater awareness of need to maintain energy efficiency	0	1	1
Payback has been extended to 5 years	1	0	1
Since the project, the end user 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

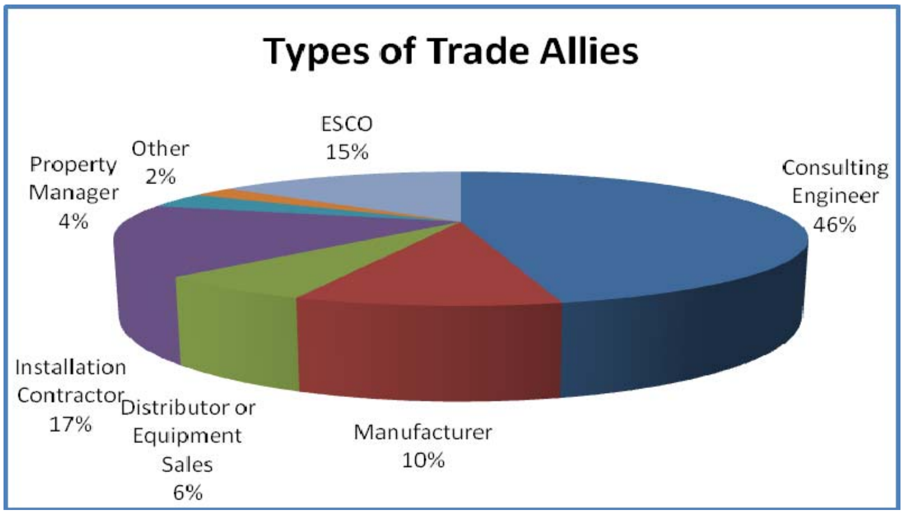
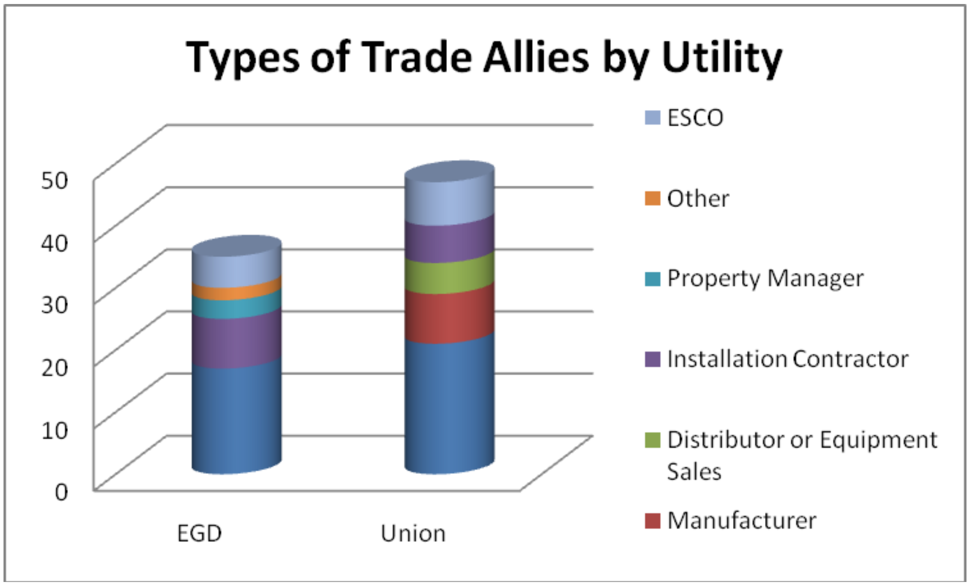
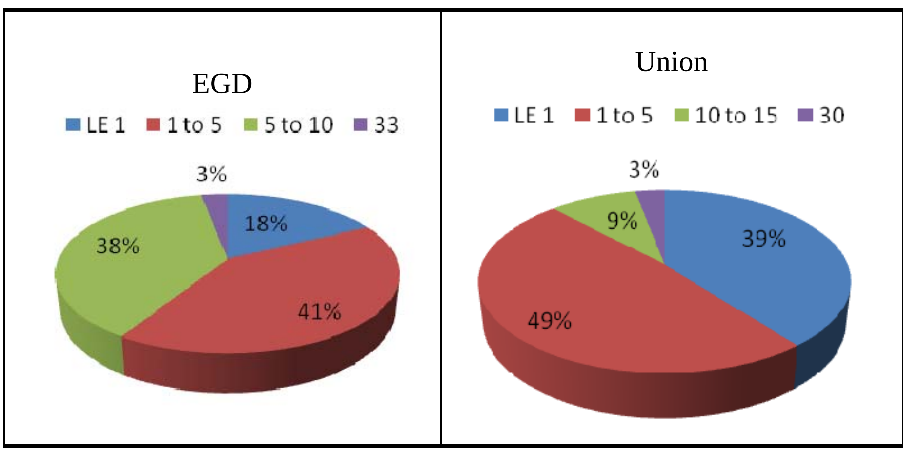


Figure 6-3. Types of Trade Allies by Utility



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

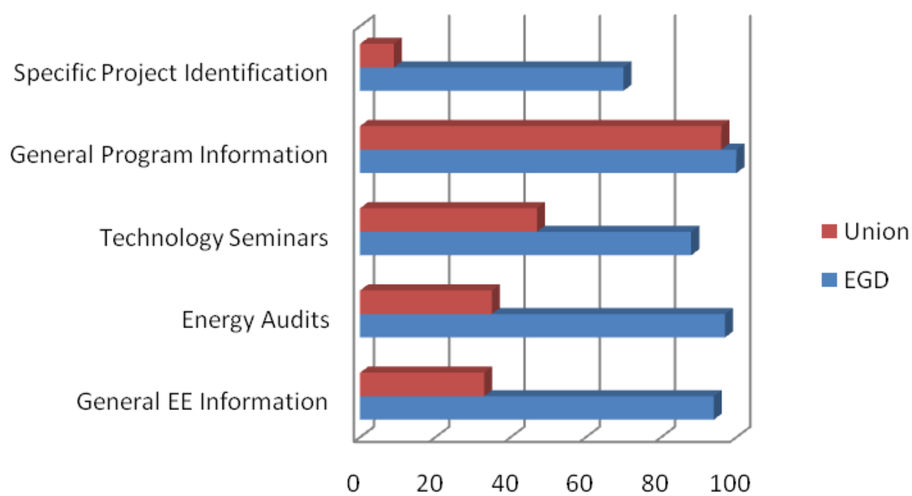
	Yes	Total	%
EGD	34	34	100
Union	27	40	68

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.

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Table of Contents

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 <u>consultants will personally conduct the interviews and most will be done on-site.</u> 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.

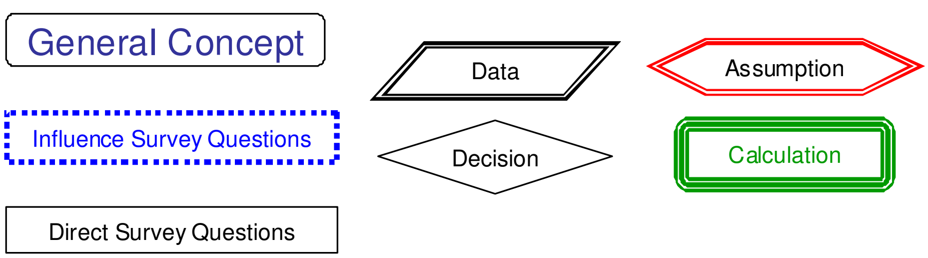
[1] In this study and Analysis Plan, "attribution" is defined as the combined program market influence of free ridership and spillover.

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.

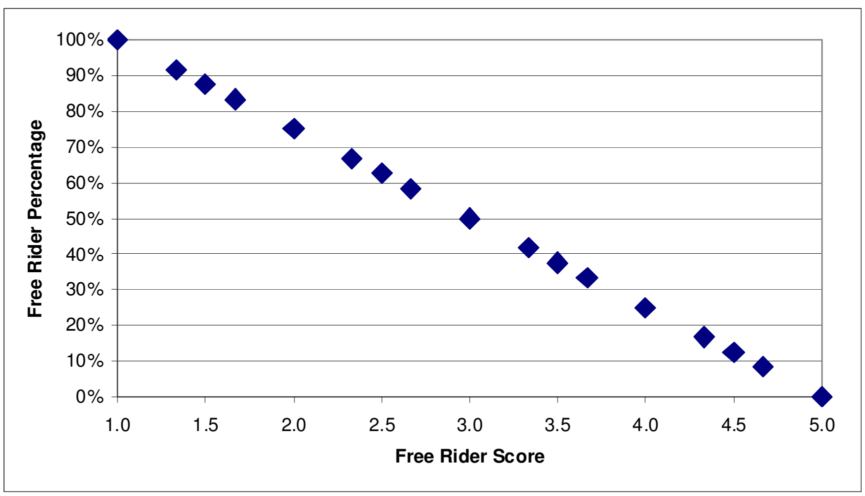
impact, but a higher score for planning indicates lower impact. Therefore, prior to calculating an average score across the three sets of questions, the planning score is inverted so that 1=5, 2=4, etc. In this way, a higher average score across these questions unequivocally represents greater program 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

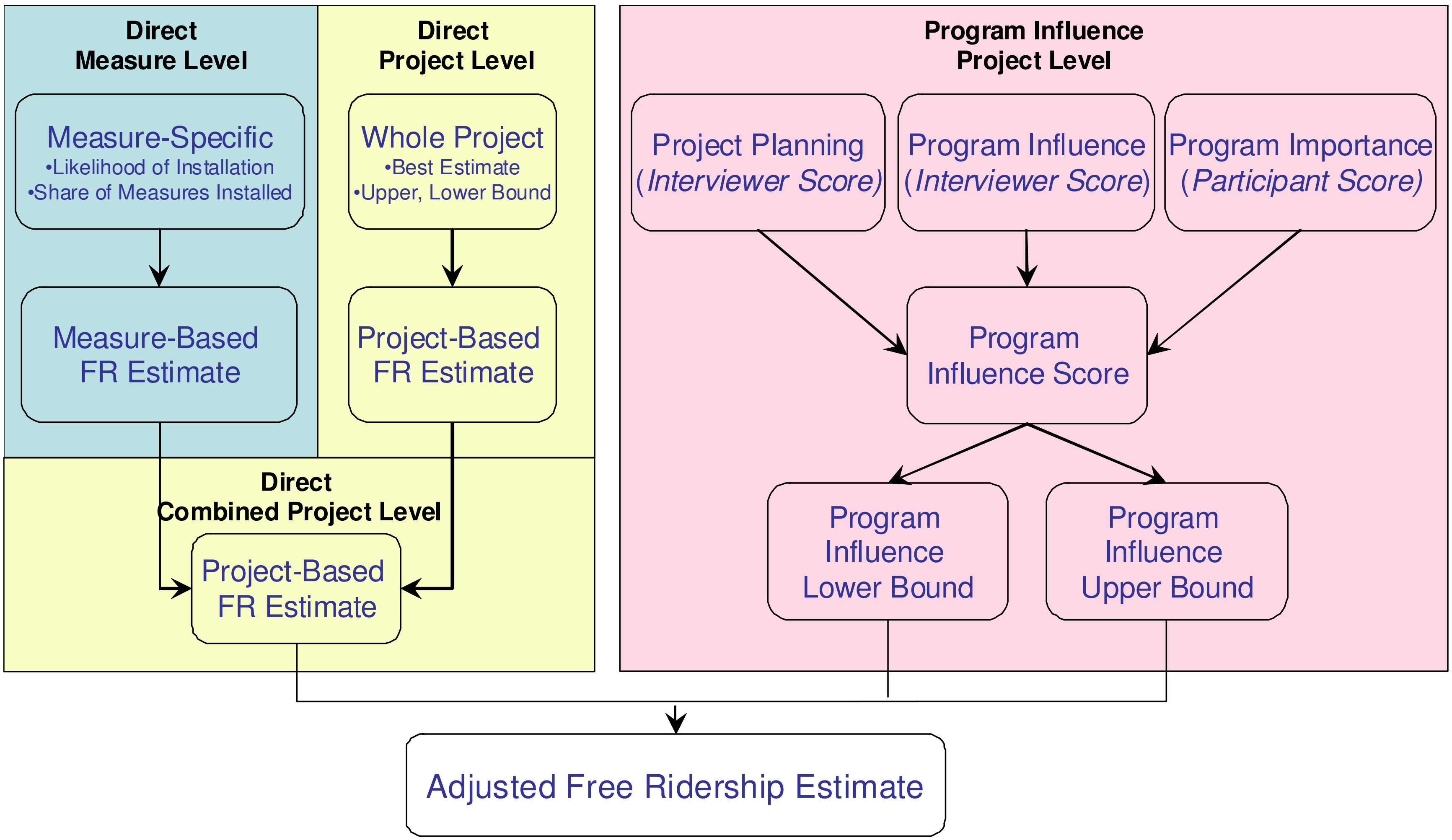


Figure 3. Free Ridership Analysis – Overview – Final Approach

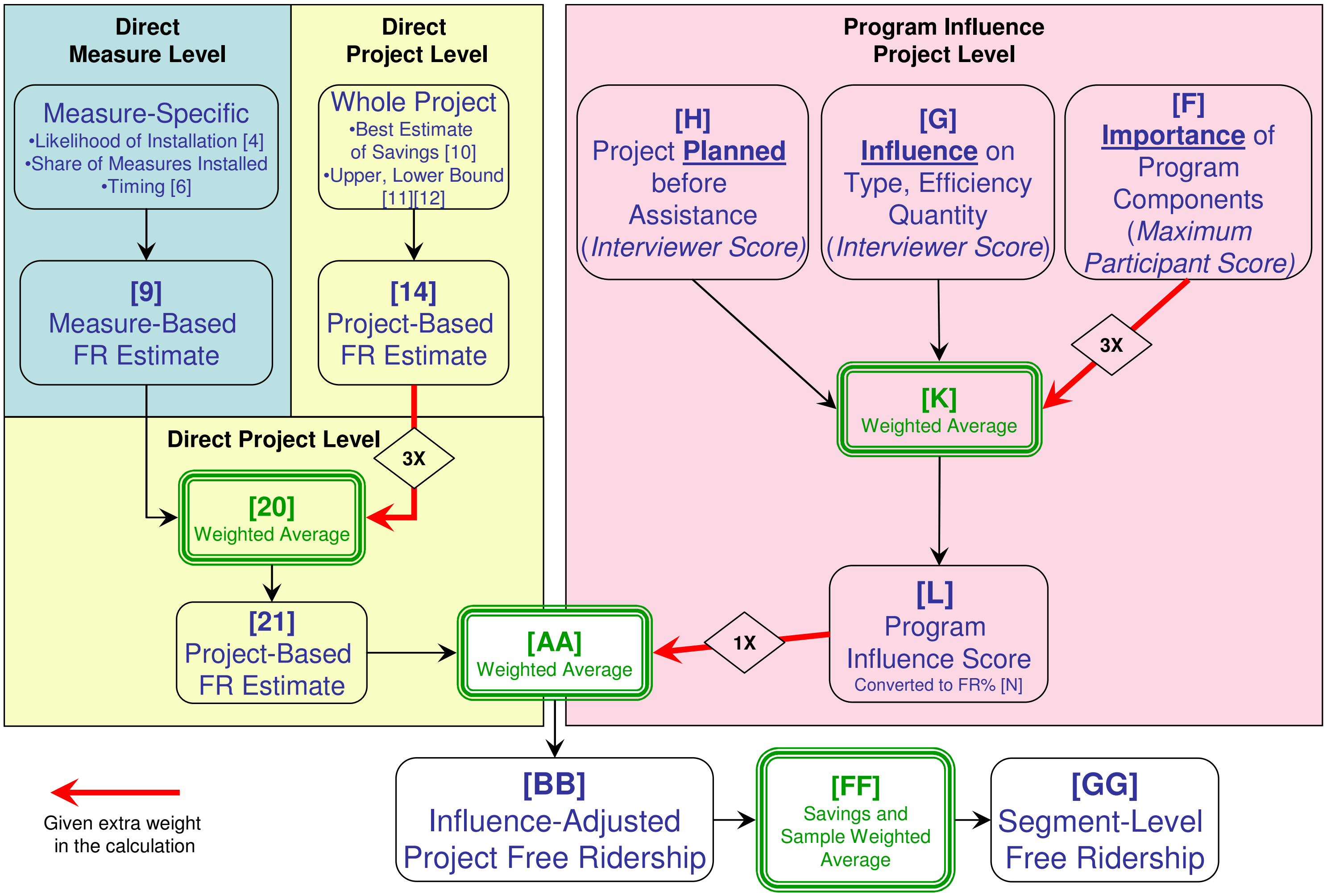


Figure 4. Free Ridership Analysis – Direct, Measure Level

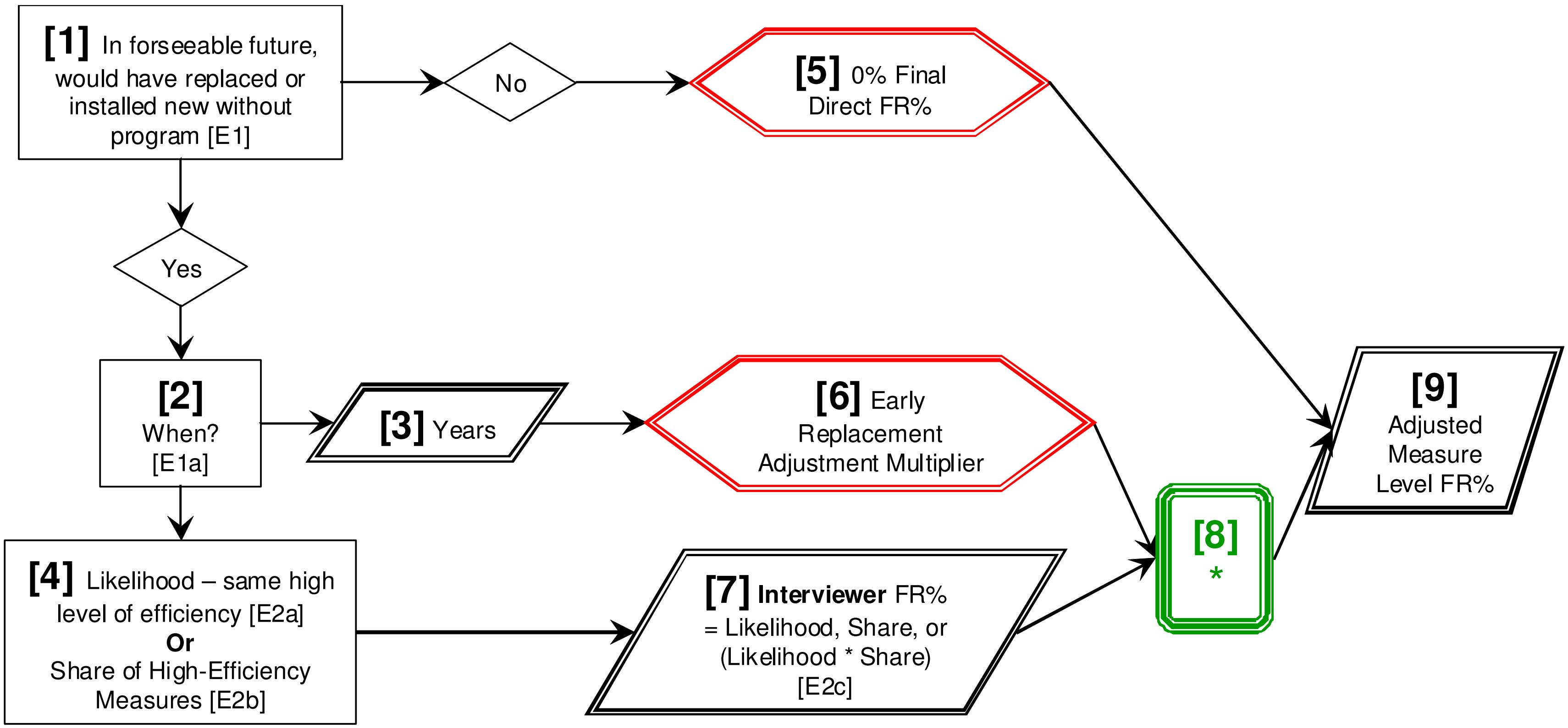


Figure 5. Free Ridership Analysis – Direct, Project Level

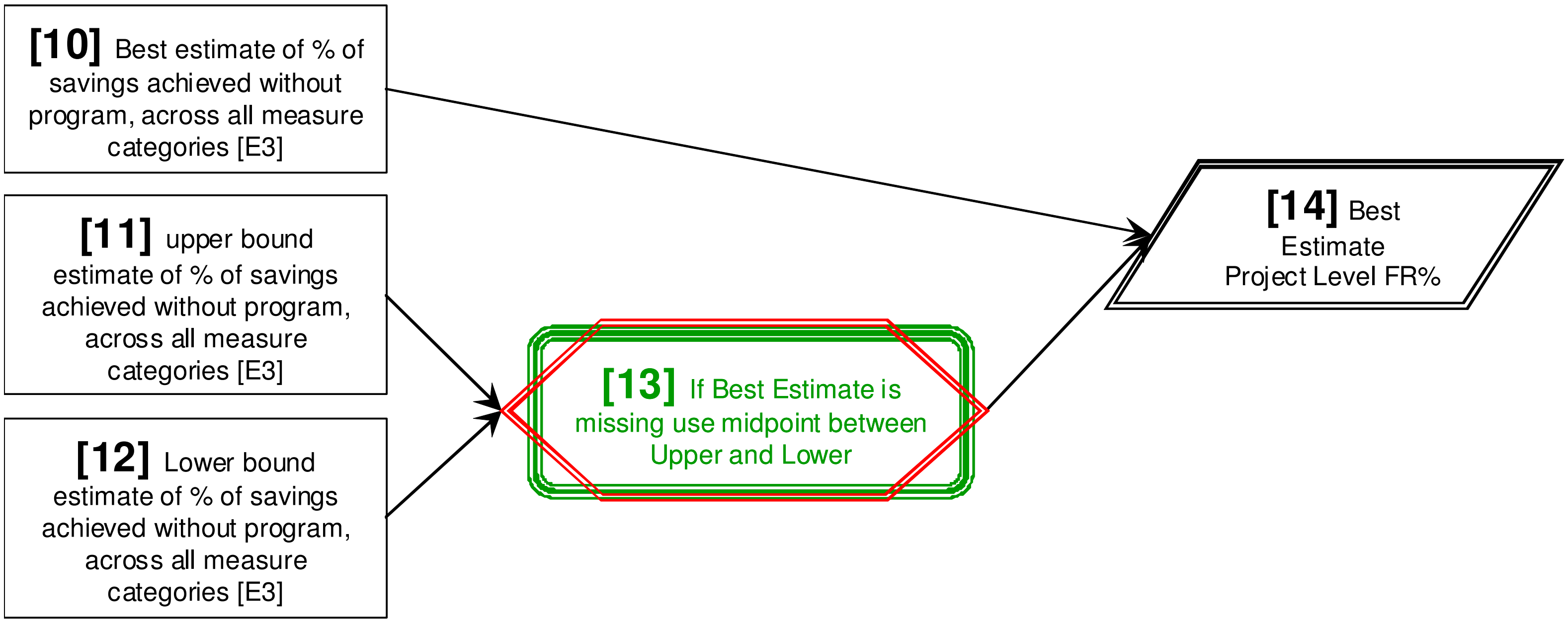


Figure 6. Free Ridership Analysis – Direct, Combined Project Level - Original

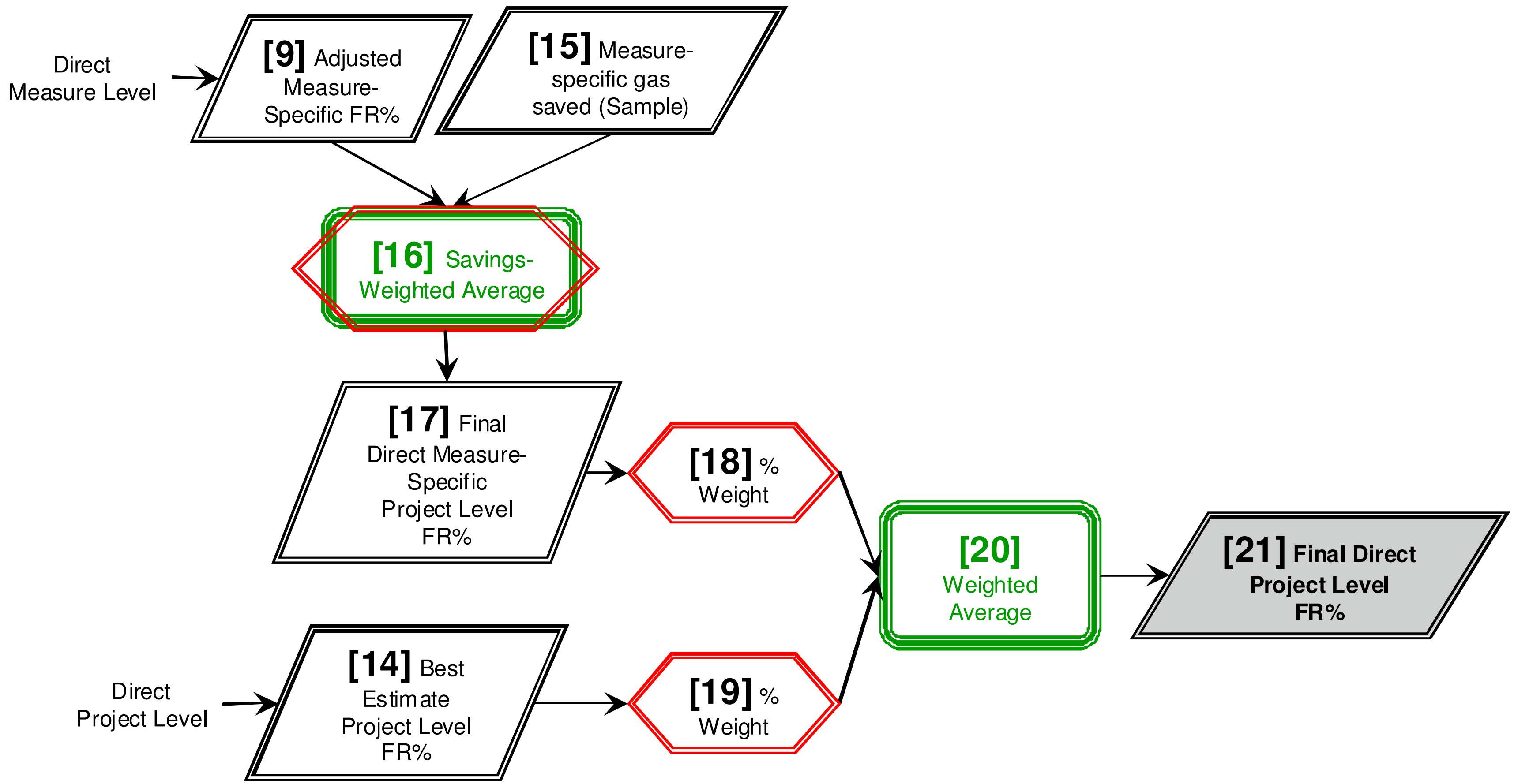
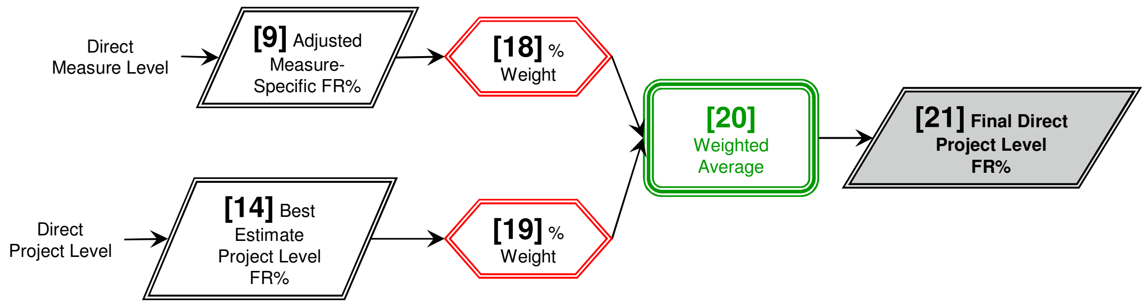
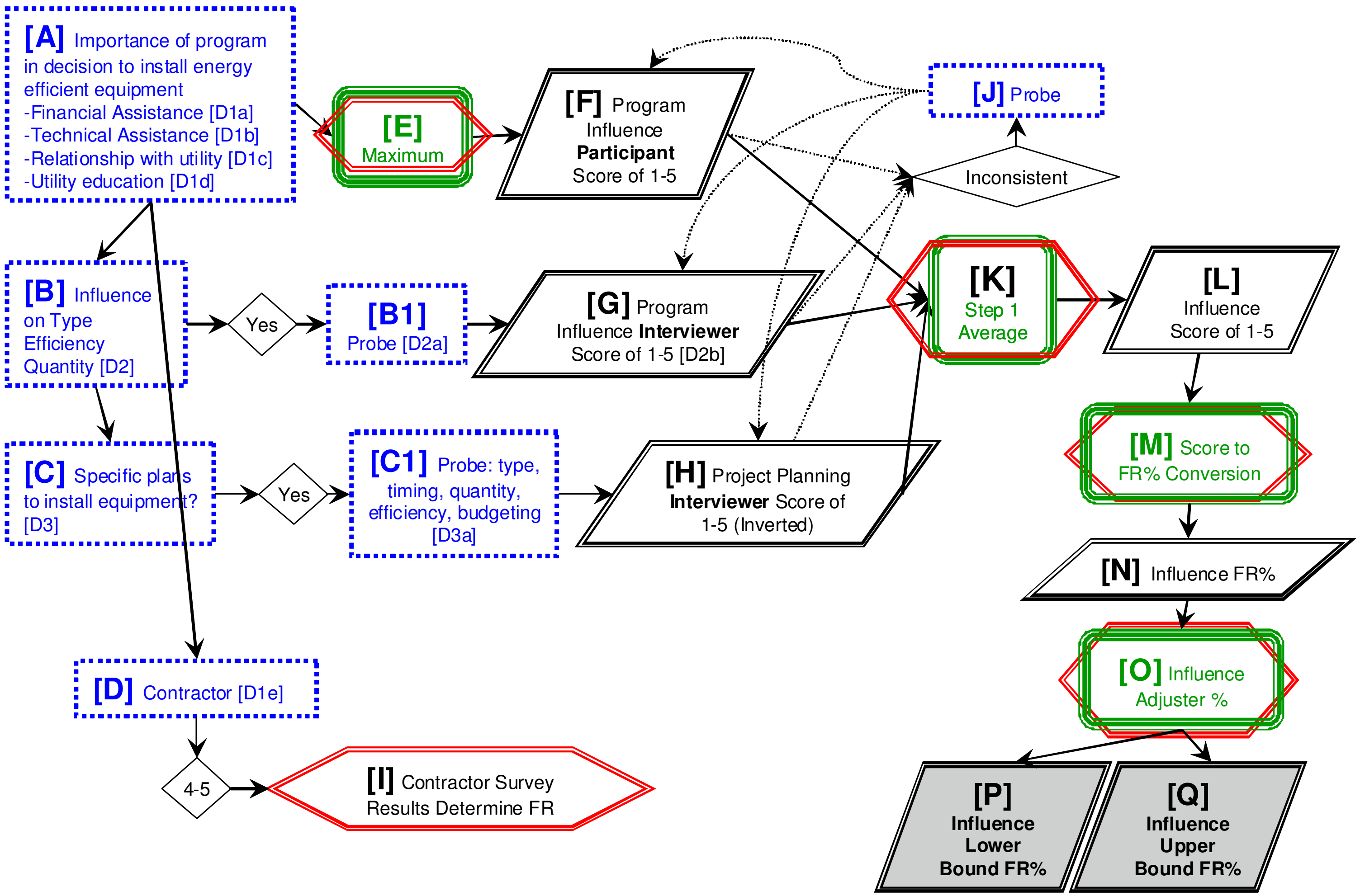


Figure 6. Free Ridership Analysis – Direct, Combined Project Level – Revised



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

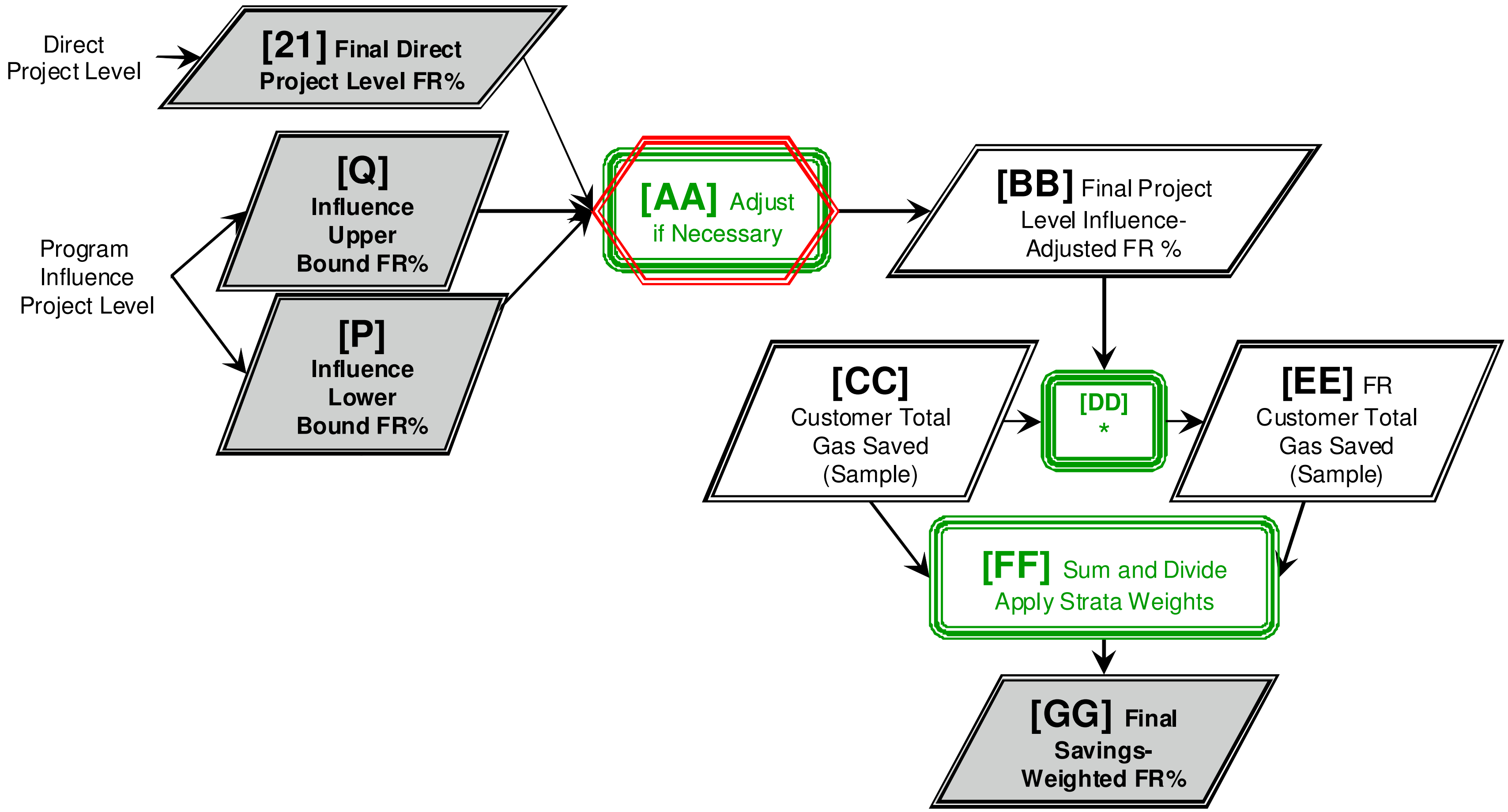
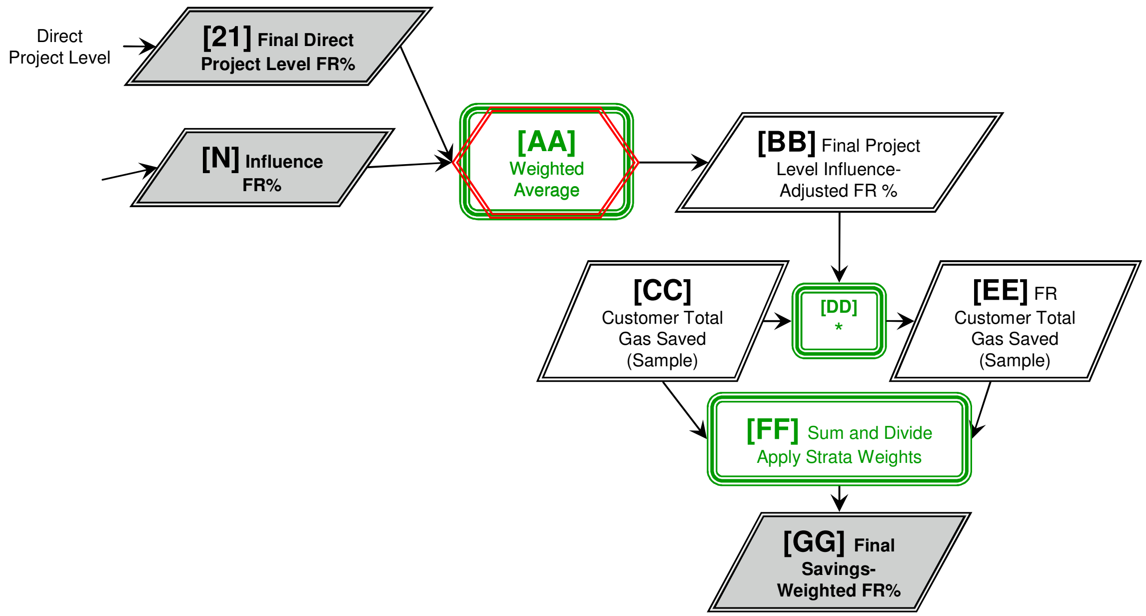


Figure 8. Free Ridership Analysis – Combined Direct and Program Influence Results - Revised



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.

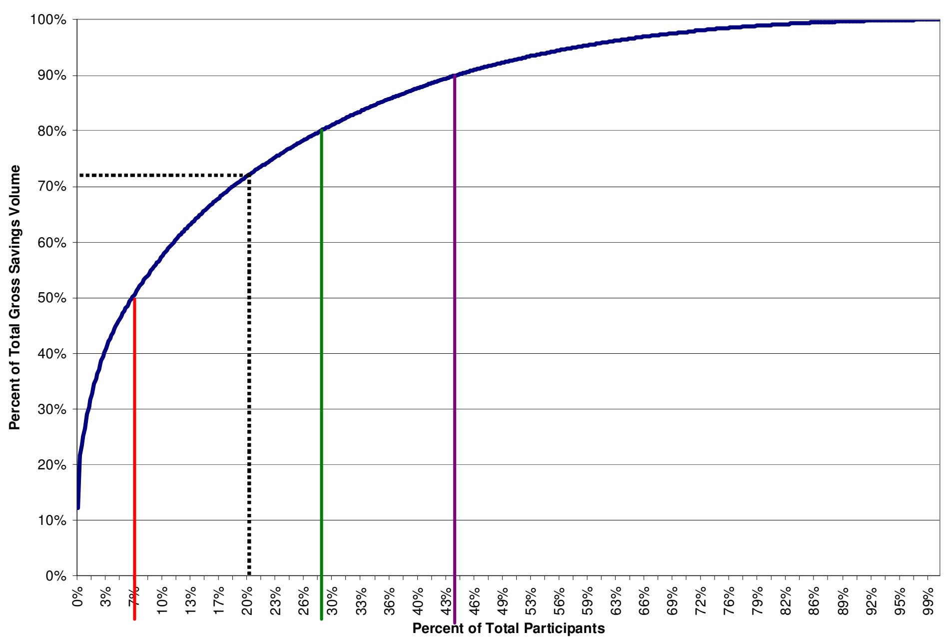
One half of the savings reported by Enbridge from the last quarter of 2006 and the first three quarters of 2007 was achieved by 6.4% of the participants, the largest 20% of projects represent 72% of the program savings, and the top 44% of participants represent 90% of the savings (Table 5 and Figure 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:

- <u>Whether spillover may exist</u>. Using yes/no questions ask whether the respondent installed energy efficiency equipment.
- <u>The amount of savings per spillover project</u>. 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___________________________________
Firm Name ______________________________
Address ________________________________
Phone Number ___________________________
Project Completion Date___________________

Interviewer Initials ________________________
Survey Date ______________________________
Sample ID # ______________________________
Project ID #_______________________________

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 any of the** *[list all 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 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.]

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 any **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]* **2=No** *FR=0%*	**1=Yes** (cont.)	**E1a. Within ____ Years of participation** *[Enter # of years]*	**E2a. Likelihood that energy efficient equipment…** …would have been installed without the program		**E2b. Share of energy efficient equipment that…** …would have been installed without the program	**E2c.** *[Entered by interviewer]* **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
2. 2 to 5
3. 6 to 10
4. 11 to 20
5. More than 20
6. Currently Unoccupied

-8. Don't know
-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
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.

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 ____________________________ Interviewer Initials ________________________

Firm Name ______________________________ Survey Date ______________________________

Address _________________________________ Sample ID # ______________________________

Phone Number ___________________________ Project ID #_______________________________

Project Completion Date____________________

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, <u>across all equipment</u>, that is the entire project, how much of these <u>extra energy savings</u> 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** *<u>at the same site</u>* **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 <u>describe how</u> 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 <u>less than</u>, <u>similar to</u>, or <u>more than</u> 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 <u>less than</u> 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 <u>greater than</u> 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!

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit A, Tab 3, page 6, line 21.

Union reports an "under spend" relative to budget for the large volume rate classes of $658,000.

Reference: Exhibit A, Tab 3, page 7; Exhibit B, Tab 1, page numbered 67.

Union was unable to achieve sufficient gas savings to justify a shareholder DSM incentive payment in respect of large volume customers. Union achieved only 6% of its overall large volume scorecard targeted gas savings.

a) Why was Union unable to spend the full budgeted large volume customer DSM amount?

b) If large volume customer DSM is the most cost effective, why was Union's savings achievement so low relative to target for this customer segment?

c) Please provide a table that lists DSM budgets, gas savings targets, and shareholder incentives earned for large volume customers for each of the 2012 through 2014 DSM program years.

Response:

a) Union was underspent in Large Volume T1 DSM customer incentives because Union's customers completed fewer T1 custom projects with lower total volume saved in 2014 relative to 2013. Union spent the full amount of budgeted funds for Large Volume Rate T2 and Rate 100 customers, as a result of their participation in the Direct Access program.

b) Union's Large Volume customers completed fewer, and smaller, projects in 2014 relative to the prior three years which were used to determine the target.

c) Please see Attachment 1.

UNION GAS LIMITED
Large Volume Summary
2012-2014 Program Years

Line No.	Year	DSM Budget ($)	Gas Savings Targets (CCM)	DSM Incentive Earned ($)
	(a)	(b)	(c)	(d)
1	2012 (1)	6,072,654	1,000,000,000	1,806,595
2	2013 (2)	6,207,467	1,295,972,859	1,362,407
3	2014 (3)	6,287,540	1,268,805,928	-

Notes:
(1) EB-2013-0109, Exhibit A, Tab 1.
(2) EB-2014-0273, Exhibit A, Tab 4.
(3) EB-2015-0276, Exhibit A, Tab 3.

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit A, Tab 3, pages 1 through 3; Exhibit A, Tab 3, Schedule 2, page 1.

Union is claiming LRAM payment from large volume customers for 2013 lost revenues.

a) Please explain why Union is seeking recover 2013 lost revenues through this application, rather than last year's DSM variance account/deferral clearance application.

Response:

a) Please see the response at Exhibit C.Staff.2 a).

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit B, Tab 1, page numbered 111, Table 13.0.

a) Please restate the referenced table, providing disaggregated figures for incentives and promotion costs (i.e. one line for incentives, and a separate line for promotion costs) for each of Rates T1 and Rates T2/100.

Response:

a) Please see the response at Exhibit C.SEC.4.

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit B, Tab 1, Appendix C, pages 8 and 9.

The tables referenced include *"Audit Adj. Rate"* entries for projects 2014-IND-0609, 0608 and 0649.

a) In each case, please explain what these adjustments are and how they were derived.

Response:

a) The audit adjustment rate for projects 2014-IND-0608 and 2014-IND-0609 was a result of Auditor Recommendation #16 as stated at Exhibit B, Tab 3, page 9:

> *"**Recommendation #16***
>
> ***2014-IND-0608, 2014-IND-0609.*** *The verified savings assume a 0.75 adjustment factor; however, the audit assumes that at the end of EUL, the condition of the pipe is the same as when it was replaced. At this point, the annual savings would be zero relative to the baseline condition. Assuming a linear fouling rate, the average savings over the life of the projects should be 50 percent of the first-year savings"*

While the audit adjustment factor should be 50% of the verified claim to account for pipe fouling, the verified project claim already accounted for a 25% reduction factor. Therefore, the net resulting adjustment factor is 0.67 and is calculated using the following equation:

$$\frac{Verified\ claim}{(1-0.25)} \times (0.5) = Verified\ claim \times (0.67)$$

This was confirmed with the Auditor's calculation as shown at Exhibit B, Tab 2, Table 14, page 34.

The audit adjustment rate of 0.5 for project 2014-IND-0649 was a result of Auditor Recommendation #14 as stated at Exhibit B, Tab 3, page 8:

> "***Recommendation #14***
>
> ***2014-IND-0649, 2014-IND-0487, 2014-IND-0664, 2014-IND-0356, 2014-IND-0522, 2014-IND-0543.*** *Savings were reduced by 50 percent due to a lack of documentation of customer standard maintenance procedures."*

The 50% reduction factor was justified by the Auditor in its Independent Audit of 2014 DSM Program Results at Exhibit B, Tab 2, page 19. It states:

> *"The 50 percent adjustment is based on professional judgment, as it was beyond the scope of the audit to attempt to quantify actual savings above baseline for these measures. We believe that 50 percent is a fair adjustment, as a 100 percent adjustment is likely too extreme and a 0 percent adjustment too low."*

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference: Exhibit B, Tab 1, Appendix N, page 3.

The large volume customer CPSV report indicates that 22 customers invested $7.2 million in the projects reviewed.

a) Please indicate how much Union paid in DSM incentives, in aggregate, to these 22 customers.

b) Please provide the total of the DSM incentives paid to each of the T1, T2 and Rate 100 classes, and the total incented DSM customer project costs for each such rate class.

Response:

a) Union paid these customers a total of $630,699 in customer incentives.

b) Please see Attachment 1.

UNION GAS LIMITED
Large Volume Summary by Rate Class
2014 Program Year

Line No.	Particulars ($)	Incentive	Incremental Cost [1]
		(a)	(b)
	South		
1	T1	663,927	5,436,895
2	T2	1,649,050	39,699,949
		2,312,977	45,136,844
	North		
3	Rate 100	904,784	14,864,679
		904,784	14,864,679
4	Total	3,217,761	60,001,523

Notes:

(1) Union interprets the request for "total incented DSM customer project costs" as the total Incremental Cost of all large volume projects, net of the 2014 realization rate.

UNION GAS LIMITED

Answer to Interrogatory from
Industrial Gas Users Association ("IGUA")

Reference**:** Exhibit B, Tab 3, page 5.

The audit committee report states:

As of 2016, [Union] will no longer be incenting projects classified as O&M Repair. O&M repair projects are those in which a customer has completed a report (i.e. maintenance) to improve energy performance, as opposed to continuing to operate less efficiently. The most common types of projects would be steam leak and steam trap repairs. It would also encompass descaling and heat exchanger cleaning projects.

a) Please confirm that the foregoing statement reflects Union's current intention, following release by the Board of its decision on Union's 2015-20 DSM Plan [EB-2015-0029].

Response:

a) Please see the response at Exhibit C.APPrO.1 part e).

UNION GAS LIMITED

Answer to Interrogatory from
London Property Management Association ("LPMA")

Reference: Exhibit A, Tab 4, Schedule 3

a) Please provide the estimated bill impact on each of a small, mid-sized and large M2 customer.

b) Please provide the estimated cost to a small M4 customer.

Response:

a) Please see Attachment 1.

b) Please see Attachment 2.

UNION GAS LIMITED
General Service Bill Impacts

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (1)	Volume (m^3) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate M2 - Small	Delivery	0.7984	14,160	113.05
2		Commodity	-	14,160	-
3			0.7984		113.05
4	Sales Service				113.05
5	Direct Purchase				113.05
6	Rate M2 - Mid-Sized	Delivery	0.7984	38,940	310.90
7		Commodity	-	38,940	-
8			0.7984		310.90
9	Sales Service				310.90
10	Direct Purchase				310.90
11	Rate M2 - Large	Delivery	0.7984	59,000	471.06
12		Commodity	-	59,000	-
13			0.7984		471.06
14	Sales Service				471.06
15	Direct Purchase				471.06

Notes:
(1) Exhibit A, Tab 4, Schedule 2, page 1, column (c).
(2) Average consumption per customer for the period April 1, 2016 to September 30, 2016.
Rate M2 - Small customer volume is based on annual consumption of 60,000 m^3.
Rate M2 - Mid-sized customer volume is based on annual consumption of 165,000 m^3.
Rate M2 - Large customer volume is based on annual consumption of 250,000 m^3.

UNION GAS LIMITED
Small Rate M4 Bill Impact

Line No.	Particulars	Annual Volume (m^3) (1)	Unit Rate for One-Time Adjustment (cents/m^3) (2)	Bill Impact One-Time Adjustment ($)
		(a)	(b)	(c) = (a x b) / 100
1	Rate M4 - Small	875,000	0.3654	3,197

Notes:
(1) For contract rate classes, the DSM deferral account disposition is a one-time adjustment based on 2014 actual volumes by customer.
(2) Exhibit A, Tab 4, Schedule 2, page 2, column (c).

UNION GAS LIMITED

Answer to Interrogatory from
London Property Management Association ("LPMA")

Reference: Exhibit A, Tab 4, Schedule 3

a) If Board approval for the rate riders for the general service class cannot be obtained in time to allow an April 1, 2015 implementation date, does Union then propose to change the recovery period to July 1, 2015 through December 31, 2015?

b) If yes, please provide a version of Exhibit A, Tab 4, Schedule 3 and the responses to Interrogatory #1 above to reflect the rate riders calculated for the above noted period. If some other time period is proposed, please provide a version of Exhibit A, Tab 4, Schedule 3 and the responses to Interrogatory #1 above to reflect the rate riders calculated for the above noted period using the time period proposed by Union.

Response:

a) Yes, if Union does not receive Board approval in time for an April 1, 2016 implementation, Union will propose a six-month recovery period beginning with the next available Quarterly Rate Adjustment Mechanism ("QRAM") application following Board approval. The next proposed six-month period would be July 1, 2016 through December 31, 2016.

b) Please see Attachments 1 to 4.

   Attachment 1 shows the derivation of the unit rates for prospective recovery for general service rate classes based on a July 1, 2016 to December 31, 2016 disposition period.

   Attachment 2 shows the bill impacts for general service rate classes consistent with Exhibit A, Tab 4, Schedule 3.

   Attachment 3 shows the estimated bill impact for each of a small, mid-sized, and large Rate M2 customer.

   Attachment 4 shows the estimated bill impact for a small Rate M4 customer. There is no change in the Rate M4 bill impact as the disposition to contract rate classes will be done as a one-time adjustment based on 2014 actual volumes by customer.

UNION GAS LIMITED
General Service Unit Rates for Prospective Recovery/(Refund) - Delivery
2014 DSM Deferral Account Disposition

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	Forecast Volume (10^3m^3) (2)	Unit Rate for Prospective Recovery/(Refund) (cents/m^3)
			(a)	(b)	(c) = (a/b)*100
	Union North				
1	Small Volume General Service	01	381	378,841	0.1005
2	Large Volume General Service	10	412	157,840	0.2609
	Union South				
3	Small Volume General Service	M1	4,830	1,140,889	0.4233
4	Large Volume General Service	M2	2,782	532,026	0.5229
5	Total General Service		8,405		

Notes:
(1) Exhibit A, Tab 4, Schedule 1, page 1.
(2) Forecast volume for the period July 1, 2016 to December 31, 2016.

UNION GAS LIMITED
General Service Bill Impacts

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m³) (1)	Volume (m³) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate 01	Delivery	0.1005	857	0.86
2		Commodity	-	857	-
3		Transportation	-	857	-
4			0.1005		0.86
5	Sales Service				0.86
6	Direct Purchase Bundled T				0.86
7	Rate 10	Delivery	0.2609	38,833	101.32
8		Commodity	-	38,833	-
9		Transportation	-	38,833	-
10			0.2609		101.32
11	Sales Service				101.32
12	Direct Purchase Bundled T				101.32
13	Rate M1	Delivery	0.4233	702	2.97
14		Commodity	-	702	-
15			0.4233		2.97
16	Sales Service				2.97
17	Direct Purchase				2.97
18	Rate M2	Delivery	0.5229	23,871	124.82
19		Commodity	-	23,871	-
20			0.5229		124.82
21	Sales Service				124.82
22	Direct Purchase				124.82

Notes:
(1) Unit rates per Exhibit C.LPMA.2, Attachment 1, column (c).
(2) Average consumption per customer for the period July 1, 2016 to December 31, 2016.

UNION GAS LIMITED
General Service Bill Impacts

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (1)	Volume (m^3) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate M2 - Small	Delivery	0.5229	19,620	102.59
2		Commodity	-	19,620	-
3			0.5229		102.59
4	Sales Service				102.59
5	Direct Purchase				102.59
6	Rate M2 - Mid-Sized	Delivery	0.5229	53,955	282.13
7		Commodity	-	53,955	-
8			0.5229		282.13
9	Sales Service				282.13
10	Direct Purchase				282.13
11	Rate M2 - Large	Delivery	0.5229	81,750	427.47
12		Commodity	-	81,750	-
13			0.5229		427.47
14	Sales Service				427.47
15	Direct Purchase				427.47

Notes:
(1) Unit rates per Exhibit C.LPMA.2, Attachment 1, column (c).
(2) Average consumption per customer for the period July 1, 2016 to December 31, 2016.

UNION GAS LIMITED
Small Rate M4 Bill Impact

Line No.	Particulars	Annual Volume (m^3) (1)	Unit Rate for One-Time Adjustment (cents/m^3) (2)	Bill Impact One-Time Adjustment ($)
		(a)	(b)	(c) = (a x b) / 100
1	Rate M4 - Small	875,000	0.3654	3,197

Note:
(1) For contract rate classes, the DSM deferral account disposition is a one-time adjustment based on 2014 actual volumes by customer.
(2) Exhibit A, Tab 4, Schedule 2, page 2, column (c).

UNION GAS LIMITED

Answer to Interrogatory from
London Property Management Association ("LPMA")

Reference: Exhibit A, Tab 4, Schedule 3

a) Please provide a version of Exhibit A, Tab 4, Schedule 3 and the responses to Interrogatory #1 above to reflect the rate riders calculated for a twelve month period rather than the six month period proposed for the general service rate classes.

b) What obstacles would preclude Union from recovering the amounts from general service customers over an a twelve month period?

Response:

a) Please see Attachments 1 to 4.

Attachment 1 shows the derivation of the unit rates for prospective recovery for general service rate classes based on a April 1, 2016 to March 31, 2017 disposition period.

Attachment 2 shows the bill impacts for general service rate classes consistent with Exhibit A, Tab 4, Schedule 3.

Attachment 3 shows the estimated bill impact for each of a small, mid-sized, and large Rate M2 customer.

Attachment 4 shows the estimated bill impact for a small Rate M4 customer. There is no change in the Rate M4 bill impact as the disposition to contract rate classes will be done as a one-time adjustment based on 2014 actual volumes by customer.

b) There are no obstacles precluding Union from recovering the balances from general service customers over a twelve-month period, however, Union's proposed six-month disposition is consistent with the recovery period used in past deferral disposition proceedings. The impact to general service customers in this application is not significantly different enough to warrant a different recovery period. As well, a six-month period ensures timely recovery of the 2014 DSM deferral balances within the 2016 calendar year.

UNION GAS LIMITED
General Service Unit Rates for Prospective Recovery/(Refund) - Delivery
2014 DSM Deferral Account Disposition

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (1)	Forecast Volume (10^3m^3) (2)	Unit Rate for Prospective Recovery/(Refund) (cents/m^3)
			(a)	(b)	(c) = (a/b)*100
	Union North				
1	Small Volume General Service	01	381	1,006,814	0.0378
2	Large Volume General Service	10	412	365,822	0.1125
	Union South				
3	Small Volume General Service	M1	4,830	3,023,850	0.1597
4	Large Volume General Service	M2	2,782	1,231,067	0.2260
5	Total General Service		8,405		

Notes:
(1) Exhibit A, Tab 4, Schedule 1, page 1.
(2) Forecast volume for the period April 1, 2016 to March 31, 2017.

UNION GAS LIMITED
General Service Bill Impacts

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m³) (1)	Volume (m³) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate 01	Delivery	0.0378	2,200	0.83
2		Commodity	-	2,200	-
3		Transportation	-	2,200	-
4			0.0378		0.83
5	Sales Service				0.83
6	Direct Purchase Bundled T				0.83
7	Rate 10	Delivery	0.1125	93,000	104.63
8		Commodity	-	93,000	-
9		Transportation	-	93,000	-
10			0.1125		104.63
11	Sales Service				104.63
12	Direct Purchase Bundled T				104.63
13	Rate M1	Delivery	0.1597	2,200	3.51
14		Commodity	-	2,200	-
15			0.1597		3.51
16	Sales Service				3.51
17	Direct Purchase				3.51
18	Rate M2	Delivery	0.2260	73,000	164.98
19		Commodity	-	73,000	-
20			0.2260		164.98
21	Sales Service				164.98
22	Direct Purchase				164.98

Notes:
(1) Unit rates per Exhibit C.LPMA.3, Attachment 1, column (c).
(2) Average consumption per customer for the period April 1, 2016 to March 31, 2017.

UNION GAS LIMITED
General Service Bill Impacts

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (1)	Volume (m^3) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate M2 - Small	Delivery	0.2260	60,000	135.60
2		Commodity	-	60,000	-
3			0.2260		135.60
4	Sales Service				135.60
5	Direct Purchase				135.60
6	Rate M2 - Mid-Sized	Delivery	0.2260	165,000	372.90
7		Commodity	-	165,000	-
8			0.2260		372.90
9	Sales Service				372.90
10	Direct Purchase				372.90
11	Rate M2 - Large	Delivery	0.2260	250,000	565.00
12		Commodity	-	250,000	-
13			0.2260		565.00
14	Sales Service				565.00
15	Direct Purchase				565.00

Notes:
(1) Unit rates per Exhibit C.LPMA.3, Attachment 1, column (c).
(2) Average consumption per customer for the period April, 2016 to March 31, 2017.

UNION GAS LIMITED
Small Rate M4 Bill Impact

Line No.	Particulars	Annual Volume (m^3) (1)	Unit Rate for One-Time Adjustment (cents/m^3) (2)	Bill Impact One-Time Adjustment ($)
		(a)	(b)	(c) = (a x b) / 100
1	Rate M4 - Small	875,000	0.3654	3,197

Notes:
(1) For contract rate classes, the DSM deferral account disposition is a one-time adjustment based on 2014 actual volumes by customer.
(2) Exhibit A, Tab 4, Schedule 2, page 2, column (c).

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Greenhouse Vegetable Growers ("OGVG")

Reference: Exhibit A, Tab 2, Appendix A, Page 5 of 12

Preamble: The free ridership rate of 54% applied to Union's Commercial/Industrial and Large Volume programs is based on the Custom Projects Attribution study performed by Summit Blue Consulting ("Summit Blue") in 2008.

a) Please provide a copy of the Summit Blue Custom Projects Attribution study.

b) Has Union applied a single 54% free ridership rate to its Commercial/Industrial and Large Volume programs in every year since the 2009 Audit? If not, please provide the free ridership rates applied to its Commercial/Industrial and Large Volume programs between 2008 and 2014 and explain the drivers of the changes from year to year; if so, please explain why the free ridership rate would remain constant over the course of 6 years despite efforts between 2009 and 2014 to educate the public (including Union's Commercial/Industrial and Large Volume customers) about the value of energy efficiency measures?

c) OGVG notes that the Commercial/Industrial Custom Projects described at Exhibit B, Tab 2, pages 19 and 20 include a number of greenhouse expansion projects where Union Gas claims savings associated with the difference between a "new construction baseline" and the results of the Custom Project in question. Please discuss whether this type of project was contemplated by the Summit Blue Custom Projects Attribution Study; more specifically, did the Summit Blue Custom Projects Attribution Study explore the appropriate free ridership rate for brand new expansion projects, as opposed to the retrofitting of existing facilities.

Response:

a) Please see the response at Exhibit C.IGUA.4 part a).

b) As a result of a 2009 Auditor's recommendation, Union has applied a 54% free ridership rate to its Commercial/Industrial and Large Volume programs in every year since the 2009 Audit. The application of an empirical free ridership rate to Union's custom portfolio has been a longstanding practice that has been filed annually with the Board.

c) The five segments included Industrial, Agriculture, New Construction, Commercial and Multifamily. Within the Agriculture segment, all agriculture custom projects (this includes greenhouse expansion projects) were included in the data population that was provided for random sampling.

UNION GAS LIMITED

Answers to Interrogatory from
Ontario Greenhouse Vegetable Growers ("OGVG")

Reference: Exhibit A, Tab 4, Page 3 of 3

Preamble: For in-franchise contract rate classes, Union is proposing to dispose of the net 2014 DSM-related deferral and variance account balances as a one-time adjustment with the first available QRAM after Board approval. This one-time adjustment approach is consistent with the methodology used for the disposition of 2013 deferral account and earnings sharing balances in the 2013 Disposition of DSM Deferral and Variance Accounts (EB-2014-0273 proceeding.

a) Please provide a table (or tables) that show the following information:

i) the number of customers within each in-franchise contract class that were charged a one-time adjustment relating to the 2013 DSM Deferral and Variance Accounts as described in the preamble;

ii) for each in-franchise contract class the minimum, maximum, average, and mean one-time adjustments that were charged in 2013 (only including amounts related to the clearance of the 2013 LRAM, DSMVA and DSMIDA accounts) along with the related % distribution and total bill impact for each representative charge (namely the % impact of the one time charge in relation to the annual distribution and total bill for the relevant customer);

iii) the number of customers within each in-franchise contract class that Union forecasts it will charge a one-time adjustment relating to the 2014 LRAM, DSMVA and DSMIDA accounts if this application is approved;

iv) for each in-franchise contract class the minimum, maximum, average, and mean one-time adjustments Union forecasts it will charge if this application is approved, along with the related % distribution and total bill impact for each representative charge (namely the % impact of the one time charge in relation of the annual distribution and total bill for the relevant customer);

v) for each in-franchise contract class the number of customers that have participated in a Commercial/Industrial Custom Project in each year that Union has run the program. Please note that in addition to showing participation in each year, OGVG is specifically interested in how many customers in each in-franchise contract class that Union Gas forecasts will be charged a one-time adjustment relating to the amounts in this application have participated in a Custom Project;

vi) please explain Union Gas' approach when the customers in a particular in-franchise contract rate class all have (or when almost all have) participated in a Commercial/Industrial Custom Project; for example, does Union Gas redirect its budget to target rate classes with material numbers of customers that have not participated in material DSM spending? Please comment on any classes where participation has (cumulatively) become close enough to 100% in recent years such that DSM spending within that class has been or will be redirected to other rate classes.

b) Please confirm that in-franchise contract class customers have the option of paying the approved one-time adjustment over time; if so confirmed please provide the process by which customers seeking to make their payment over time may arrange to do so, and explain how the maximum time period available to customers for such payments is determined. If not confirmed, please explain why this option is not available to in-franchise contract customers.

c) Please explain how an in-franchise contract class customer can forecast the value of the one-time adjustment it will be charged if the application is approved as filed. If the information that a customer requires in order to forecast the level of its own one time adjustment is not readily available to the customer, please advise how the required information can be obtained from Union Gas.

Response:

a)

i)- iv) Please see Attachment 1.

v) Please see Attachment 2.

vi) Union does not redirect budget to individual rate classes based on participation levels within the rate class. Union does not set participation restriction for a rate class as all customers have equal access to a variety of Union's DSM offerings. Union may restrict spending within a rate class due to budget rules as set out in the 2012-2014 Multi-year DSM Plan proceeding (EB-2011-0327) Settlement Agreement.

b) In-franchise contract class customer's one-time adjustment invoice is payable when the invoice is due and late payment charges will apply for unpaid amounts. Customers may contact their Account Manager to propose alternative payment arrangements depending on their circumstances on a case-by-case basis.

c) Union included the proposed unit rate for disposition of the 2014 DSM deferral balances by rate class in the December 14, 2015 Enerline/Factsline communication that is provided to in-franchise contract class customers. Contract customers can obtain their consumption for the applicable period from previous bills or from Unionline, Union's electronic web based system. A customer could forecast their one-time adjustment by multiplying the unit rate for disposition by their consumption for the applicable period. Union advised customers of their estimated credit or charge related to the disposition of the 2014 DSM deferral balances through email correspondence sent on December 10, 2015.

UNION GAS LIMITED
Bill Impact of 2013 DSM Deferral Acount Disposition
One-Time Adjustment for Contract Customers

Line No.	Particulars	Number of Customers	2013 DSM One-Time Adjustment ($)	Percent of Delivery Bill	Percent of Total Sales Bill (1)
		(a)	(b)	(c)	(d)
	Union South				
1	Rate M4	167			
2	Minimum		380	7.1%	1.9%
3	Maximum		78,456	16.9%	2.2%
4	Average		11,242	13.2%	2.2%
5	Median		8,070	11.7%	2.1%
6	Rate M5	145			
7	Minimum		11	0.0%	0.0%
8	Maximum		89,138	13.5%	1.5%
9	Average		9,204	10.4%	1.4%
10	Median		4,875	8.3%	1.4%
11	Rate M7	4			
12	Minimum		(125,994)	(5.2%)	(0.9%)
13	Maximum		(43,875)	(9.2%)	(1.0%)
14	Average		(72,925)	(6.5%)	(0.9%)
15	Median		(63,954)	(9.0%)	(1.0%)
16	Rate T1	38			
17	Minimum		2,284	1.9%	0.5%
18	Maximum		40,568	7.2%	0.7%
19	Average		13,880	5.6%	0.7%
20	Median		12,256	5.6%	0.7%
21	Rate T2	22			
22	Minimum		3,614	0.5%	0.1%
23	Maximum		116,549	2.2%	0.1%
24	Average		34,911	1.6%	0.1%
25	Median		30,107	2.1%	0.1%
	Union North				
26	Rate 20	55			
27	Minimum		490	0.9%	0.3%
28	Maximum		180,380	6.5%	0.5%
29	Average		12,250	5.4%	0.5%
30	Median		4,455	3.7%	0.5%
31	Rate 100	17			
32	Minimum		733	0.3%	0.0%
33	Maximum		22,324	0.6%	0.0%
34	Average		5,326	0.6%	0.0%
35	Median		3,128	0.6%	0.0%

Notes
(1) Sales bills were estimated based on the customer's delivery bill and their consumption multiplied by Union's average gas supply charges in 2013.

UNION GAS LIMITED
Bill Impact of 2014 DSM Deferral Account Disposition
One-Time Adjustment for Contract Customers

Line No.	Particulars	Number of Customers	2014 DSM One-Time Adjustment ($)	Percent of Delivery Bill	Percent of Total Sales Bill (1)
		(a)	(b)	(c)	(d)
	Union South				
1	Rate M4	171			
2	Minimum		61	1.3%	0.7%
3	Maximum		55,087	17.3%	1.5%
4	Average		10,346	12.1%	1.4%
5	Median		7,723	9.5%	1.4%
6	Rate M5	116			
7	Minimum		6	0.0%	0.0%
8	Maximum		751	0.3%	0.0%
9	Average		136	0.2%	0.0%
10	Median		105	0.2%	0.0%
11	Rate M7	30			
12	Minimum		2,126	9.3%	1.2%
13	Maximum		139,332	16.3%	1.3%
14	Average		41,404	11.4%	1.2%
15	Median		33,316	13.3%	1.3%
16	Rate T1	38			
17	Minimum		(57,138)	(9.8%)	(0.6%)
18	Maximum		(2,594)	(2.2%)	(0.5%)
19	Average		(19,427)	(7.2%)	(0.6%)
20	Median		(16,342)	(7.2%)	(0.6%)
21	Rate T2	23			
22	Minimum		846	0.1%	0.0%
23	Maximum		34,040	0.6%	0.0%
24	Average		10,477	0.5%	0.0%
25	Median		7,697	0.2%	0.0%
	Union North				
26	Rate 20	55			
27	Minimum		15	0.2%	0.1%
28	Maximum		272,405	9.7%	0.7%
29	Average		15,049	6.7%	0.6%
30	Median		7,000	5.5%	0.6%
31	Rate 100	16			
32	Minimum		(66,820)	(1.5%)	(0.1%)
33	Maximum		(754)	(0.2%)	(0.0%)
34	Average		(16,257)	(1.6%)	(0.1%)
35	Median		(9,476)	(1.7%)	(0.1%)

Notes:
(1) Sales bills were estimated based on the customer's delivery bill and their consumption multiplied by Union's average gas supply charges in 2014.

UNION GAS LIMITED
Custom DSM Program Participants by Contract Rate Class

Line No.	Particulars (1)	2014	2013	2012
		(a)	(b)	(c)
	Union South			
1	M4	62	51	53
2	M5	39	57	35
3	M7	14	2	2
4	T1	18	21	15
5	T2	20	18	14
6		153	149	119
	Union North			
7	Rate 20	24	17	26
8	Rate 100	15	14	14
9		39	31	40
10	Total	192	180	159

Notes:
(1) Includes DSM Study participants.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Greenhouse Vegetable Growers ("OGVG")

Reference: Exhibit A, Tab 3, Schedule 2, Pages 2 and 3 of 3

Preamble: These schedules demonstrate the volumetric savings within the in-franchise contract classes from its DSM programs in 2014 as a result of 2013 and 2014 programs, and go on to calculate the related lost distribution revenue as a result of those volumetric savings.

a) Please estimate the commodity savings associated with the total volumetric savings within the in-franchise contract classes in 2014 relating to 2013 and 2014 DSM programs, showing those savings on a class by class basis. Please explain any assumptions made with respect to the price of natural gas used in the estimation.

b) Please provide the number of contract customers within each in-franchise contract class, if any, that fell below their applicable Minimum Annual Volume (MAV) in 2014, along with the total penalty paid by those customers as a result of falling below their MAV. To the extent any customers fell below their MAV and paid a related penalty, please provide the number of such customers that were participants in Union DSM programming either in 2014 or previous years.

c) Assuming that there are (or could be in the future) customers that fall below their MAV, pay a penalty as a result of falling below their MAV, and have participated in Union Gas DSM programming, please explain how Union Gas ensures that it does not double recover the impact of its DSM programs by both charging a penalty to customers who fall below their MAV as a result of DSM programming while at the same time recovering that same lost revenue through the LRAM.

Response:

a) Please see Attachment 1.

b) A minimum annual volume ("MAV") reflects a commitment by a customer to take delivery of, or otherwise pay for, a given quantity of gas for a period of time. In the event a customer does not take delivery of the minimum volume, the customer shall pay an amount equal to the deficiency from the minimum times a delivery charge.

   A customer's contract may include an MAV as a requirement to qualify for a rate class (for example, Rate M4 has an MAV requirement of 146 times the Contract Demand), when contracting for a negotiated rate or in lieu of an aid-to-construct payment as the customer's commitment toward the economics of a capital project. An MAV deficiency charge is not a penalty as the customer received a benefit related to its commitment to the MAV.

Please see Attachment 2 for the requested information.

c) Union does not consider the impact of MAV charges in the calculation of its LRAM balance.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism Commodity Savings
2013 Audited LRAM Results

Line No.	Particulars	2013 Net LRAM Volumes (1) 10^3 m^3	2014 Average Gas Commodity Rate (2) $\$/10^3$ m^3	Estimated Commodity Savings ($)
		(a)	(b)	(c) = (a) x (b)
	Union South			
1	M4	10,037	19.324	193,948
2	M5	14,773	19.324	285,460
3	M7	4,762	19.324	92,013
4	T1	10,489	19.324	202,682
5	T2	91,909	19.324	1,776,006
6		131,969		2,550,109
	Union North			
7	Rate 20	4,393	17.287	75,937
8	Rate 100	20,021	17.287	346,096
9		24,414		422,032
10	Total	156,382		2,972,141

Notes:
(1) Exhibit A, Tab 3, Schedule 2, page 2.
(2) Average Gas Commodity Rate calculated as the average of Union's quarterly commodity and fuel rates during 2014.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism Commodity Savings
2014 Audited LRAM Results

Line No.	Particulars	2014 Net LRAM Volumes (1) $10^3 m^3$	2014 Average Gas Commodity Rate (2) $\$/10^3 m^3$	Estimated Commodity Savings ($)
		(a)	(b)	(c) = (a) x (b)
	Union South			
1	M4	7,805	19.324	150,825
2	M5	6,386	19.324	123,397
3	M7	6,446	19.324	124,559
4	T1	2,733	19.324	52,821
5	T2	29,054	19.324	561,419
6		52,424		1,013,021
	Union North			
7	Rate 20	3,956	17.287	68,389
8	Rate 100	17,300	17.287	299,063
9		21,257		367,452
10	Total	73,681		1,380,473

Notes:
(1) Exhibit A, Tab 3, Schedule 2, page 3.
(2) Average Gas Commodity Rate calculated as the average of Union's quarterly commodity and fuel rates during 2014.

UNION GAS LIMITED
DSM Participation by Customers with MAV Charge
2012-2014 Program Years

Line No.	Particulars	Number of Customers with MAV charge in 2014 (1)	Amount ($)	2012-2014 DSM Participation (2)
		(a)	(b)	(c)
	South			
1	M4	8	157,396	5
2	M5	6	18,090	4
3	M7	4	57,871	3
4	T1	6	23,164	6
5	T2	5	76,759	5
		29	333,281	23
	North			
6	Rate 20	2	217,638	2
7	Rate 100	3	74,507	3
8		5	292,145	5
9	Total	34	625,426	28

Notes:
(1) These customers received an MAV charge on their account in 2014.
(2) Reflects number of customers from column (a) that participated at least once in Union's DSM Program from 2012-2014.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Greenhouse Vegetable Growers ("OGVG")

Reference: Exhibit A, Tab 3, Schedule 3

Preamble: This table illustrates the variation between the DSM costs embedded in 2014 rates for each class, and the DSM costs allocated to each class in 2014 on an actual basis.

a) The evidence shows a variation between embedded and actual DSM costs of

i) 53.1% for the M4 rate class;

ii) (35.4%) for the M5 rate class; and

iii)77.9% for the M7 rate class.

Please explain the drivers for these large variations between the embedded and actual amounts, and discuss whether the variations from the embedded amounts in 2014 is accounted for in planning for subsequent years.

b) Please compare the total cumulative DSM Budget approved in the 2012-2014 DSM Plan against the actual total cumulative DSM spending in 2012, 2013 and 2014 on a rate class by rate class basis. To the extent there are variations in any of the rate classes in excess of 10% please why Union, on a 3 year basis, would deviate so materially from its budget for a rate class, and what measures it takes (if any) to stay within budget on a rate class by rate class basis either within the year or on a cumulative basis over a number of years (i.e. by offsetting material overspending in one year with underspending in a subsequent year).

Response:

a) The main driver of variances between these rate classes is due to rate class eligibility requirements that changed effective January 1, 2014 for these rate classes. As a result of this change, 22 Rate M4 and Rate M5 customers in Union 2013 Board-approved forecast were required to move to Rate M7 effective January 1, 2014. More detail on this change can be found in Union's 2015-2020 DSM Plan proceeding (EB-2015-0029), Exhibit A, Tab 1, page 20.

The allocation to the M4 rate class was above the amount approved in rates which was due to DSM participation in this rate class increasing significantly compared to the assumptions used when developing the DSM budget rate class allocations for the 2012-2014 Multi-year DSM Plan (EB-2011-0327). Union has endeavored to take into account the change in rate class eligibility and past participation levels when allocating the DSM budget to individual rate classes for the 2015-2020 DSM Plan.

b) Please see Attachment 1.

Union monitors its compliance with the annual requirements from the 2012-2014 DSM Plan (EB-2011-0327) Settlement Agreement, dated January 31, 2012, including requirements around rate class allocation of DSM costs compared to budget. The Settlement Agreement allowed Union to exceed the allocation in rates by up to 100%, Union managed its programs within these requirements. As per the 2012-2014 Guidelines, Union is allowed to spend 15% above the approved annual budget to pursue programs that prove to be very successful so long as Union operates within the terms of the Settlement Agreement.

UNION GAS LIMITED
Cumulative DSM Budget vs. Spend
2012-2014 Program Years

Line No.	Particulars	DSM Costs in 2012 Rates(1)	DSM Costs in 2013 Rates(2)	DSM Costs in 2014 Rates(3)	DSM Costs in 2012-14 Rates	Actual 2012 DSM Costs(1)	Actual 2013 DSM Costs(2)	Actual 2014 DSM Costs(3)	Actual 2012-14 DSM Costs	Cumulative Variance 2012-14	Variance
		(a)	(b)	(c)	(d) = (a) + (b) + (c)	(e)	(f)	(g)	(h) = (e) + (f) + (g)	(i) = (h) - (d)	(j) = (i)/(d)
	South										
1	M1	10,223,670	10,450,635	10,585,447	31,259,752	9,928,224	10,333,194	11,758,887	32,020,305	760,552	2.4%
2	M2	3,811,036	3,895,641	3,945,893	11,652,569	3,740,320	4,772,607	4,788,535	13,301,463	1,648,893	14.2%
3	M4	1,572,104	1,607,005	1,627,734	4,806,843	2,708,435	2,729,864	2,492,072	7,930,370	3,123,528	65.0%
4	M5	2,624,378	2,682,639	2,717,244	8,024,262	2,089,944	2,757,127	1,754,936	6,602,007	(1,422,255)	(17.7%)
5	M7	885,953	905,621	917,304	2,708,878	453,765	487,495	1,631,542	2,572,801	(136,077)	(5.0%)
6	T1	4,313,703	1,800,914	1,824,145	7,938,761	4,758,916	1,820,057	1,076,292	7,655,264	(283,497)	(3.6%)
7	T2	-	2,608,553	2,642,202	5,250,755	-	2,770,207	2,872,733	5,642,940	392,185	7.5%
		23,430,843	23,951,008	24,259,970	71,641,821	23,679,604	25,670,550	26,374,997	75,725,151	4,083,329	5.7%
	North										
9	Rate 01	3,650,512	3,731,553	3,779,689	11,161,753	3,016,785	2,992,512	3,221,030	9,230,327	(1,931,427)	(17.3%)
10	Rate 10	1,160,460	1,186,222	1,201,523	3,548,204	1,516,814	1,361,335	1,244,049	4,122,198	573,994	16.2%
11	Rate 20	953,332	974,496	987,067	2,914,894	1,326,339	1,343,800	1,394,033	4,064,171	1,149,278	39.4%
12	Rate 100	1,758,951	1,798,000	1,821,193	5,378,145	1,782,675	1,470,730	1,479,687	4,733,092	(645,053)	(12.0%)
13		7,523,254	7,690,270	7,789,472	23,002,996	7,642,613	7,168,376	7,338,799	22,149,788	(853,208)	(3.7%)
14	Total	30,954,097	31,641,278	32,049,442	94,644,817	31,322,217	32,838,927	33,713,796	97,874,939	3,230,121	3.4%

Notes:
(1) EB-2013-0109, Exhibit A, Tab 1, Appendix A, Schedule 5.
(2) EB-2014-0273, Exhibit A, Tab 4, Schedule 3.
(3) EB-2014-0276, Exhibit A, Tab 3, Schedule 3.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Sustainable Energy Association ("OSEA")

Reference: Exhibit A, Tab 2, Page 5

An O&M custom DSM project is any project where natural gas savings are derived from the repair, replacement, or optimization of an existing piece of equipment or system (e.g. steam leak/trap repair). Custom DSM projects are categorized as either O&M or Capital projects.

Please advise how Union Gas categorizes and accounts for Custom DSM projects that have both capital and O&M components, where synergies may be available.

Response:

Union uses its judgement to account for custom DSM projects that have both capital and O&M components. Typically, a project with a material capital component (e.g. the customer has bid for capital through an internal capital requisition process) that is operation and maintenance related is treated as a Capital Project. These tend to be custom projects with higher customer costs, and Union has recognized this with a higher capital equipment incentive available for those participating customers.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Sustainable Energy Association ("OSEA")

Reference: Exhibit A, Tab 2, Pages 11-12

In its 2013 DSM Deferrals Decision, the Board agreed that an updated custom free ridership study should be completed as soon as possible to support free ridership estimates in the future. Union supports this recommendation and the TEC has prioritized a joint utility net-to-gross ("NTG") study that will develop new free ridership and spillover factors for Enbridge and Union's commercial and industrial custom programs. The TEC selected DNV Kema as the consultant to lead the study. The study methodology and scope of work has been developed and study results are expected mid-2016.

In its 2013 DSM Deferrals Decision the Board agreed that a formal persistence study should be given priority to provide support for the persistence of savings associated with large custom commercial and industrial DSM programs. In an August 21, 2015 Board letter establishing the Board's process to evaluate the results of DSM programs from 2015-2020, the Board recognized that one of the current responsibilities of the TEC included the initiation of a Persistence Study. TEC members completed a jurisdictional scan and observed limited evidence of jurisdictions that have conducted a commercial and industrial program persistence study in the past ten years. The scan also uncovered that more than 90% of studies available are related to electricity and not to natural gas. In September 2015, Board staff shared with the TEC that the work to date that has been initiated by the TEC with respect to the Persistence Study will be transitioned to the Board when the Evaluation Advisory Committee ("EAC") is established. At the November 2015 TEC Meeting, Board staff and the TEC discussed the topic of a transition plan for TEC projects moving to the EAC. Board staff shared that they will initiate a persistence study, with the input from the EAC, in late 2015/early 2016.

Given the delays in the Free Ridership Study and the Persistence Study referenced above and the transition of responsibilities to the Board and the EAC, please explain what impact Union Gas expects on the future timeliness of the implementation of the recommendations of the Board and Board Staff.

Response:

Union will adhere to the evaluation process outlined in Section 7.1 of the Board's Guidelines in the DSM Framework Consultation (EB-2014-0134) and further detailed in the Board's August

21, 2015 letter in the DSM Evaluation Process (EB-2015-0245) proceeding. Part of the newly outlined DSM evaluation governance involves a third party Evaluation Contractor retained by the Board. Union expects implementation timelines to be determined by the Evaluation Contractor with input from the Evaluation Advisory Committee. Union is not in a position to speculate on future timeliness of the implementation of the recommendations of the Board and Board staff.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Sustainable Energy Association ("OSEA")

Reference: Exhibit A, Tab 3, Page 9

The 2014 Large Volume (Rate T1, Rate T2 and Rate 100) program did not achieve a DSM Incentive, based upon its performance compared to the targets approved by the Board in the 2013-2014 DSM Plan for Large Volume Customers proceeding (EB-2012-0337).

Please explain why the Large Volume Program did not deliver the expected results.

Response:

Please see the response at Exhibit C.IGUA.5.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Sustainable Energy Association ("OSEA")

Reference: Exhibit B, Tab 1, Page 19

Free ridership and spillover do not get included in the calculations for this metric.

Please explain why free ridership and spillover are not included for in this metric.

Response:

Free ridership and spillover are not included for the purpose of calculating the Residential Deep Savings scorecard metric as this metric is simply the number of homes/program participants meeting the minimum savings and measure implementation thresholds outlined in the 2012-2014 Multi-year DSM Plan (EB-2011-0327), Settlement Agreement, dated January 31, 2012.

The savings associated with these homes are accounted for in the Cumulative Natural Gas Savings (m^3) metric on the Resource Acquisition scorecard and are included net of free ridership.

UNION GAS LIMITED

Answer to Interrogatory from
Ontario Sustainable Energy Association ("OSEA")

Reference: Exhibit B, Tab 1, Page 97

Savings from projects that are obvious safety hazards (e.g. gas leaks or very large steam leaks) or are otherwise obviously free riders should not be eligible for Union incentives. Discussions as to whether other broad classes of maintenance or behavioral projects (e.g. steam traps tests and repairs, pipe insulation) should be eligible for the program should be determined at the policy level prior to the beginning of the program year.

Status Update: Pending – The AC accepts the Auditor's recommendation in principle that savings from projects that are obvious safety hazards should not be eligible for incentives. The AC also agrees that if classes of projects are to be made ineligible that this policy should be established in advance.

The AC agrees that in the future Union will not claim projects involving fixing gas leaks for DSM savings.

There are classes of projects, generally O&M projects (e.g. cleaning heat exchangers, fixing steam leaks or steam traps) for which there might be an increased potential of overlap between the concepts of baseline and free ridership. The AC does not propose to prohibit savings from these projects, but rather clearly delineate how baseline and free ridership should be treated. In last year's report the parties agreed that

> Where the conservation measure is of a behavioural or maintenance nature, the information about the customer's current practises (prior to participation in the program) must be collected.

Free ridership should then be evaluated by a separate set of questions in free ridership surveys to ensure that there is no overlap between the concepts of baseline (the customer's current practices prior to participation in the program) and free ridership. Adjusting the baseline to reflect customer's current practice would require re-evaluation of existing free ridership to prevent overlap between the two concepts. Union will refer this to the TEC for discussion in the context of the net to gross work currently being done. Recommendation #6 above provides for identifying this subset of projects so that customized survey questions can be asked.

Please provide additional details on the nature of gas leaks identified above. Please explain why gas distributors should not claim gas savings from leaks, whether on customer premises or on their own systems, where leaking gas is even a greater contributor to global warming, presents a health hazard and the Low Income program includes healthy home elements.

Response:

The 2013 Commercial/Industrial Custom Project Savings Verification ("CPSV") included a gas leak project. Given the hazard presented by a gas leak, the Auditor assumed that for safety reasons the project would require immediate repair. This was used to support the overarching recommendation that savings from projects that are obvious safety hazards would have to be addressed regardless of program incentives. For this reason, the 2013 Audit Committee ("AC") agreed that this category of maintenance project (i.e. gas leaks) should not be considered an eligible DSM project.

For the specific 2013 CPSV project, Union disagreed with the auditor's characterization of the project as a safety issue where the repair would be considered part of a routine maintenance procedure. The gas piping leaks at the facility were located on the roof and emitted gas directly to the outdoor environment, and therefore did not pose a safety hazard (Exhibit B, Tab 1, Recommendation #26, p. 102).

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Please provide a table of all of the custom projects reviewed by the CPSV reviewers, showing the following columns with information for each project:

a) Reviewer name
b) Project number
c) Nature of project
d) In-service date of project
e) Claimed CCM
f) CPSV recommended CCM
g) Final Audit-approved CCM
h) Project cost as verified
i) Incentive paid
j) Simple payback

Response:

Please see Attachment 1.

2014 Custom Projects Reviewed by CPSV Verifiers

Project Type	Reviewer Name a.	Project Number b.	Nature of Project c.	In-Service Date of Project d.	Claimed Net Cumulative Natural Gas Savings (m^3) e.	CPSV Recommended Net Cumulative Natural Gas Savings (m^3) f.	Final Audited Net Cumulative Natural Gas Savings (m^3) g.	Project Cost as Verified (Gross) h.	Incentive Paid i.	Simple Payback w/o Incentive (years) j.
Low Income	Michaels Energy	2014-COM-0095	Roof Insulation	25-01-2014	38,399	59,128	59,128	$15,270	$3,840	23.8
Low Income	Michaels Energy	2014-COM-0282	VFD on MAU	12-11-2014	57,019	82,137	82,137	$3,628	$1,814	2.0
Low Income	Michaels Energy	2014-COM-0299	Windows	14-11-2014	74,309	20,468	20,468	$22,069	$7,431	25.6
Low Income	Michaels Energy	2014-COM-0179	VFD on MAU	30-05-2014	143,650	56,159	56,159	$9,665	$4,832	5.0
Low Income	Michaels Energy	2014-COM-0181	VFD on MAU	30-05-2014	134,349	42,494	42,494	$5,109	$2,555	4.9
Low Income	Michaels Energy	2014-COM-0300	Windows and Doors	15-09-2014	143,773	6,631	6,631	$10,217	$14,377	34.8
Low Income	Michaels Energy	2014-COM-0302	Windows	17-11-2014	241,148	66,833	66,833	$15,347	$24,115	6.4
Low Income	Michaels Energy	2014-COM-0312	HVAC Controls	26-11-2013	100,220	-	-	$17,850	$8,925	-
Low Income	Michaels Energy	2014-COM-0306	Solar Pre-Heater	14-11-2014	818,121	619,077	619,077	$228,900	$81,812	51.7
Low Income	Michaels Energy	2014-COM-0313	HVAC Controls	11-11-2014	1,081,746	629,009	629,009	$205,880	$100,080	22.9
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0178	Steam leak repairs	24-11-2013	12,820,375	7,748,548	3,874,274	$80,283	$40,000	0.4
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0569	Multi-measure process and energy intensity upgrades	01-11-2013	25,336,800	25,336,800	25,336,800	$89,598,370	$120,000	49.7
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0087	High efficiency, direct fired H&V unit	15-12-2013	119,269	128,561	128,561	$4,000	$1,296	1.4
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0183	Insulate dryer drum	14-05-2013	672,446	326,308	326,308	$19,800	$7,309	2.2
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0112	Steam leak repairs & 2 process heating coil replacements	22-09-2013	3,008,492	3,208,813	1,604,406	$5,040	$2,520	0.2
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0166	Process oven burner upgrade and heat	22-04-2014	2,445,296	2,445,296	2,445,296	$49,680	$26,579	1.1

Project Type	Reviewer Name a.	Project Number b.	Nature of Project c.	In-Service Date of Project d.	Claimed Net Cumulative Natural Gas Savings (m^3) e.	CPSV Recommended Net Cumulative Natural Gas Savings (m^3) f.	Final Audited Net Cumulative Natural Gas Savings (m^3) g.	Project Cost as Verified (Gross) h.	Incentive Paid i.	Simple Payback w/o Incentive (years) j.
			recovery							
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0056	Deaerator heat recovery	01-02-2014	4,763,880	2,360,518	2,360,518	$15,615	$7,808	0.2
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0079	Steam leak repairs	28-11-2013	2,767,544	2,592,266	1,296,133	$4,600	$2,300	0.2
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0051	Greenhouse expansion - multi-measure	25-02-2013	2,057,838	3,784,475	3,784,475	$314,830	$31,954	3.0
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0025	Greenhouse expansion - multi-measure	03-02-2014	10,797,967	10,026,684	10,026,684	$1,290,000	$62,140	4.1
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0024	Greenhouse expansion - multi-measure	15-01-2014	7,996,734	7,463,619	7,463,619	$849,847	$56,200	4.2
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0114	Greenhouse expansion - multi-measure	10-06-2014	7,804,521	8,008,161	8,008,161	$655,675	$59,800	3.3
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0172	Insulation of steam supply lines	01-05-2014	5,469,713	5,561,750	5,561,750	$15,500	$7,750	0.1
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0320	Greenhouse expansion - multi-measure	20-09-2014	3,216,703	3,466,877	3,466,877	$151,448	$40,000	1.4
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0021	Greenhouse expansion - multi-measure	26-12-2013	20,071,169	18,816,721	18,816,721	$1,647,500	$70,200	3.2
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0022	Greenhouse expansion - multi-measure	19-12-2013	14,502,755	13,596,333	13,596,333	$1,405,750	$61,400	3.8
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0570	Insulate steam, condensate, hot water piping	21-02-2013	6,610,540	6,610,540	6,610,540	$106,000	$40,000	0.9
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0333	Heat exchanger upgrade	21-07-2014	3,751,742	2,799,384	2,799,384	$115,003	$40,000	1.6

Project Type	Reviewer Name a.	Project Number b.	Nature of Project c.	In-Service Date of Project d.	Claimed Net Cumulative Natural Gas Savings (m^3) e.	CPSV Recommended Net Cumulative Natural Gas Savings (m^3) f.	Final Audited Net Cumulative Natural Gas Savings (m^3) g.	Project Cost as Verified (Gross) h.	Incentive Paid i.	Simple Payback w/o Incentive (years) j.
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0210	Heat exchanger upgrade	15-12-2013	1,136,853	1,022,376	1,022,376	$50,000	$12,357	1.7
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0240	Upgrade building systems to LEED standards	31-07-2014	7,570,947	6,880,018	6,880,018	$13,000,000	$40,000	24.5
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0115	Steam leak repairs	01-05-2014	962,826	925,796	462,898	$9,392	$4,696	1.0
Commercial/ Industrial	Byron Landry & Associates	2014-IND-0261	Insulate piping, valves and heat exchangers	01-04-2014	158,985	195,233	195,233	$51,191	$1,728	13.9
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0345	Boiler control upgrades and adjustments	09-10-2014	750,180	539,042	539,042	$12,480	$14,948	0.5
Commercial/ Industrial	Byron Landry & Associates	2014-COM-0239	Upgrade building systems to LEED standards	01-09-2013	306,894	416,751	416,751	$445,000	$3,336	47.7
Large Volume	Diamond Engineering	2014-IND-0649	Steam leak repairs	01-11-2014	16,074,470	17,976,800	8,988,400	$15,890	$7,945	0.1
Large Volume	Diamond Engineering	2014-IND-0670	Steam leak repairs	30-09-2014	17,083,526	8,772,678	4,489,600	$526,227	$20,000	6.5
Large Volume	Diamond Engineering	2014-IND-0487	Steam leak repairs	31-12-2013	11,887,826	7,867,840	3,933,920	$530,045	$20,000	7.5
Large Volume	Diamond Engineering	2014-IND-0664	Steam trap replacements	05-09-2014	1,018,000	996,590	498,295	$8,019	$4,009	0.2
Large Volume	Diamond Engineering	2014-IND-0356	Steam trap replacements	31-12-2013	3,367,750	3,780,280	1,890,140	$25,149	$12,574	0.3
Large Volume	Diamond	2014-IND-0522	Steam trap	01-11-2014	7,140,421	10,796,660	5,398,330	$218,337	$20,000	0.8

Project Type	Reviewer Name a.	Project Number b.	Nature of Project c.	In-Service Date of Project d.	Claimed Net Cumulative Natural Gas Savings (m^3) e.	CPSV Recommended Net Cumulative Natural Gas Savings (m^3) f.	Final Audited Net Cumulative Natural Gas Savings (m^3) g.	Project Cost as Verified (Gross) h.	Incentive Paid i.	Simple Payback w/o Incentive (years) j.
	Engineering		replacements							
Large Volume	Diamond Engineering	2014-IND-0452	Process improvement to allow productive use of steam generated on weekends	01-10-2014	13,311,278	22,245,600	22,245,600	$1,352,455	$65,000	5.0
Large Volume	Diamond Engineering	2014-IND-0675	Evaporator steam injector repair	16-11-2014	5,125,817	5,659,840	5,659,840	$16,000	$8,000	0.2
Large Volume	Diamond Engineering	2014-IND-0371	Control programming to close dampers when OA not needed for process	28-11-2014	913,569	1,589,760	1,589,760	$920	$460	0.03
Large Volume	Diamond Engineering	2014-IND-0620	Repair of boiler preheater	07-06-2014	2,525,612	2,030,670	2,030,670	$264,391	$20,000	0.4
Large Volume	Diamond Engineering	2014-IND-0612	Re-route condensate from condensing turbine back to boiler	11-01-2014	66,484,536	66,782,800	66,782,800	$362,465	$55,975	0.2
Large Volume	Diamond Engineering	2014-IND-0615	Burner upgrade on process furnace	25-08-2014	35,898,400	36,616,000	36,616,000	$348,212	$50,000	0.4
Large Volume	Diamond Engineering	2014-IND-0608	COG pipeline replacement/cleaning	07-11-2013	42,279,902	39,951,000	26,647,800	$261,272	$80,000	0.6
Large Volume	Diamond Engineering	2014-IND-0622	COG pipeline replacement	01-11-2013	5,877,760	11,817,400	11,817,400	$62,300	$20,000	0.1
Large Volume	Diamond Engineering	2014-IND-0431	Feedwater economizer on backup boiler	01-07-2014	5,427,632	339,204	339,204	$300,000	$50,000	48.9
Large Volume	Diamond Engineering	2014-IND-0299	High-efficiency turbine generator	01-07-2014	2,288,003	854,036	854,036	$800,000	$24,870	51.8

Project Type	Reviewer Name a.	Project Number b.	Nature of Project c.	In-Service Date of Project d.	Claimed Net Cumulative Natural Gas Savings (m^3) e.	CPSV Recommended Net Cumulative Natural Gas Savings (m^3) f.	Final Audited Net Cumulative Natural Gas Savings (m^3) g.	Project Cost as Verified (Gross) h.	Incentive Paid i.	Simple Payback w/o Incentive (years) j.
Large Volume	Diamond Engineering	2014-IND-0287	Kiln insulation replacement	01-01-2014	949,366	1,398,400	1,398,400	$134,657	$10,319	5.3
Large Volume	Diamond Engineering	2014-IND-0543	Steam trap repairs	01-11-2014	12,765,262	14,908,600	7,454,300	$205,467	$20,000	0.5
Large Volume	Diamond Engineering	2014-IND-0609	COG pipeline replacement/cleaning	06-09-2014	73,702,240	82,579,200	55,048,200	$956,000	$100,000	1.5
Large Volume	Diamond Engineering	2014-IND-0630	Pipe insulation repairs	31-12-2013	49,248,925	45,153,600	45,153,600	$337,691	$10,000	0.4
Large Volume	Diamond Engineering	2014-IND-0632	Pipe insulation repairs	31-12-2013	16,338,022	15,005,200	15,005,200	$109,244	$10,000	0.4
Large Volume	Diamond Engineering	2014-IND-0667	Pipe insulation repairs	31-12-2013	40,061,244	55,347,200	55,347,200	$367,734	$21,546	0.4

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Please confirm that none of the baselines for any of the custom projects assume a cap-and-trade system for carbon in Ontario.

Response:

Confirmed. 2014 custom project baselines do not assume a cap-and-trade system for carbon in Ontario.

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit A, Tab 2, Page 7

Please confirm that the procedures for 2014 by which the Auditor assessed the reasonableness of the baseline were the same as those used for 2013 results.

Response:

Confirmed.

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Table 13.0

Please refile this table but, on each line that aggregates "incentives/promotion" or "incentives/promotion/admin" break that out into the individual lines. Please ensure that transfers between categories are included for this more granular reporting.

Response:

Please see Attachment 1.

	2014 Spend	2014 Budget	Variance	Budget Transfers	Total DSMVA
	A	B	C=A-B	D	E=C-D
Program Budget					
Resource Acquisition Scorecard					
Residential Incentives	$ 1,701,192	$ 898,847	$ 802,345	$ -	$ 802,345
Residential Promotion	$ 1,280,974	$ 1,835,000	$ (554,026)	$ -	$ (554,026)
Residential Administration	$ 532,284	$ 613,340	$ (81,056)	$ (81,056)	$ -
Residential Evaluation	$ 173,300	$ 21,302	$ 151,998	$ 151,998	$ -
Commercial/Industrial Incentives	$ 8,566,038	$ 6,437,093	$ 2,128,945	$ 300,000	$ 1,828,945
Commerical/Industrial Promotion	$ 1,184,752	$ 1,570,000	$ (385,248)	$ -	$ (385,248)
Commercial/Industrial Administration	$ 2,786,916	$ 2,856,355	$ (69,439)	$ (69,439)	$ -
Commercial/Industrial Evaluation	$ 103,687	$ 63,906	$ 39,781	$ 39,781	$ -
IEMS	$ 100,000	$ 639,061	$ (539,061)	$ (300,000)	$ (239,061)
Large Volume Scorecard (Rate T1, T2/R100)					
Large Volume T1 Incentives	$ 663,927	$ 1,176,342	$ (512,415)	$ -	$ (512,415)
Large Volume T1 Promotion	$ 3,446	$ 106,510	$ (103,064)	$ -	$ (103,064)
Large Volume T2/R100 Incentives	$ 2,553,834	$ 2,537,669	$ 16,165	$ -	$ 16,165
Large Volume T2/R100 Promotion	$ -	$ -	$ -	$ -	$ -
Large Volume T1/T2/R100 Administration	$ 771,923	$ 965,527	$ (193,604)	$ (134,553)	$ (59,051)
Large Volume T1/T2/R100 Evaluation	$ 108,595	$ 42,604	$ 65,991	$ 65,991	$ -
Low-Income Scorecard					
Low-Income Program Incentives	$ 6,224,933	$ 5,245,688	$ 979,245	$ -	$ 979,245
Low-Income Program Promotion	$ 1,235,066	$ 960,876	$ 274,190	$ -	$ 274,190
Low-Income Administration	$ 825,767	$ 1,034,799	$ (209,032)	$ -	$ (209,032)
Low-Income Evaluation	$ 243,580	$ 42,603	$ 200,977	$ 200,977	$ -
Market Transformation Scorecard					
Optimum Home Incentives	$ 748,124	$ 937,145	$ (189,021)	$ (189,021)	$ -
Optimum Home Promotion	$ 114,717	$ 325,000	$ (210,283)	$ (210,283)	$ -
Optimum Home Administration	$ 400,117	$ 206,818	$ 193,299	$ 193,299	$ -
Programs Sub-total	**$ 30,323,172**	**$ 28,516,484**	**$ 1,806,688**	**$ (32,306)**	**$ 1,838,994**
Portfolio Budget					
Research	$ 834,986	$ 816,085	$ 18,901	$ 18,901	$ -
Evaluation	$ 398,782	$ 1,032,178	$ (633,396)	$ (458,747)	$ (174,649)
Administration	$ 2,156,856	$ 1,684,704	$ 472,152	$ 472,152	$ -
Portfolio Sub-total	**$ 3,390,624**	**$ 3,532,967**	**$ (142,343)**	**$ 32,306**	**$ (174,649)**
Total 2014 DSM Budget	**$ 33,713,796**	**$ 32,049,450**	**$ 1,664,345**	**$ -**	**$ 1,664,345**

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Appendix E

Please provide a table showing all claimed CCM for Custom O&M projects. Please provide a calculation of the total incremental impact of those projects on the DSMIDA.

Response:

Table 1 shows the cumulative natural gas savings (m^3) ("CCM") claimed in the Resource Acquisition and Large Volume portfolios for Custom O&M projects. The Low Income portfolio has not been included as there are no Custom O&M projects claimed in this program.

Table 1

	Audited Cumulative Natural Gas Savings (m^3)
Resource Acquisition	185,360,321
Large Volume	633,067,279

Union notes that the calculation of DSM Incentive on a scorecard is not linear. For example, any CCM claimed between 0% and 50% of a scorecard does not contribute anything to the DSM Incentive amount claimed. The impact of removing the CCM related to Custom O&M projects is approximately $1.4 million at the margin. However, since cumulative natural gas savings (m^3) from Custom O&M projects are claimed throughout the year, a calculation at the margin is not representative of the contribution of Custom O&M projects to the total DSM Incentive claimed.

If the entire category of Custom O&M projects is removed, Union's 2014 target would have to be revised given that the target is formulaic and based on 2013 achievement. As such, Union has adjusted both the target and the 2014 savings claim to exclude Custom O&M projects. This ensures that the 2014 target and achievements are assessed based on similar project eligibility criteria. In this scenario, Union's achievement is still above the upper band and there would be no impact to the DSM Utility Incentive.

Table 2 shows Union's revised 2014 Resource Acquisition Scorecard (targets and achievement) assuming the entire category of Custom O&M projects is removed and not included in Union's program offering.

Table 2

Metrics	Metric Target Levels: Lower Band	Metric Target Levels: Target	Metric Target Levels: Upper Band	Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
Cumulative Natural Gas Savings (m^3)	523,713,677	698,284,903	872,856,129	90%	776,211,489	122%	110%
Deep Savings – Residential	204	254	304	5%	996	842%	42%
Deep Savings - C/I	8.97%	9.97%	10.97%	5%	7.88%	-5%	0%
						Total Scorecard Target Achieved	150%[1]
						Scorecard Incentive Achieved	$5,666,634

[1] Scorecard is capped at 150%. Actual scorecard achievement is 152%.

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Appendix L, pp. 1-3

Please provide an explanation why the amounts claimed for every single one of the low income projects reviewed were materially incorrect. Please provide a description of any internal information or control issues, or other factors, that Union believes have contributed to the poor accuracy results for this category of projects. Please provide any evidence in the possession of Union Gas that show whether or not the adjustments by the reviewer are in fact indicative of similar adjustments required for the projects not reviewed (i.e. whether the statistical assumptions relevant to the sample are actually reasonable).

Response:

Union's savings estimates for custom projects are based on the best information available, which may change from the time a project application is approved to when it is verified. A summary of factors contributing to the 2014 low income project savings adjustments include:

- Customer equipment operating schedules differed or the equipment was not operating as expected at the time of the verification site visit
- Verifier determination that windows projects should be considered advancements and savings calculated based on a dual baseline
- Verifier savings adjustments for competing energy efficiency measures installed simultaneously with building heat distribution controls

Union continues to refine its approach to estimating savings while promoting adoption of energy efficient measures by incorporating lessons learned through its project application process as well as feedback resulting from the evaluation process.

The sample for the 2014 Low-Income custom project savings verification includes 10 projects from a total population of 27 projects and represents 65% of the total population in terms of cumulative natural gas savings (m^3). These adjustments have been extrapolated to the remainder of the projects via the realization rates, which are applied to the entire Low-Income custom project portfolio.

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Appendix L, p. 13

Please explain how the 103% efficiency issue was eventually resolved. If it was never resolved (i.e. if the cause of the problem was never identified), please explain why.

Response:

This issue was resolved by the verifier (Michaels Energy) by replacing the 103% efficiency with a 96% efficiency across all temperature bins. This is discussed in Exhibit B, Tab 1, Appendix L, page 38.

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Appendix M

Please confirm the reviewer's general assumption in reviewing each project that, unless there was "hard evidence" to the contrary, the savings proposed by the Applicant should be used.

Response:

The Commercial/Industrial Verifier (Byron Landry) did not adopt a general assumption in reviewing each project that unless there was "hard evidence" to the contrary, the savings proposed by the applicant should be used. Rather, the Verifier provided an independent opinion based on his professional judgement. The basis for this opinion was consistent with the endorsed and approved 2014 Custom Project Savings Verification Terms of Reference ("CPSV ToR") by both the Technical Evaluation Committee and Audit Committee. The CPSV ToR states:

> *"Using information collected during site-visits and interviews as well as its own expertise, the consultant will develop its own independent estimate of the savings for the project. The independent estimate should be based on the consultant's own tools, calculations and assumptions. Note that Union's savings goals are expressed as total lifetime savings. Thus, the consultant's work must address both the reasonableness of estimates of annual savings and the reasonableness of estimates of the life of those savings. The consultant's basis for assumptions made in developing the independent estimates of lifetime savings (both first year savings and measure life) must be, to the extent practical, documented with appropriate references and/or other forms of substantiation. If the consultant cannot identify a reference, the consultant must provide a rationale for their assumption."*

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Appendix M, p. 2

Please confirm that the claimed savings for steam leak repairs were 13.5% of the total, but after review the savings from those projects were 10.8% of the total. Please confirm that approximately 65% of the reviewer's CCM reductions for the reviewed projects represented reductions in projects designated as steam leak repairs.

Response:

Union confirms that the claimed gross cumulative natural gas savings (m^3) for the steam leak repairs in the sampled Commercial/Industrial ("C/I") projects were 13.5% of the total claimed sample savings. Union also confirms that after the Custom Project Savings Verification ("CPSV") review, the verified steam leak repair savings represented 10.8% of the total verified project sample savings.

However, Union calculates the reductions in projects designated as steam leak repairs to represent 46.9 % of the total gross cumulative natural gas savings (m^3) reductions made by the verifier and not 65%. Table 1 shows the inputs for this calculation.

Table 1

Gross Cumulative Natural Gas Savings (m^3) Reductions	
Total reduction in m^3 to Steam Leak Projects	11,051,770 m^3
Total reduction in m^3 by Verifier for the entire sample	23,564,349 m^3
Percentage of total reduction from steam leak projects	46.9 %

UNION GAS LIMITED

Answer to Interrogatory from
School Energy Coalition ("SEC")

Reference: Exhibit B, Tab 1, Appendix N

Please provide a copy of the report with only the portions that need to be redacted – i.e. with customer-identifying information - actually redacted, similar to the reports in Appendices L and M.

Response:

Please see Union's Submission on Information Filed Confidentially dated March 7, 2016.