ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board (STAFF)

Interrogatory

Issue 13

Reference:

Exhibit E, Tab 5, Schedule 1, Attachment 1 and 2

Question(s):

Enbridge Gas has included a table that lists the NTG and EUL values for various sectors and technologies.

a) Please confirm the sources of the NTG and EUL values included in these tables.

Response

Sources for the Commercial, Industrial and Large Volume Industrial custom NTG values (Exhibit E, Tab 5, Schedule 1, Attachment 1, page 1 – first table):

All NTG values (except for Custom Commercial Program Operational Improvement) are based on the free-ridership rates from the 2018 Natural Gas Demand Side Management Free Ridership Based Attribution Evaluation[1], and spillover rates from the DNV-GL CPSV Participant Spillover Results (filed as Exhibit I.13.EGI.PP.41, Attachment 2). NTG values from each legacy utility were weighted based on 2019 Union and EGD rate zones verified annual gas savings within each reported sector, to create single combined NTG values for 2023+ programs.

Custom Commercial Program Operational Improvement represents low-cost/no-cost measures that optimize the operation of a building. As this measure is new to the custom offering, the NTG value was derived based on former commercial offerings that supported similar low-cost/no-cost operational improvement measures (i.e. RunSmart and RunItRight). The 75% NTG value represents the midpoint between the RunSmart NTG value of 100% and RunItRight NTG value of 50%.

[1] *2018 Natural Gas Demand Side Management Free Ridership Based Attribution Evaluation, OEB, March 13, 2020* https://www.oeb.ca/sites/default/files/2018-DSM-Free-Ridership-Evaluation.pdf

Sources for the Prescriptive, Direct Install, and Midstream NTG values (Exhibit E, Tab 5, Schedule 1, Attachment 1, Pages 1 to 5 – second table):

Target Market		**Equipment Details**		**Prescriptive Offer**	**Direct Install Offer**	**Midstream Offer**	
Sector	**Decision Type / Measure Category**	**Efficient Equipment**	**Building/Space Type/Size**	**NTG**	**NTG**	**NTG**	**Source**
Commercial Cooking	New Construction / Natural Replacement	Energy Star Fryer		80%	80%	80%	1
Commercial Cooking	New Construction / Natural Replacement	Energy Star Convection Ovens		80%	80%	80%	1
Commercial Cooking	New Construction / Natural Replacement	Energy Star Steam Cookers		80%	80%	80%	1
Commercial Cooking	New Construction/ Natural Replacement	High Efficiency Under-Fired Broiler	All sizes	80%	80%	80%	1
Commercial Cooking	New Construction/ Natural Replacement	Energy Star Rack Oven	All sizes	80%	80%	80%	1
Commercial Space Heating	New Construction / Retrofit	Energy Recovery Ventilation (ERV)	All segments and efficiencies	30%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction / Retrofit	Heat Recovery Ventilation (HRV)	All segments and efficiencies	95%	95%	95%	1
Commercial Space Heating	New Construction / Natural Replacement	Energy Recovery Ventilation (ERV) - Incremental	All segments and efficiencies	30%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction / Natural Replacement	Heat Recovery Ventilation (HRV) - Incremental	All segments and efficiencies	95%	95%	95%	1
Commercial Space Heating	New Construction /Retrofit	Air Curtain - Pedestrian Doors	All sizes	50%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction /Retrofit	Air Curtain - Dock-In Shipping and Receiving Doors	All sizes	50%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction /Retrofit	Air Curtain - Drive-In Shipping and Receiving Doors	All sizes	50%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2

Commercial Space Heating	Retrofit	Dock Door Seals	All sizes	50%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction/ Natural Replacement	Condensing Make Up Air Unit (MUA)	All types and segments	95%	95%	95%	1
Commercial Space Heating	New Construction / Natural Replacement	Condensing Unit Heater	All sizes	100%	100%	100%	1
Commercial Space Heating	New Construction/ Natural Replacement / Retrofit	Demand Control Kitchen Ventilation	All sizes	62%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction/ Natural Replacement	Demand Control Ventilation	All segments	8%	80%	80%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	Retrofit	Demand Control Ventilation	All segments	8%	95%	95%	Direct Install & Midstream: 1. Prescriptive: 2
Commercial Space Heating	New Construction / Retrofit	Destratification Fans	All sizes	90%	90%	90%	1
Commercial Space Heating	New Construction / Natural Replacement	High Efficiency Condensing Furnace		82.5%	82.5%	82.5%	1
Commercial Space Heating	New Construction / Retrofit	Infrared Heater	All types and sizes	7%	67%	67%	Direct Install & Midstream: 1. Prescriptive: 2
Multi-Residential Water Heating	Retrofit	Faucet Aerator	All types and efficiencies	90%	90%	90%	1
Multi-Residential Water Heating	New Construction / Retrofit	Low-flow showerhead	All efficiencies	90%	90%	90%	1
Commercial Water Heating	New Construction / Natural Replacement	Condensing Storage Water Heater	All sizes and segments	95%	95%	95%	1
Commercial Water Heating	New Construction / Natural Replacement	Condensing Tankless Water Heater	All sizes and segments	98%	98%	98%	1
Commercial Water Heating	New Construction / Natural Replacement	Energy Star Dishwasher - Conveyor type	All temps	73%	73%	73%	1
Commercial Water Heating	New Construction/ Natural Replacement	Energy Star Dishwasher - Stationary door type	All temps	80%	80%	80%	1
Commercial Water Heating	New Construction/ Natural Replacement	Energy Star Dishwasher - Undercounter	All temps	60%	60%	60%	1

Commercial Water Heating	New Construction / Retrofit	Ozone Laundry Treatment	All types and sizes	92%	92%	92%	1
Residential Space Heating	New Construction / Natural Replacement	97% or Higher Efficiency Furnace		100%	N/A	N/A	1
Residential Space Heating	New Construction / Retrofit	Adaptive Thermostat	All install types	96%	N/A	N/A	1
Residential Space Heating	Retrofit	Heat Reflector Panels		100%	N/A	N/A	1
Residential Space Heating	Retrofit	Programmable Thermostat		57%	N/A	N/A	1
Residential Water Heating	Retrofit	Faucet Aerator	All types and efficiencies	67%	N/A	N/A	1
Residential Water Heating	New Construction	High Efficiency Gas Storage Water Heaters		100%	N/A	N/A	1
Residential Water Heating	New Construction / Retrofit	Low-flow showerhead	All efficiencies	90%	N/A	N/A	1
Residential Water Heating	Retrofit	Pipe Wrap		96%	N/A	N/A	1
Residential Water Heating	New Construction / Natural Replacement	Tankless Water Heater	All types and efficiencies	98%	N/A	N/A	1
Reference							
1	EB-2014-0354 Joint Application for Approval of New and Updated Conservation Measures						
2	2017 C&I Prescriptive Verification, Final Report - Measurement of NTG Factors and Gross Savings Verification, Itron, June 7, 2019. Note: Where legacy utilities had different NTG factors for the same measure, the lower NTG factor was used.						

Sources for Residential – Whole Home, Residential – Air, Sealing (single measure), All Low Income (Single Family, Multi-Family), and Commercial – Whole Building P4P NTG and EUL values (Exhibit E, Tab 5, Schedule 1, Attachment 1, page 6, third and fourth table):

	NTG	**Source**
Residential - Whole Home	95%	1
Residential - Air Sealing (single measure)	95%	Professional air sealing is new and as such does not have an existing NTG factor. Professional air sealing (described at Exhibit E, Tab 1, Schedule 2, Pages 17 to 18) includes in-depth third-party assessments and actions that are expected to have low occurrence without utility program intervention.
All Low Income (Single Family, Multi-Family)	100%	Refer to Exhibit I.5.EGI.SEC.14
Commercial - Whole Building P4P	100%	The Whole Building P4P offering is a new offering that incorporates a significant amount of upfront and ongoing engagement by Enbridge; from initial recruitment via benchmarking and identifying high-potential sites, to opportunity identification and workshops, and subsequent on-going technical support for implementation. The proposed NTG of 100% reflects the high level of engagement required to support a customer through the offering to achieve their deep savings target.

	EUL	**Source**
Residential - Whole Home	25 yrs.	1
Residential - Air Sealing (single measure)	15 yrs.	2019 IESO/OEB Achievable Potential Study
Low-Income - Whole Home	25 yrs.	1
Commercial - Whole Building P4P	10 yrs.	The Whole Building P4P offering is a new offering that will encompass savings from capital, operational and behavioral measures, where the EUL ranges from 5 to 25 years. As such 10 year EUL was deemed appropriate.
Reference		
1: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge Gas Distribution		

Sources for Commercial/Industrial Custom EUL Guideline values (Exhibit E, Tab 5, Schedule 1, Attachment 2):

Technology	Equipment Type	Sector	EUL	Source
Boilers	Space heating - Under 300 MBHp	Commercial & Multi- Residential	25 yrs.	2
	Space heating - 300 to 2500 MBHp	Commercial & Multi-Residential	25 yrs.	2
	Domestic Hot Water	Commercial & Multi-Residential	25 yrs.	2
	Controls (Non Burner Mod.)	All	15 yrs.	2
	Controls (Burner Modification)	All	20 yrs.	2
	Air Makeup (line)	Industrial	15 yrs.	1
	Oxy-Fuel	Industrial	20 yrs.	1
	Low NOx Boiler	Industrial	25 yrs.	1
Building Optimization	Operational Improvement	Commercial	5 yrs.	1
Economizers	Conventional and condensing	Industrial & Commercial	20 yrs.	2
Electronic Burner Control	Linkage-Less Controls, Modulating Motors, Mod Motors	Industrial & Commercial	20 yrs.	2
Agriculture	IR Poly	Greenhouse	5 yrs.	2
	Energy Curtains	Greenhouse	10 yrs.	2
	Grain Dryer	Commercial	20 yrs.	1
HVAC	Air Curtains (single and double door)	Commercial	15 yrs.	2
	High Speed Doors		15 yrs.	2
	Building Automation System - New	Industrial & Commercial	15 yrs.	2
	Cooling tower for HVAC systems	Commercial	15 yrs.	1
	Destratification		15 yrs.	1
	Dessicant Cooling	Industrial & Commercial	15 yrs.	1
	Exhaust Fan Controls	Commercial	15 yrs.	2
	Heat Recovery (COM)	Commercial	15 yrs.	2
	Heat Recovery (IND)	Industrial	20 yrs.	2
	Infiltration Controls - Dock Seals	Commercial	10 yrs.	2
	Infiltration Controls - Air Doors	Industrial & Commercial	15 yrs.	2
	Advance Building Automation System	Commercial & Multi-Residential	15 yrs.	2
	Demand Control Ventilation	Industrial & Commercial	15 yrs.	1
	Make-Up Air	All	15 yrs.	1
	Heat Reflector Panels	Commercial & Multi-Residential	15 yrs.	2
	VFD retrofit on MUA	Commercial / Multi-Residential and Industrial	15 yrs.	2
	Infrared heaters	Industrial	17 yrs.	1
	Furnace	Industrial	18 yrs.	1
	Turndown controls on Modulating Boiler	Commercial	15 yrs.	2

Heat Exchangers	Plate - Plate or Tube-Tube (COM)	Commercial	17 yrs.	2
	Plate - Plate or Tube-Tube (IND)	Industrial		2
	Air -Air (COM)	Commercial		2
	Air -Air (IND)	Industrial		2
Insulation	Roof/Ceiling insulation	Industrial & Commercial	25 yrs.	2
	Pipe Insulation	Industrial & Commercial	14 yrs.	2
	Building Weatherization - Air sealing	Commercial	15 yrs.	1
	Building Envelope	Commercial	25 yrs.	2
	Tank Exterior Insulation	Industrial & Commercial	20 yrs.	1
Ovens and Thermal oxidizers	Low Temperature (less than 300°C)	Industrial	20 yrs.	2
	Medium Temperature (300°C - 1000°C)	Industrial	20 yrs.	2
	High Temperature (>1000°C)	Industrial	20 yrs.	2
Process Controls	Electronic Loop Controllers	Industrial	20 yrs.	2
	PLC's	Industrial	20 yrs.	2
	Flame Supervision (relays)	Industrial	20 yrs.	2
Steam Distribution	Steam Traps	Industrial & Commercial	6 yrs.	2
	Steam Valve	Industrial	10 yrs.	1
		Food Services		
Water Conditioners	Reverse Osmosis (RO)	Industrial	20 yrs.	2
	Ion Exchange	Industrial	20 yrs.	2
Industrial Equipment	All other industrial equipment	Industrial	20 yrs.	2
Water heating	Ice Resurfacing	Commercial	10 yrs.	3
<u>References</u>				
1	EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge Gas Distribution			
2	Final Report: Custom Measure Life Review, May 10 2018, Michaels Energy			
3	Enbridge Gas 2016 DSM Audited Results			

Note that the following items were included in the Application’s table in error, and as such have been removed:

- Boilers, Industrial Process - greater than 2500MBHp
- Water heating, High Extraction Washer

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Issue 13

Reference:

Exhibit C, Tab 1, Schedule 1, Page 48

Preamble:

Avoided costs are long-term estimates forecasted over the lifetime of DSM measures and include:

- Avoided natural gas commodity costs
- Avoided natural gas upstream transportation and third-party services costs
- Avoided natural gas seasonal storage costs.
- Avoided unaccounted for natural gas fuel losses.
- Avoided natural gas downstream infrastructure costs[3]
- Avoided costs, other resources (electricity, heating fuel oil, propane, and/or water)
- Avoided carbon costs"

Question(s):

(a) Please provide a live excel workbook (or spreadsheets) containing a full breakout of all of the prices and inputs for the avoided cost calculations underlying Enbridge's application (e.g. \$/m3, \$/kWh, etc.). Include the forecast carbon price for avoided carbon costs for each year both as \$/tonne CO2e and as \$/m3 of gas.

(b) Please describe Enbridge's forecast avoided carbon price in 2031 and beyond.

(c) Please provide the basis of the proposed EGI Discount Rate of 6.08% for calculating DSM Avoided Costs.

<u>Response:</u>

a) Please see response to Exhibit I.5.EGI.ED.16a.

b) Please see response to Exhibit I.5.EGI.ED.16d.

c) Enbridge Gas uses a 4% real discount rate to determine the net present value of avoided costs over the lifetime of DSM measures, consistent with the 2015-2020 DSM Framework (Exhibit C, Tab 1, Schedule 1, page 49).

   This rate was converted into a nominal rate of 6.08% using the following equation and an inflation factor of 2%[1]:

$$Nominal\ discout\ rate = (1 + 4\%) \times (1 + inflation\%) - 1$$

[1] EB-2021-0002, EGI DSM Multi-year Plan and Framework Application (Update: September 29, 2021), Exhibit C, Tab 1, Schedule 1, p. 48 and Exhibit E, Tab 5, Schedule 1, Attachment 3, p. 1 and p. 3.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Issue 13

Reference:

Exhibit E Tab 5 Schedule 1 Attachment 3 Attachment 4- Guidehouse DSM Avoided Costs Study

Question(s):

a) Please provide a Comparison of the Ontario/EGI Avoided Cost for the *Residential DSM Programs* to US jurisdiction's reviewed by Guidehouse.

b) Provide the Ranges ($ Canadian)

c) What does the IESO use for electricity CDM?

Response:

a - b)

The Guidehouse Inc. review explored avoided cost practices and policies in various jurisdictions, not avoided cost prices/values. The scope of the review did not include an assessment of residential avoided costs specifically, or the reporting of avoided cost prices/values used in other jurisdictions.

In some cases, Guidehouse Inc. included avoided cost prices/values where the consultant deemed it informational with respect to the practice or policy in that jurisdiction. However, avoided cost prices/values were not the focus and therefore Enbridge Gas cannot provide a comparison of avoided cost prices among jurisdictions. Furthermore, Enbridge Gas submits that the comparison of avoided costs prices/values between Ontario and other jurisdictions would not be valuable information, as prices vary depending on the market in question.

c) Enbridge Gas does not have a detailed understanding of the IESO's electricity avoided costs and therefore cannot confidently point to what the IESO uses. It should be noted that avoided costs used for CDM Frameworks may not be appropriate for DSM Frameworks, due to the complexity of electricity avoided costs, which may not be appropriate for natural gas programming. For further comments, refer to Exhibit I.5.EGI.ED.16 part (i). For information about what Enbridge Gas uses for electricity avoided costs, refer to Exhibit I.5.EGI.ED.16 part (f).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Issue 13

Reference:

Exhibit E Tab 5 Schedule 1 Page 2 Attachment 1 Pages 5 and 6

Preamble:

As has been outlined in Section 9.0 of the Proposed Framework, Enbridge Gas will use the NTG and EULs provided in Attachment 1 and Attachment 2 in order to determine actual results, until such time as NTG and EUL values are re-evaluated through the OEB led EM&V planning process.

Question(s):

a) Justify the Net to Gross NTG values for the Residential Sector Measures for Residential Space Heating Whole House and Air-Sealing Measures for non-low income homes.

b) Why are the NTG values of 95% reasonable? In the latter case many homeowners do Air-sealing, for example if new doors and windows are installed. Please discuss and provide the basis for the 95% NTG

c) Are the other Residential NTG values based on verified/audited results? If so provide the references. If not, please provide the working Papers for each of the NTG values.

Response:

a - b)

The 95% NTG value for the Whole Home offering continues to be the best available information, and has been used by the utility in recent years, including being adopted as the NTG value for the offering through OEB audits. For more details on the source of the NTG factor for the offering, refer to page 5 of Exhibit I.13.EGI.STAFF.84.

The Professional Air sealing measure is a new measure being introduced via the Single Measure offering. Enridge Gas believes the 95% value is reasonable as this is a new measure being introduced into the market, and no existing NTG factor exists. Professional air sealing (as described at Exhibit E, Tab 1, Schedule 2, pages 17 to 18) includes in-depth third-party assessments and actions that are expected to have low occurrence without utility program intervention. In addition, the professional Air sealing measure is a stand-alone measure with no dependency on the installation of additional measures in the participants home.

c) The sources/references for all residential NTG values can be found in Exhibit I.13.EGI.STAFF.84. The only residential NTG value that is not sourced/referenced via an OEB document is the professional air sealing single measure described in parts a and b above.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Issue 13

Reference:

Exhibit E, Tab 4, Schedule 2, Attachment 2, Page 19 SeeLine Group Ltd- Conclusion

Preamble:

Lessons from Ontario and other jurisdictions support the concept of revising the regulatory framework as it pertains to the NTG application to remove disputes that can be burdensome on the regulators and challenging for rate-payers when associated delays create a bottleneck for financial clearances. Furthermore, having clearly defined evaluation processes and protocols would similarly avoid confusion and contention. The effectiveness of the various evaluation processes will largely be determined by the clarity in the roles and protocols established that guide them.

Question(s):

a) Confirm how NTG ratios are set/confirmed under the OEB Gas DSM Framework.

b) Does EGI agree with the SeeLine Conclusion? Please discuss

c) What changes does EGI propose to NTG for RA programs?

d) How are ratepayers and utilities rewarded/penalized based on NTG ratios. Please Discuss

Response:

a) Under the current OEB DSM Framework, NTG ratios are either studied or established in various ways.

   NTG ratios that have been selected by the EAC to be studied by the Evaluation Contractor have been evaluated using the customer self-report approach (as described in Exhibit E, Tab 4, Schedule 1, paragraph 10). The NTG ratios from these studies are ultimately confirmed by the OEB via DSM Deferral and Variance Account Disposition applications.

Where studies have not been conducted, NTG ratios are established in various ways, including:

- Put forward by the utility within its DSM Plan applications, and confirmed by the OEB via its Decision on the DSM Plan application;
- Put forward by the utility to the Evaluation Contractor, especially for new measures introduced within a DSM Framework term, and confirmed by the OEB via DSM Deferral and Variance Account Disposition applications.
- Established by the Evaluation Contractor and EAC, especially for measures where an existing approved NTG ratio is not explicitly obvious, confirmed by the OEB via DSM Deferral and Variance Account Disposition applications.

b) Enbridge Gas generally agrees with SeeLine’s conclusion. Enbridge Gas submits that the modernization of NTG evaluation methodologies can result in more accurate NTG ratios, as described in Exhibit E, Tab 4, Schedule 5, pages 5 to 7. Furthermore, the documentation of such methodologies within EM&V Protocols can result in the benefits described at Exhibit E, Tab 4, Schedule 5, paragraph 3.

c) Enbridge Gas is not submitting a specific change to NTG evaluation methodologies. Rather, Enbridge Gas is requesting the development of EM&V Protocols, with the first initiative being a comprehensive assessment of NTG evaluation methodologies. Through this process, the modernization of NTG evaluation methodologies can be thoroughly assessed among the EAC and expert consultants. This request is described at Exhibit E, Tab 4, Schedule 5, pages 1 to 7.

d) Enbridge Gas only claims natural gas savings results against natural gas savings targets on its DSM scorecards after NTG ratios have been applied. This ensures that scorecard results reported by the Company only includes savings influenced by the company, based on the guidelines for changes to NTG ratios (the guidelines for applying changes to NTG ratios for the purpose of calculating shareholder incentive is described at Exhibit C, Tab 1, Schedule 1, Section 9.3). In some instances (such as instances where the NTG change was directly within the utility’s influence during the program year), the company is rewarded on its DSM scorecard if NTG ratios are improved. In those same instances, the company is penalized on its DSM scorecard if NTG ratios become less favourable.

   Ratepayers benefit from accurate updates to NTG ratios, as this mechanism encourages the Company to design/deliver DSM programs in a way that maximizes savings influenced by the program while minimizing savings claimed from non-program influences. It is critical, however, that the NTG evaluation methodology is as effective as possible, as inaccurate assessments of NTG ratios can result in ill-advised program changes.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Green Energy Coalition (GEC)

Interrogatory

Issue 13

Question(s):

On p. 6 of Exhibit E, Tab 5, Schedule 1, Enbridge states that the avoided carbon cost that it includes in its cost-effectiveness analyses is “based on the Federal Carbon Charge, applied by rate class, weighted by the customer volume forecast subject to the Federal Carbon Charge.”

a) Please provide an Excel file, with formulae intact, that show how this weighted average carbon tax was developed.

b) What is the rationale for not including the value of avoided federal carbon charge for some customers?

c) Please clarify what “applied by rate class” means in this statement. Is the Company assessing cost-effectiveness of different programs using different carbon tax rates based on the expected differences in rate classes of customers who will participate in each program? Or has the Company simply developed a single Company-wide weighted average carbon tax that it applies uniformly to all of its programs?

d) If the Company is using a single weighted average carbon tax rate for cost-effectiveness assessment of all programs, wouldn’t that under-value the cost-effectiveness of residential and small commercial programs if all gas sales to residential and small commercial customers are subject to the full federal carbon tax? If not, why not?

e) If the Company is using a single weighted average carbon tax rate for cost-effectiveness assessment of all programs, would that over-value the cost-effectiveness of programs that disproportionately serve larger customers not subject to the tax? If not, why not?

Response:

a) Please see response to Exhibit I.5.EGI.ED.16 Attachment 1 and 2, specifically the “Avoided Carbon” tabs.

b) Some customers are exempt from paying the Federal Carbon Charge.[1] As such, applying the value of carbon to all DSM savings would overstate avoided carbon costs.

c) When a DSM measure or project is processed by the utility for a specific customer, the rate class of the customer is recorded. "Applied by rate class" means the utility uses the customer's rate class to calculate the TRC-Plus value for their DSM measure or project. The weightings used for each rate class can be found in Exhibit E, Tab 5, Schedule 1, Attachment 3, pages 1 and 3, Tables A and C. The weightings were developed based on the percentage of forecasted volumes delivered to each rate class that are subject to the Federal Carbon Charge. The assumptions and calculations for the weightings can be found in the "Avoided Carbon" tabs of Exhibit I.5.EGI.ED.16 Attachment 1 and 2.

For clarity, the paragraph above describes how actual TRC-Plus results will be calculated. When forecasting TRC-Plus however, future participant customer rate classes are unknown. Therefore, to forecast TRC-Plus, Enbridge Gas used a similar approach described in the paragraph above, but aggregated the rate classes to a "market segment" level. Those weightings can be found in Exhibit E, Tab 5, Schedule 1, Attachment 3, pages 1 and 3, Tables B and D. The assumptions and calculations for those weightings can also be found in the "Avoided Carbon" tabs of Exhibit I.5.EGI.ED.16 Attachment 1 and 2.

d - e)

Enbridge Gas is not using a single weighted avoided carbon cost for all DSM measures or projects. Refer to part c above for details on Enbridge Gas's approach.

Enbridge Gas's approach is balanced, to limit the understatement or overstatement of avoided carbon costs. By way of example, customers in the EGD rate zone 1 will have 100% of avoided carbon costs applied to them (Exhibit E, Tab 5, Schedule 1, Attachment 3, page 1, Table A). The volumes delivered to this rate class are all forecasted to be subject to the Federal Carbon Charge, as these are generally all residential customers. Similarly, other rate classes in Table A which include customers not subject to the Federal Carbon Charge have weightings less than 100%.

[1] EB-2021-0209, Enbridge Gas Federal Carbon Pricing Program Application, (September 29, 2021), Exhibit A, Tab 2, Schedule 1, pp. 3-6.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Green Energy Coalition (GEC)

Interrogatory

Issue 13

Question(s):

Regarding pages 1 and 3 of Exhibit E, Tab 5, Schedule 1, Attachment 3:

a) Are all of the rate classes listed eligible to participate in Enbridge's DSM programs? If not, which rate classes are not eligible?

b) How did Enbridge estimate the fraction of sales to each customer class that are not subject to the federal carbon tax?

c) Please provide the "weights" Enbridge used for each rate class in calculating the residential, commercial/industrial and large volume weighted averages in Tables B and D.

Response:

a) Please see table below:

Table 1
DSM Eligibility by Rate Class

EGD Rate Zone	
Rate Class	DSM Eligibility
1	Yes
6	Yes
9	No
100	Yes
110	Yes
115	Yes
125	No
135	Yes
145	Yes
170	Yes
200	No
300	No
Union Rate Zones	
Rate Class	DSM Eligibility
1	Yes
10	Yes
M1	Yes
M2	Yes
20	Yes
25	No
100	Yes
M4	Yes
M5	Yes
M7	Yes
M9	No
M10	No
T1	Yes
T2	Yes
T3	No

b - c)

Please see response to Exhibit I.13.EGI.GEC.20a and c.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Green Energy Coalition (GEC)

Interrogatory

Issue 13

Reference:

Exhibit E, Tab 3, Schedule 1, Page 3 of 9

Question(s):

Please provide all analyses the company is aware of that compare the cost-effectiveness of electric versus gas air source heat pumps.

Response:

Please see response to Exhibit I.10h.EGI.STAFF.77b.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Issue 13

Question(s):

a) Please provide the TRC Plus test results for the proposed DSM programs and portfolio based on an updated carbon price increasing from $65 per tonne in 2023 by $15 per year to $170 per tonne CO2e in 2030 and future years.

	2023	2024	2025	2026	2027	2028	2029	2030
Carbon Price ($/tonne CO_2e)	$65	$80	$95	$110	$125	$140	$155	$170

b) Please provide the TRC Plus test results for the proposed DSM programs and portfolio based on application of an average program spill-over of 10% applied to the net-to-gross ratio across all programs.

Response:

a) The TRC Plus test results in Table 1 of Exhibit D, Tab 1, Schedule 4, page 2, includes the updated Federal Carbon Charge projections as per the Avoided Costs in Exhibit E, Tab 5, Schedule 1, Attachment 3.

b) Please see the following table of the TRC Plus test results with an average program spillover of 10% to the net-to-gross ratio across all programs.

2023 TRC-Plus Forecast with an Average Spillover of 10% Applied	TRC-Plus Benefits[1]	TRC Costs	Net Benefits[2]	TRC-Plus Ratio
Residential Program	**$139,222,212**	**$72,597,714**	**$66,624,497**	**1.92**
Residential Whole Home	$81,764,920	$50,374,007	$31,390,913	1.62
Residential Single Measure	$10,235,125	$8,462,823	$1,772,302	1.21
Residential Smart Home	$47,222,167	$12,272,460	$34,949,707	3.85
Program Level Admin		$1,488,425	-$1,488,425	
Commercial Program	**$157,481,958**	**$34,368,966**	**$123,112,992**	**4.58**
Commercial Custom	$123,514,009	$14,344,823	$109,169,186	8.61
Prescriptive Downstream	$10,283,192	$4,230,941	$6,052,251	2.43
Direct Install	$15,975,673	$6,326,684	$9,648,989	2.53
Prescriptive Midstream	$7,709,083	$6,157,430	$1,551,654	1.25
Program Level Admin		$3,309,088	-$3,309,088	
Industrial Program	**$259,050,136**	**$18,651,999**	**$240,398,138**	**13.89**
Industrial Custom	$259,050,136	$14,874,385	$244,175,752	17.42
Program Level Admin		$3,777,614	-$3,777,614	
Low Income Program	**$57,957,362**	**$21,362,531**	**$36,594,831**	**2.71**
Home Winterproofing	$25,009,913	$15,010,965	$9,998,948	1.67
Affordable Housing Multi-Residential	$32,947,449	$4,903,424	$28,044,025	6.72
Program Level Admin		$1,448,142	-$1,448,142	
Large Volume Program	**$21,333,901**	**$7,471,538**	**$13,862,362**	**2.86**
Direct Access	$21,333,901	$7,254,914	$14,078,986	2.94
Program Level Admin		$216,624	-$216,624	
Energy Performance Program	**$0**	**$584,156**	**-$584,156**	**0.00**
Whole Building Pay 4 Performance (P4P)[3]	$0	$530,000	-$530,000	0.00
Program Level Admin		$54,156	-$54,156	
Building Beyond Code Program		**$5,618,903**		
Low Carbon Transition Program		**$625,291**		
Program Subtotal	**$635,045,568**	**$161,281,099**	**$473,764,469**	**3.94**
Portfolio Costs		$18,360,000		
Portfolio Total	**$635,045,568**	**$179,641,099**	**$455,404,469**	**3.54**

1. Forecast 2023 TRC-Plus Benefits are calculated using 2021 Avoided Costs (best available at the time of plan submission).
2. Net Benefits are the difference between the TRC-Plus Benefits and the TRC Costs.
3. Based on the program design, energy savings are not forecasted until Year 2 (2024).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Issue 13

Question(s):

a) Please provide all studies Enbridge has available related to potential spill-over impacts for each sector (which have not already been filed), including the study conducted by Summit Blue for Enbridge.

b) Why has Enbridge not applied spill-over enhancements over the current DSM Framework and related DSM programs.

c) In Enbridge's opinion, what would be the best approach to maximize DSM program spill-over from energy and emission results in Ontario municipalities?

Response:

a) Potential spillover effects have been studied three separate times for the Union and EGD Rate Zones.

- *Summit Blue Custom Projects Attribution Study* completed October 31, 2008. This study included estimates of spillover for 2006-2007 Union Rate Zones and EGD Rate Zone custom CI projects. Please see Attachment 1.
- *DNV-GL CPSV Participant Spillover Results* completed May 23, 2018. As part of DNV-GL's broader 2015 custom offering NTG Study, this study included estimates of spillover for the 2013-2014 Union Rate Zones' custom CI offering and Large Volume program, and EGD Rate Zone's custom CI and RunItRight offerings. Please see Attachment 2.
- *Itron 2017 C&I Prescriptive Verification Study* completed February 7, 2020. This study included estimates of spillover for specific prescriptive measures in Union Rate Zones' 2017 CI prescriptive offering and EGD Rate Zone's 2017 CI prescriptive offering. Please see Attachment 3.

b) Enbridge Gas has applied the spillover rates from the *DNG-GL CPSV Participant Spillover* and *Itron C&I Prescriptive Verification* studies to the appropriate custom and prescriptive DSM offerings in the current DSM Framework. Spillover rates are included in the company's NTG factors provides at Exhibit E, Tab 5, Schedule 1, Attachment 1.

c) The Company's work with municipalities is focused on finding alignment between a municipality's GHG emission reduction initiatives and goals and Enbridge Gas's DSM programs offers. There are two areas that could result in DSM spillover. A coordinated approach to the development of the MEP, between Enbridge Gas and the municipality, will provide a platform for the existing DSM programs and funding to be leveraged. As part of that joint work, the municipalities could introduce additional measures that are not part of Enbridge Gas's program but could be delivered through a "one window" approach to the community.

The second opportunity is through joint marketing and outreach efforts of Enbridge Gas and the municipalities. Enbridge Gas is continually focused on creating awareness and educating the public on the benefits of energy conservation. This marketing and outreach could lead to projects that are not part of a collaborative arrangement with an attribution agreement, or in other words spillover.

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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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.

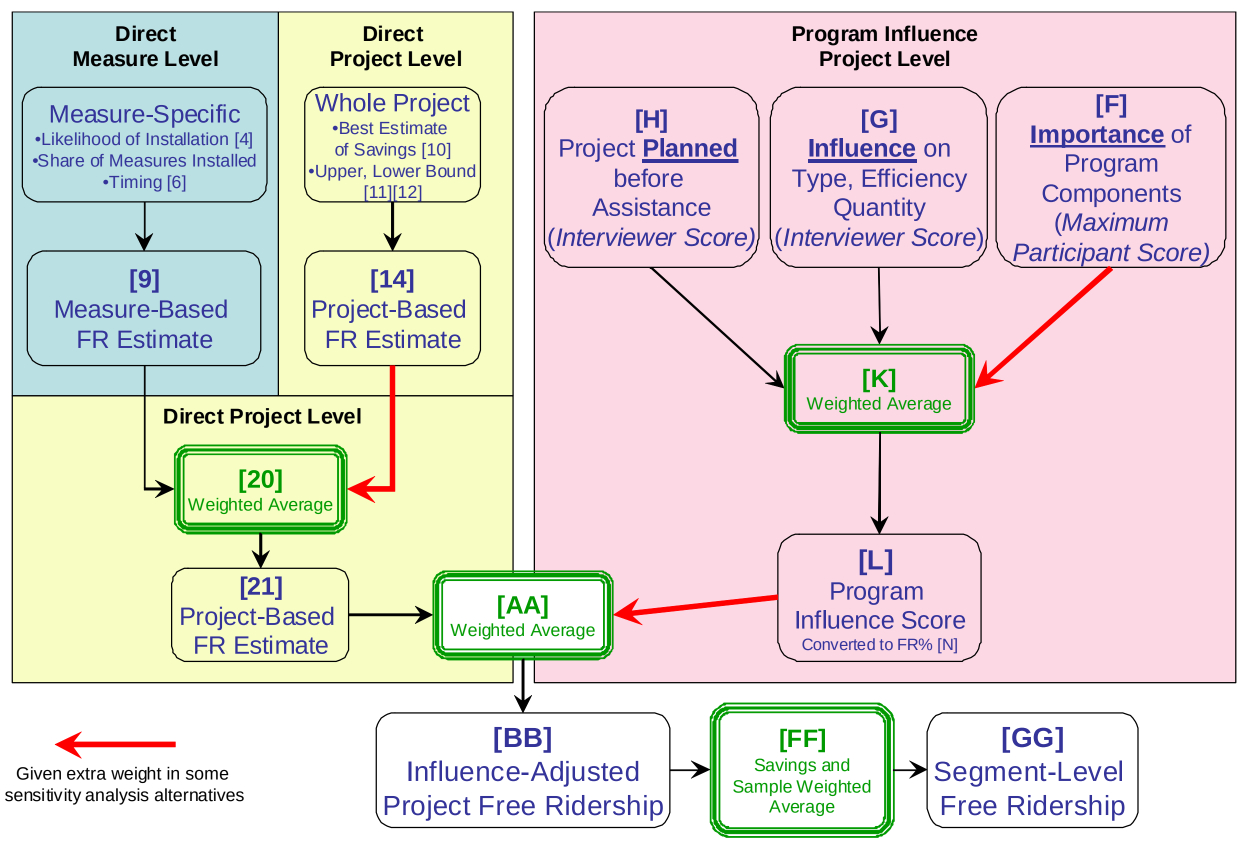
Figure 2-1 presents an overview of the survey and analysis approach. Key points in the diagram are labeled with numbers and letters in square brackets, which we will refer to below. Free ridership was discussed with each respondent in both **direct questions** aimed at obtaining respondent estimates 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.

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[10] Weiss, p. 14.

[11] Vine, Ed. *The Human Dimension of Program Evaluation.* Lawrence Berkley Lab, LBL-33601, 1993.

[12] *Assessment of Energy and Capacity Savings Potential in Iowa Volume 2: Free Riders and Spillover – A Look Back, A Path Forward*, prepared for the Iowa Utility Association by Quantec, July 25, 2002.

[13] Personal correspondence with Gary Cullen, Summit Blue Consulting, October 2007.

Table 3-1. Selected Findings on NTG Ratios

		NTG Ratio
Residential	Efficiency Vermont[14] Energy Trust of Oregon[15]	1.19 1.00
Non-residential	NYSERDA (overall)[16] NYSERDA (CIPP)[17] Wisconsin Power & Light (Shared Savings)[18]	1.09 0.97 0.91

It is difficult to capture long-term market effects with an annual assessment of free ridership. A study done for Massachusetts regulators[19] noted that an annual snapshot of free-ridership and spillover measured without adequately considering the market effects associated with over a decade and a half of energy efficiency programs in Massachusetts will result in potentially biased estimates of net savings. Energy efficient technologies having high market share and few alternatives as a result of these market effects can mean energy efficiency programs now will have high free-ridership.

However, many other jurisdictions do conduct studies to assess the annual impact of free ridership and spillover using several methods. The most common methods used are described briefly below and in more detail in the rest of the section.

- **Self-Report** methods rely on responses to survey questions asking end users and/or vendors what they would have done in the absence of the program support. These methods are primarily used to determine if participating end users would have installed program measures without the program. However, these methods can also determine what additional efficiency improvements participating customers have made outside the program, how participating vendor sales practices would have been different without the program, and how nonparticipating vendor and customer practices have changed since the advent of the program.

- **Econometric Methods** consist of statistical models that compare participants' and non-participants' energy and demand patterns, their knowledge about efficiency options, and/or the trade-offs they are willing to make between efficiency options and the costs of purchasing and installing them. They

[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:

[23] TecMarket Works, *California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals*, April 2006.

[24] Schare, S. & Ellefsen, J. *Advancing the "Science" of Free Ridership Estimation: An Evolution of the Self-Report Method for New York Energy $mart[SM] Programs, 2007.*

[25] *Standardized Methods for Free Ridership and Spillover Evaluation – Task 5 Final Report (Revised).* (PA Consulting Group Inc. 2003).

[26] National Grid (Massachusetts Electric, Nantucket Electric), NSTAR Electric, Northeast Utilities (Western Massachusetts Electric), Unitil (Fitchburg Gas & Electric Company), Cape Light Compact).

[27] Schare, S. & Ellefsen, J. Advancing the "Science" of Free Ridership Estimation: An Evolution of the Self-Report Method for New York Energy $mart[SM] Programs, 2007.

- Set the stage with the respondent by talking about the various ways the participant interacted with the program (including, for example, technical assistance, training, and financial incentives).

- Direct estimation of free ridership from the perspective that is most appropriate for the **project** and to which the respondent can best relate his program experience. This takes the form of either the likelihood that the high-efficiency measures would have been installed without the program, or the share of high-efficiency measures that would have been installed without the program.

- Separate estimation of free ridership addressing the complete project across all measure types and, alternatively, addressing decisions to install specific measures. The dual line of questioning allows respondents to provide a big-picture view of the program's influence on the project as well as to focus on specific measures, which may have been influenced by the program to varying degrees.

- Quantitative incorporation of qualitative responses based on interviewers' probing for details and causality. This aspect of the approach relies on experienced interviewers who are able to apply appropriate judgment to assign influence scores reflecting the degree to which the program affected equipment-purchasing decisions.

- Ask supporting or influencing questions that could be used to verify whether direct responses are consistent with participants' views of the program's influence.

The theory behind attribution analysis is that only impacts caused by the program should be included in net savings estimates; however, absolute proof of causality is unattainable since one can never observe what would have happened in the absence of the program. Consequently, causality "must be justified or rationalized on the basis of *a priori* argument, outside evidence, intuition, theory, or some other informal means."[28] The necessity of this approach to attribution analysis, relying in part on intuition and outside assumptions, is supported by Heckman in his argument that "there is no mechanical algorithm for producing a set of 'assumption free' facts or causal estimates based on those facts."[29]

3.2.3 Triangulation of Methods

California's new evaluation protocols for NTG impact evaluation rely heavily on self-report methods but require triangulation of methods for the enhanced level of rigor. In 2006-2007, California awarded contracts to over 70 consulting firms to perform impact evaluations of all IOU energy efficiency programs; as part of this process the CPUC supported the development of an Evaluation Framework[30] and a set of protocols[31] developed by a NTG Working Group composed of industry leaders in the evaluation field[32]. The Evaluation Framework notes that NTG can be expected to vary depending upon the maturity

[28] Moffitt, R., "*Causal Analysis in Population Research: An Economist's Perspective*," Johns Hopkins Univ., 2003.

[29] Heckman, J., "Causal Parameters and Policy Analysis in Economics: A Twentieth Century Retrospective," *The Quarterly Journal of Economics*, Volume 115, No. 2, 2000, pp. 45-97.

[30] TecMarket Works, *The California Evaluation Framework*, Southern California Edison, 2004.

[31] TecMarket Works, *California Energy Efficiency Evaluation Protocols: Technical, Methodological and Reporting Requirements for Evaluation Professionals*, April 2006.

[32] Summary of Guidelines for Estimating Net-To-Gross Ratios Using the Self-Report Approach, Self-Report_NTG_Checklist_Ridge for CA_sept 07

of the equipment or service, type of delivery in the program, maturity of the program, and customer sector. The California documents classify NTG methods as econometric (comparing participant and non-participants and adjusting for selectivity biases through econometric models) and survey-based (asking participants what they would have done).

California has three levels of rigor that can be applied to NTG analysis—basic, standard, and enhanced. Participant self-report through surveys is the required method for the basic level of rigor; for the standard level of rigor, one of three methods can be used (billing analysis, self-report, econometric or discrete choice). The enhanced level requires triangulation using more than one of the methods in the standard rigor level. The enhanced level must include analysis and justification for the method for deriving the triangulation estimate from the various methodologies used.

Guidelines were developed for using the self-report method to estimate NTG ratios; these are consistent with Summit Blue's methodology:

1) identify the correct respondent
2) use multiple questions
3) assess validity and reliability of each question
4) include consistency checks
5) make the questions measure-specific
5) include and document partial free-ridership
6) assess deferred free-ridership [This is equivalent to EGD's "advancement" approach – see the discussion under section 2.1]
7) develop scoring algorithms
8) explain handling of non-responses and "don't knows"
9) weight the NTG for size of impacts
10) report precision of the estimated NTG
11) pre-test the questionnaire
12) use multiple respondents
13) consider third-party influence.

3.2.4 When to Use Market Share or Self-Report

Market sales methods can also be used to estimate free riders and spillover. A study done for Wisconsin Focus on Energy in 2006[33] developed an approach to assist in determining whether market sales or self-report methods are appropriate for net-to-gross assessment of results for various programs. The screening criteria outlined below provide a description of the screening process used to determine which method to use. For the first two criteria, the quality of available data depends in part on the details involved in data collection which in turn depends on resources available.

[33] *Net-to-Gross Method Selection Framework for Evaluating Focus on Energy Programs*, Goldberg M.L., Bloch, O., Prahl, R., Sumi, D., Ward, B., Winch, R. and Talerico, T., March 16, 2006.

Table 3-2. Screening Criteria for Self Report versus Market Share NTG Approaches

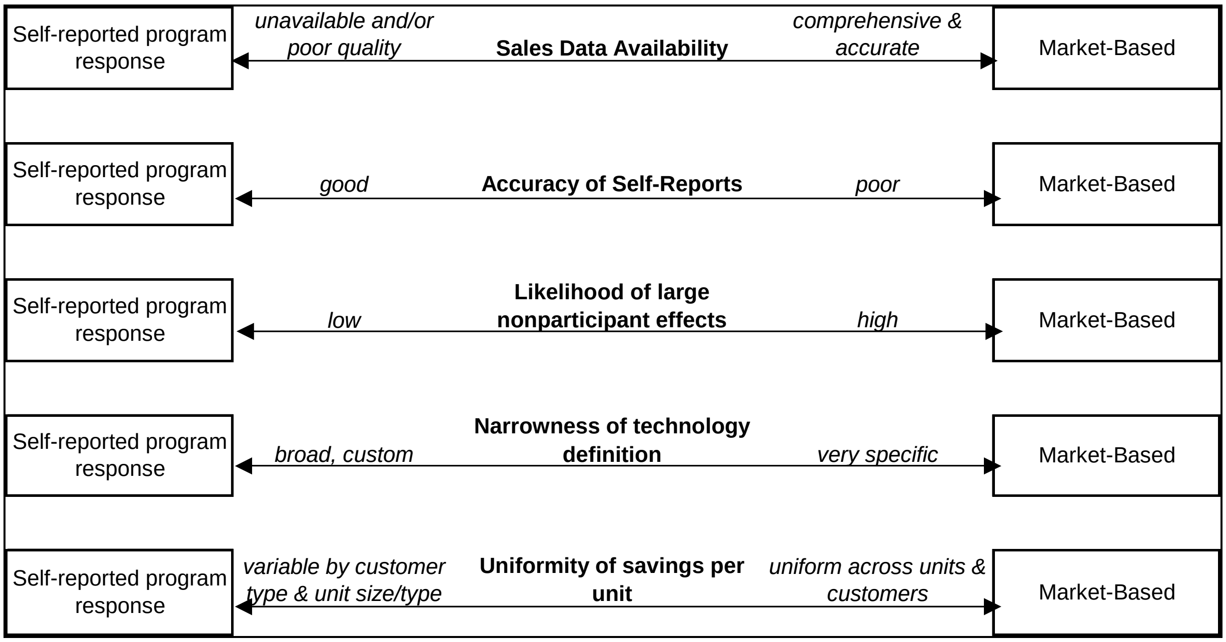
Screening Criteria	Example Screening Questions
Sales Data Availability: The availability of current and baseline market sales data enables estimating free ridership based on such data.	Are current and baseline data readily available? Are the data comprehensive and complete? Able to supplement/overcome shortcomings in data with other data collection techniques? Is the baseline estimate reliable?
Accuracy of Self-Reports: The ability of end users and vendors to report accurately what would have occurred in the absence of the program enables the use of program-response self-report methods.	Can end users/vendors accurately report what would have occurred without program? Supply-side actors can comment on programmatic versus non-programmatic influence on market? Has program altered the supply side in ways a participant would not be able to recognize?
Likelihood of Large Non-participant Market Effects: The likelihood of substantial non-participant market effects may indicate a need for applying methods for adequately capturing such effects.	Is the scale of program large relative to overall market? Are primary sales driving components (promotions, incentives) available at a consistent level throughout the year? Does the program have broad reach across market niches? Does program theory predict significant non-participant effects?
Narrowness of Technology Definition: A market data approach is suggested if the technology is a single type and well-defined, versus encompassing multiple categories, types, or wide variations.	Does program offer "custom" solutions (broad definition) or "prescriptive" measures (narrow definition)? Does program target specific technologies (narrow definition) or a broad range of technologies (broad definition)?
Uniformity of Unit Savings: The choice of method is guided by whether savings per unit is sufficiently consistent across types of units & customers to adequately quantify in terms of total units sold, or needs information on unit characteristics by customer type.	Do units promoted through the program come in widely varying size ranges/savings levels? Is an engineering estimate of necessary? Large variation in customer application of measures? Do savings per unit vary by customer application? Expect savings to vary widely by customer?

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

Taken together, these factors can indicate an overall preference for one method or another. In some cases, the preference will be clear-cut. In others, the two methods may be nearly equally good—or nearly equally poor. The diagram in Figure 3-1 below indicates for each criterion what condition points toward use of market sales approaches and what condition points toward self-reported program responses.

By definition, measures implemented in custom programs do not fall into easily defined buckets for which market sales can be easily or accurately estimated. Even if discrete pieces of equipment can be identified, obtaining relevant and adequate market sales information can be very difficult.

Figure 3-1. NTG Method Selection Screening Criteria[34]



3.2.5 Overview of Pros and Cons

The survey approach is the most straightforward way to estimate free ridership and spillover and is usually the lowest cost approach. As noted by the NAP Guidelines…"survey methods can be used with any program regardless of the number of participants" whereas econometric methods "can only be used with programs with large numbers of participants because the models need large amounts of data to provide reliable results".[35] In California, econometric methods are preferred in situations with enough participants and comparable non-participants, and when the program is large enough to justify the expense. However, programs with either a very small number of participants or non-participants or where comparability is a severe problem (such as industrial plants with unique facilities) are not amenable to these methods and need to rely on a survey-based method[36]. Market share methods are generally used to assess market transformation programs or in situations where participation is not well defined.

Table 3-3 below shows an overview of the pros and cons of all of the methods discussed above.

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[34] *Net-to-Gross Method Selection Framework*, ibid, Figure 1 p. 4.

[35] National Action Plan for Energy Efficiency. Model Energy Efficiency Program Impact Evaluation Guide 2007.

[36] Vine, Ed. *The Human Dimension of Program Evaluation*, *Lawrence* Berkley Lab, LBL-33601, 1993

Table 3-3. Comparison of Free Rider and Spillover Methodologies

Methodology	Pros	Cons
Billing Analysis	Quantitative estimates of magnitude of net impacts from statistically valid methods based on historical billing data.	Includes participants and non-participants in one model; sample not randomly determined due to self-selection. Could produce biased coefficient estimates if unobserved characteristics, which influence decision to participate, are not accounted for. Needs good historical data for each customer and this can reduce the number of data points. Large customers can overly bias results.[37]
Other Econometric or Discrete Choice Methods	Useful for programs that seek to transform the market. Modeling can provide more accuracy because tests for bias and precision can be included.	Econometric models need good historical data for each customer and this can reduce number of data points. Also needs data to account for variables that might be influencing the results. For discrete choice models it is difficult and costly to get accurate data on types and efficiency levels of existing equipment.[38] Neither method includes trade allies effects.
Self-Report	Simpler and less expensive than all other approaches. Can use all data points unlike billing or econometric analysis which requires historical data. Can be used in a variety of situations. Directly addresses the behaviours the program is seeking to affect. Flexible and so can take into account the complexities of program-participant interaction.	Potential for non-response bias, limited respondent recall of program influence on decision-making, and potential investigator bias in translating responses into free ridership values. Tends to underestimate spillover.
Market Share Approaches	Addresses trends in the entire market for equipment.	By definition, measures implemented in custom programs do not fall into easily defined buckets for which market sales can be easily or accurately estimated. Even if discrete pieces of equipment can be identified, obtaining relevant and adequate market sales information can be very difficult.

[37] Torok, C., Cavalli, J. and O'Drain, M. *Any Way You Slice It: Issues of Behavior and Influence in Net Impact Analysis*, 1999.

[38] Kandel, A. *Theory-Based Estimation of Energy Savings from DSM, Spillover, and Market Transformation Programs Using Survey and Billing Data.* Program Measurement and Evaluation, 2002.

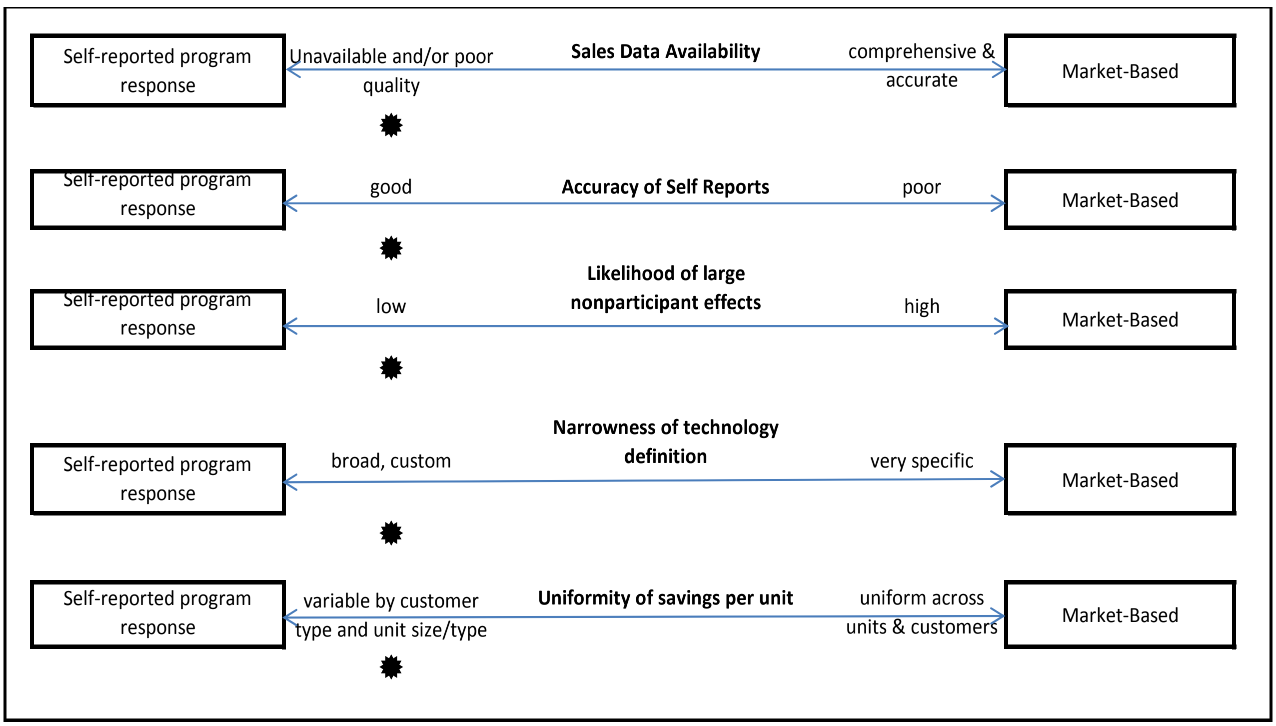
3.3 Best Method to Assess Union-Enbridge Custom Projects Free Riders and Spillover

This section applies the information discussed in the previous section about various methodologies to the Union-Enbridge research requirements to determine NTG for custom projects with large industrial and commercial customers.

It is clear that neither discrete choice models nor market share methods are appropriate methodologies for this research. Discrete choice models must focus on clear, standardized equipment choices. However, the Custom Projects measures are by definition custom and not easily placed into categories that are amenable to discrete choice analysis.

Applying the NTG method selection criteria to the custom projects program, as shown in Figure 3-2 below, clearly indicates that the self-report method is preferred over the market share approach.

Figure 3-2. Applying NTG Screening Criteria to Custom Projects



The self-report method using interviews with customers is more appropriate for this research than billing analysis or other econometric models. Table 3 compares self-report to the other two methods (combined as pros and cons are similar) based on relevant program characteristics. For example, the Custom Projects programs offered by Union Gas and Enbridge Gas Distribution are targeted specifically at large commercial and industrial customers and target complex and unique systems rather than offering prescriptive rebates. In addition, in some segments, e.g., agriculture, most eligible customers participate, making the selection of a non-participant group problematic. As shown in the table, there are problems in applying econometric methods which do not occur with self-report methods. The ideal methodology would be to apply California's Enhanced Level of Rigor which requires triangulation of estimates by at least two methods. This approach is very costly however, and still has the problems identified in Table 3-3 for econometric models.

Table 3-4. Compare Self-Report to Econometric Methods

Program Characteristic	Self-Report Methods	Econometric Methods
Targets large customers.	In-person or telephone surveys can be used with large customers.	Large customers can overly bias results
Non-participants difficult to identify.	Does not require non-participant data for free ridership or inside spillover.	Requires both participants and non-participants in analysis.
May not detect savings at whole building/facility level.	Targets measure level information.	Energy use data generally only available at building/facility level.
External factors likely to be significant.	Survey accounts for relevant external factors.	Need to collect appropriate data to adjust for external factors.
Focused on process changes rather than equipment.	Survey accounts for changes to processes as well as equipment.	Discrete choice and other models focus on equipment choices.

Based on this assessment, Summit Blue recommends using self-report methodology as described in the Analysis Plan, which modifies the methodology developed for other jurisdictions to the specific Union-Enbridge programs.

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4 SAMPLING AND DATA COLLECTION

This section reports on the sample design and data collection process for the study.

4.1 Participant and Trade Ally Survey

The sample was drawn from customers who participated in the Custom Projects Program between the fourth quarter of 2006 and the third quarter of 2007, inclusive. (As a result, the population of participants shown below will not match numbers reported by the utilities.)

There were 594 projects in the population for EGD and 345 for Union. We completed interviews covering 233 projects. For EGD 156 or 26% of the projects were completed and for Union 77 or 22% , which is an average of 25% across both utilities (see Table 4-1). Multifamily projects represented 35% of the population and 31% of the completed interviews. Industrial projects represented 24% of the projects and 18% of the completed interviews.

Table 4-1. Participant and Trade Ally Sample Disposition

	Population			Completes			Percent of Total		
Sector	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**
Agriculture	39	20	59	9	8	17	23%	40%	29%
Building Retrofit	114	138	252	44	21	65	39	15	26
Industrial	111	114	225	23	19	42	21	17	19
New Construction	58	13	71	24	12	36	41	92	51
Multi-Family	272	60	332	56	17	73	21	28	22
Total	594	345	939	156	77	233	26	22	25
Percent of Total									
Agriculture	7%	6%	6%	6%	10%	7%			
Building Retrofit	19%	40%	27%	28%	27%	28%			
Industrial	19%	33%	24%	15%	25%	18%			
New Construction	10%	4%	8%	15%	16%	15%			
Multi-Family	46%	17%	35%	36%	22%	31%			
Total	100%	100%	100%	100%	100%	100%			

4.2 Audit-Only Survey

The sample was taken from customers who had audits in 2005 to provide the optimal balance between providing enough time for the customers to have acted on the recommendations in the audit and ensuring that the audit is not so far in the past that respondents have trouble recalling details of the recommendations. Because the sample will be based on a single year, the result of the analysis can be expressed in spillover per year.

The audit-only spillover survey and analysis was completed for EGD only as Union Gas was unable to find any companies who had an audit in 2005 and had not implemented one of the recommended measures through the program. As a result, the savings inspired by the Union Gas audits will appear in the program tracking data rather than in spillover. EGD provided a sample of 37 customers who had an audit but did not appear in the tracking data as having implemented a relevant measure. We attempted to complete a survey with each of those customers to estimate spillover and completed 24 surveys (including one who did not recall the audit).

4.3 Non-participant Survey

The utilities provided contact information for 1,228 non-participating customers and Global Target Marketing attempted to contact all customers for a screening interview (see Table 4-2). As expected, many respondents (32%) were screened out because they did not implement a measure since 2005. A further 10% were screened out because they were participants and 26% were screened out because they were not aware of the program. Just over one quarter (26%) had implemented a measure since 2005 and were aware of the program but the measure was not influenced by the program. Together, 94.6% of the respondents were screened out for the reasons stated above, leaving a total of 66 customers, or 5.4% of the total population, who were influenced by the program to implement measures (and did not receive a financial incentive).

These 66 customers were asked to participate in a follow up interview to help quantify savings and 38 agreed (3.1% of the total).

Table 4-2. Non-participant Spillover Screening and Engineering Survey Disposition

	Total		Union Gas				Enbridge Large Volume			
			Commercial		Industrial		Commercial		Industrial	
Screened (Total)	1,228	100.0%	1,078	100.0%	41	100.0%	72	100.0%	37	100.0%
Unaware of Energy Efficiency Program	321	26.1%	297	27.6%	3	7.3%	11	15.3%	10	27.0%
Received Financial Incentives	124	10.1%	88	8.2%	20	48.8%	14	19.4%	2	5.4%
Did Not Install/Modify Equipment Since 2005	398	32.4%	354	32.8%	8	19.5%	26	36.1%	10	27.0%
Installed Measure and Aware Of But Not Influenced By Program	319	26.0%	284	26.3%	6	14.6%	16	22.2%	13	35.1%
Installed Measure and Influenced by Program	66	5.4%	55	5.1%	4	9.8%	5	6.9%	2	5.4%
Agreed To Follow-Up	38	3.1%	33	3.1%	3	7.3%	1	1.4%	1	2.7%
Total Follow-up Interviews	27	2.2%	22	2.0%	3	7.3%	-	0.0%	1	2.7%
Total Providing Savings Estimates	5	0.4%	3	0.3%	2	4.9%	-	0.0%		0.0%

Note: The numbers in the middle rows (between the dark lines) sum to the total in the top row. The last three rows are components of the row titled "Installed Measure and Influenced by Program".

5 FINDINGS

The findings are presented in four parts, representing free ridership and three kinds of spillover, inside, outside, and audit-only. The final section combines the free ridership and spillover into one calculation to produce the final net-to-gross ratio.

5.1 Free Ridership Results

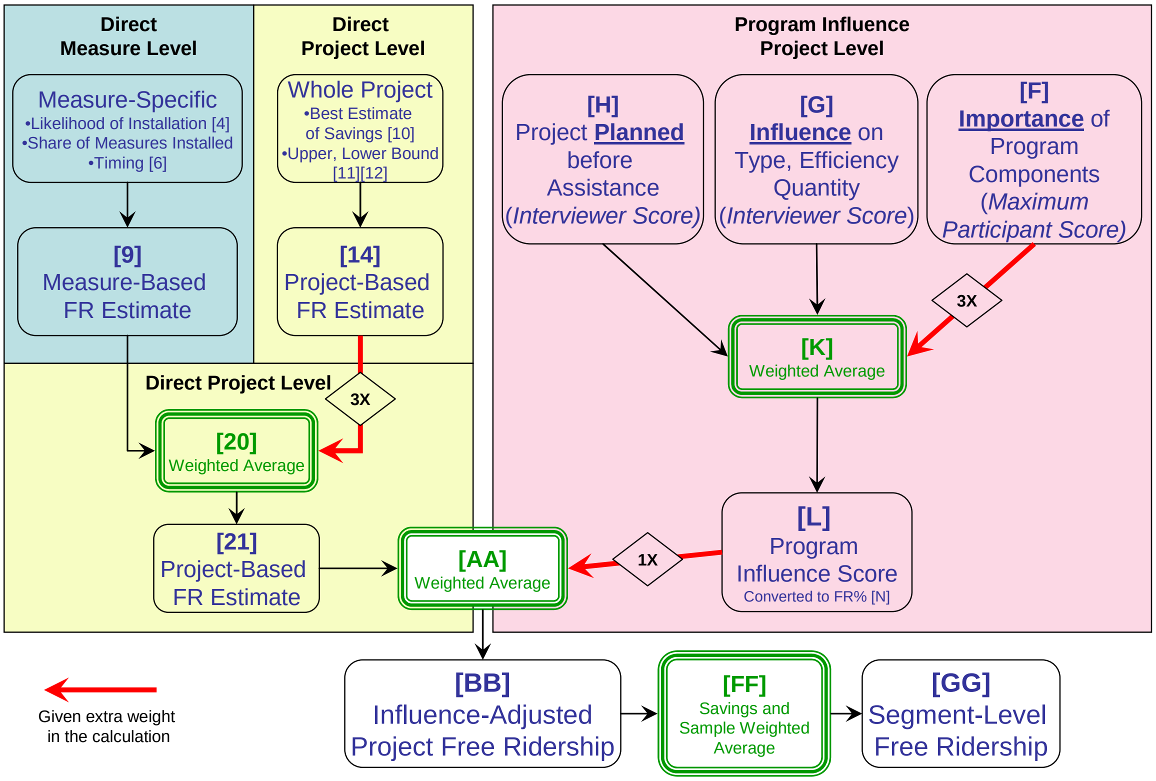
As discussed in the methodology chapter (and in the analysis plan), the calculation of free ridership requires combining answers from several different questions to come up with a single free ridership number for each measure. At several points in the calculation assumptions have to be made about how to combine answers. Should we take the maximum answer from a group of related questions? Should answers be averaged? Should some answers get more weight than others? Some calculation assumptions lend themselves to a clear decision. For example converting a 1-5 score into a free ridership percentage using a straight line conversion seems the obvious choice (where 1=0%, 3=50%, and 5=100%). Other calculation assumptions, do not present a clear answer. For example, when combining the project-based free ridership estimate with the program influence score, should they be averaged? If so, should one carry more weight than another? For those assumptions, we performed a sensitivity analysis, examined the open-ended responses and interview notes, and took into account the program approach to identify the most appropriate calculation approach. The next few paragraphs describe the recommended calculation approach. Following that are the results produced from that approach.

5.1.1 Recommended Calculation Approach

Three assumptions in the calculation had the most effect on the end result and were of the type that required a broad analysis of the program and survey data to suggest the appropriate calculation approach. Those three are shown at [20], [K], and [AA] in the calculation overview diagram in Figure 5-1. After examining all available evidence, we conclude that the most appropriate approach is to give the weights shown in the diamond shapes in those calculations. First, giving triple weight to [14] in the calculation at [20] is appropriate for the following reasons:

- The calculation at [20] averages direct measure level questions [9] and direct project level questions [14]. The direct measure level questions expect the respondent to think discretely about separate components of the project decision. The direct project level question [10] asks them to think about the project as a whole, and considering all program involvement. Given that the utility interacts with the customer over a long period of time, in a variety of ways, and that the measures are typically complex with many factors influencing the decision, it seems less likely that the respondent will be able to successfully think about a component of the decision than about the decision taken as a whole. As a result, the answer to the direct project level question [10] is probably more believable than the measure-based estimate [9]. Because of that conclusion, we weight the project-based estimate more heavily than the measure-based estimate in [20] by a factor of 3.

Figure 5-1. Final Calculation Overview



Second, giving triple weight to [F] in the calculation at [K] is appropriate for the following reasons:

- Point [H] in this calculation is an interviewer score of the amount of planning that went on for the measure before the program got involved. There are several potential weaknesses in the answers to this question that argue for reducing its weight in the calculation at [K]:
  - Program staff were frequently providing assistance to the participants over a long period of time. By the time the measure was installed (and we called on the participant for an interview), respondents may have forgotten the history of the project planning. Those involved in the initial planning may no longer be at the company or in a position to pass along the history of the planning to those ultimately interviewed.
  - Because the program projects are often complex and related to equipment central to a company's output, the fact that plans were in place prior to program involvement does not necessarily imply that the program had no influence. For example, the decision to modify a production line may be driven by changes in the market for their product. Thus plans might be in place to change equipment prior to program involvement but the program involvement could still affect the efficiency of the equipment chosen.
  - Because the program projects are often complex, planning takes place over a long period of time and proceeds through several steps. The program could get involved after initial planning took place – e.g., the decision was made to modify a production line – but before the specifications were written for the equipment affected by the program. Assessing the program's influence on planning in such a circumstance can be difficult to apply in a standard and uniform fashion across projects.

- Point [G] in the calculation at [K] is an interviewer score of the program's influence on the type, efficiency and quantity of the equipment installed. The driving question at [G] was as follows: "Did the assistance you received from [Enbridge/Union] in any way influence your capital funding acquisition process, the type or efficiency level of the equipment or the amount of high efficiency equipment you installed or process changes implemented?" Many of the projects implemented under this program were implemented primarily to address issues other than energy costs. In many cases, the program's hoped-for impact was to increase the energy efficiency of the project rather than inspire the change in the first place. As a result, factors other than energy are often driving decisions about capital funding and the type and quantity of equipment installed and it is unlikely that the program will have much if any affect on those factors. The question at hand was designed to measure the program's influence on those factors in addition to the efficiency of the equipment. This has the effect of diluting the impact of the efficiency issue in the final interviewer score. These weaknesses in this question argue for reducing its weight in the calculation at [K].

- Point [F] represents several questions on the importance of several program components or types of assistance in the participant's decision to install energy efficiency equipment. The questions in [H] and [G] ask the respondent to think about <u>all</u> program assistance as a bundle while focusing on a specific aspect of the decision process. The questions in [F], on the other hand, ask the respondent to think about individual components of program assistance while focusing on the whole decision process. As discussed above, given that the measures are typically complex with many factors influencing the decision, it seems less likely that the respondent will be able to successfully think about a component of the decision (as in [H] and [G]) than about the decision taken as a whole (as in [F]). The [F] series of questions brings in the specific components of the program assistance and, particularly given the drawbacks with [H] and [G], seems more likely to give a more accurate picture of the program's influence.

Finally, giving equal weight to [21] and [L] in the calculation at [AA] is appropriate for the following reasons:

- The conclusions drawn above on [20] and [K] give more weight to questions that address the whole project rather than specific components. They provide two different approaches for the respondent to address the program's influence: estimating savings that would have happened in the absence of the program in [14], and the how important program components were in the decision to install energy efficiency equipment in [F]. Addressing the same general issue from two different perspectives ought to provide a more robust estimate of the true impact.

- Given that the questions at [14] and [F] have already had their weight in the calculation increased, giving more weight to one or the other of these components in the calculation at [AA] would have the effect of ensuring that the final result is largely driven by the answer to one question (or one type of question in the case of [F]). This places too much importance on a single question and is contrary to the philosophy of the general approach which is of triangulating at the answer from a variety of perspectives.

5.1.2 Results

Using the calculation approach defined above produces a total free ridership rate across both utilities and all sectors of 48% as shown in Table 5-1. The free ridership rate for EGD is 41% and it is 54% for Union Gas. Free ridership rates of near 50% are not uncommon in custom programs throughout North America. In a 2006 study Summit Blue performed for Alliant Energy, we found five programs out of 21 with free ridership rates above 40%.[39] Summit Blue recommends that the utilities use the utility-specific total free ridership values of 41% and 54% as the best estimate of free ridership. Those results are based on larger sample sizes than the sector-specific results and proved more stable in the sensitivity analysis. The sector-specific results are based on smaller sample sizes and should only be used to support program management, for example to support targeting and marketing decisions.

Table 5-1. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

5.1.3 Bin Analysis

As discussed above, there are several potential weaknesses in the answers to some of the questions asked of participants. Given that the utility is often involved well in advance of project implementation, it is possible that in the intervening time the institutional memory of the history of the utility's program involvement has been lost. It is also possible that the participant has taken ownership of the information or approach that originally came with support from the utility and now views it as their own, not something brought to them by the utility. Now of course without defining away the possibility of free ridership even existing, we cannot say that prior utility program involvement prior to project implementation is evidence that free ridership does not exist. However, there is one area that is more concrete than simple "prior program involvement" that is worth examining. In some cases, the utilities supported energy audits that looked for and provided support to decisions to implement specific energy efficiency measures. It seems reasonable to conclude that at least in some cases those audits inspired the subsequent installation or modification. It also seems possible that if the audit were some time before implementation, the respondents we talked to may not have been aware of the influence of the audit.

[39] Shared Savings Decision-Making Process Evaluation Research Results. Jeff Erickson, Summit Blue Consulting for Wisconsin Power & Light (Alliant). August 11, 2006.

To examine the possible implications of this issue, we performed a bin analysis. We received from the utilities dates of energy audits or studies done in advance of specific measures that were addressed in our participant interviews. The free ridership savings were placed in two bins based on historical data provided by the utilities. Projects that met any of the following criteria were placed in a "Preceding Audit" bin:

- A utility-sponsored audit or feasibility study preceded the measure implementation and was directly related to the measure installed.
- The same measure had been installed through the program in a previous program year.
- EGD paid part or all of the salary for an on-site energy manager at the facility prior to the measure implementation.

All other projects were placed in a "No Preceding Audit" bin. In this way, on a measure-by-measure basis, we put the m^3 savings that had been defined as free ridership into one of two bins. The results are shown in the following table. As in the previous table, the total free ridership across both utilities is 48% (the bottom right cell in the table). Splitting this into two pieces shows that the total free ridership is made of 25% from projects that had preceding audits and 23% that did not. (Note that 25%+23%=48%, the total free ridership percentage.) The "Preceding Audit" values represent just over half of the total free ridership for the two utilities combined and represent well over half of Union's free ridership.

Table 5-2. Free Ridership Split Based on Preceding Audit

	Preceding Audit			No Preceding Audit			Total		
Sector	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**	**EGD**	**Union**	**Total**
Agriculture	6%	0%	3%	34%	0%	15%	40%	0%	18%
Commercial Retrofit	0%	7%	2%	12%	52%	25%	12%	59%	27%
Industrial	12%	44%	31%	38%	12%	22%	50%	56%	53%
Multifamily	0%	0%	0%	20%	42%	26%	20%	42%	26%
New Construction	0%	6%	2%	26%	27%	26%	26%	33%	28%
Total	8%	38%	25%	33%	16%	23%	41%	54%	48%

One possible interpretation of the "Preceding Audit" free ridership values is that they are spillover caused by the audit and the "No Preceding Audit" values are pure free ridership. If the audit altered the participant behavior and/or plans, but the respondent either was not aware of that change or had forgotten about the program's earlier influence, then the "Preceding Audit" values would accurately be described as spillover. If, on the other hand, the earlier measure implementations were also free riders and the audit truly did not significantly affect the decision-making process, then the "Preceding Audit" values would not be spillover.

The preparation for the surveys, the surveys themselves, and the survey process were designed to get to respondents with knowledge of the history of the project and remind participants of their company's past involvement in the program. Given the high free ridership rates, it seemed appropriate to do some additional research in this area. We called back three of the largest participants who had prior audits to verify whether they were aware of the audits and to gauge the impact of the audits on their planning and decision process. In two of the three cases, we judged that our original free ridership estimate was accurate and that the prior audits were not driving factors in the decision. In the third case we adjusted responses from the earlier interview to reflect the new information we received in the follow-up call.

5.1.4 What is Driving the Results?

This section examines various factors that may help explain where the most significant issues with free ridership are.

Sector

Industrial gross m^3 savings represent 84% of the total program savings (Table 5-3) and therefore drive the final results. The Industrial sector accounts for 77% of EGD's gross savings and 89% of Union's.

Table 5-3. Gross m^3 Savings as Percent of Total by Sector

Sector	EGD	Union	Total
Agriculture	3%	3%	3%
Industrial	77%	89%	84%
Multifamily	8%	1%	4%
New Construction	2%	1%	1%
Commercial Retrofit	10%	6%	7%
Total	100%	100%	100%

The EGD Industrial free ridership rate is 50% and Union's is 56% (see Table 5-4, which is identical to Table 5-1). The other EGD sectors have relatively low free ridership rates, with the exception of Agriculture, which is only 3% of the total savings. The other Union sectors (with the exception of agriculture) have fairly high free ridership rates, which explains why the total Union free ridership rate is higher than EGD's, given that their Industrial rates are close.

Table 5-4. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

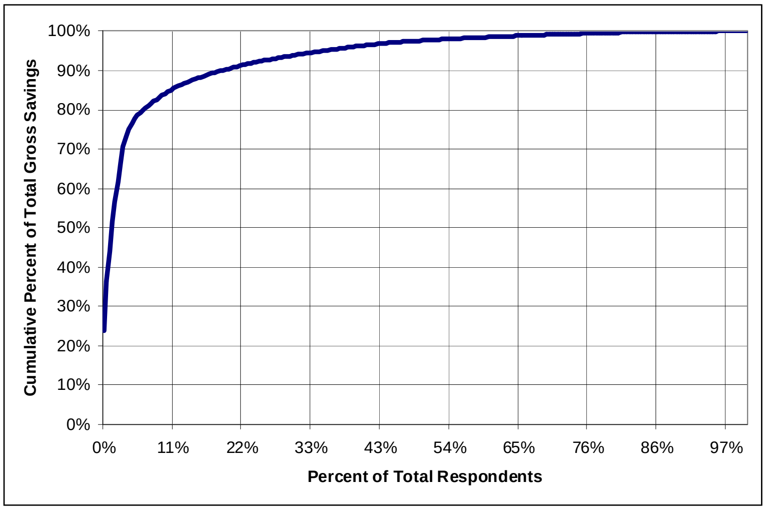
Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

Company Size

Program gross m^3 savings are concentrated in a relatively small number of participants. The top 10% of respondents based on gross m^3 savings consume 84% of total program savings (among those interviewed) (Figure 5-2). The 15 companies with the most m^3 savings together save 80% of total gross m^3 savings. The free ridership rate for those 15 companies is 56% across both utilities. If we eliminate those 15 companies, the free ridership rate drops to 34%.

Figure 5-2. Cumulative Percent of Gross Savings



Measure Type

Machine/Process measures account for 44% of the gross savings and HVAC measures account for 39%; together they drive the final results. The Machine/Process free ridership rate is 56% and HVAC is 46%. Lighting and “Other” measures have fairly high free ridership rates and Hot Water, Envelope, and Controls have fairly low rates.

Table 5-5. Free Ridership By Measure Type

Measure Type	Free Ridership Rate
Machine/Process	56%
HVAC	46%
Lighting	43%
Other	37%
Agriculture	29%
Envelope	22%
Hot Water	15%
Controls	13%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

Other Observations

There are several factors that influence the free ridership results, which can be loosely categorized into factors that increase free ridership, those that decrease free ridership, and those that reflect well on the program but that do not improve the free ridership value.

Factors that increase free ridership

- In many energy efficiency programs for large, complex projects the utility incentive will typically not be particularly large compared to the overall project cost. As a result, the respondents may feel that it has relatively little impact on the direction of their project. (On the other hand, the existence of an incentive can raise the level of interest and still have an effect even if the incentive is not large.)

- Regardless of the size of the incentive, it can only have an impact on decision making if the potential recipient feels the chances of receiving the incentive are reasonably high. Because custom projects can involve multiple vendors any confusion about who will receive the incentive will reduce its overall impact on the decision process.

- Design Engineers and Energy Performance Contractors see themselves as sophisticated energy users, and pride themselves on being knowledgeable and competent on energy efficiency issues and in providing the most energy efficient solutions to their clients. This may imply that approaches that aim to influence these channels are not as effective in changing existing energy efficiency choices.

- Again because custom projects can involve multiple vendors, some vendors may be insulated from the key decision makers by other vendors. As a result, any program activities targeting these vendors may fail to influence the final decisions.

- Large industrial end-users often have the accounting mechanisms in place to understand the effects of energy use on their bottom line, they require highly specialized technologies for their application, and they have the in-house expertise to identify and evaluate efficient options for those specialized technologies. In addition, there may be a number of very competent consultants and suppliers who assist the industry with energy efficiency and in a number of other technical support areas. For this kind of company, assistance provided by utility programs must stand out in some particular way to be noticed. The subtleties of that assistance may be lost as time goes on and as staff change, making it harder to identify the effects of that assistance when looking back over time.

Factors that decrease free ridership

- The Utility provides an independent third party verification of the predicted savings and this is very valuable in the decision making process in many organizations.

Positive stories, but ones that do not improve the free ridership

- The participants are quite pleased with their involvement with the program, glad to get the Utility's assistance, and satisfied with the program.

- The Program assistance and incentives help grease the skids, but they do not change the direction or destination of the sled.

- One trade ally reported "The program gives a comfort factor on value of energy efficiency measures. It improves the interaction between the utility and the customer."

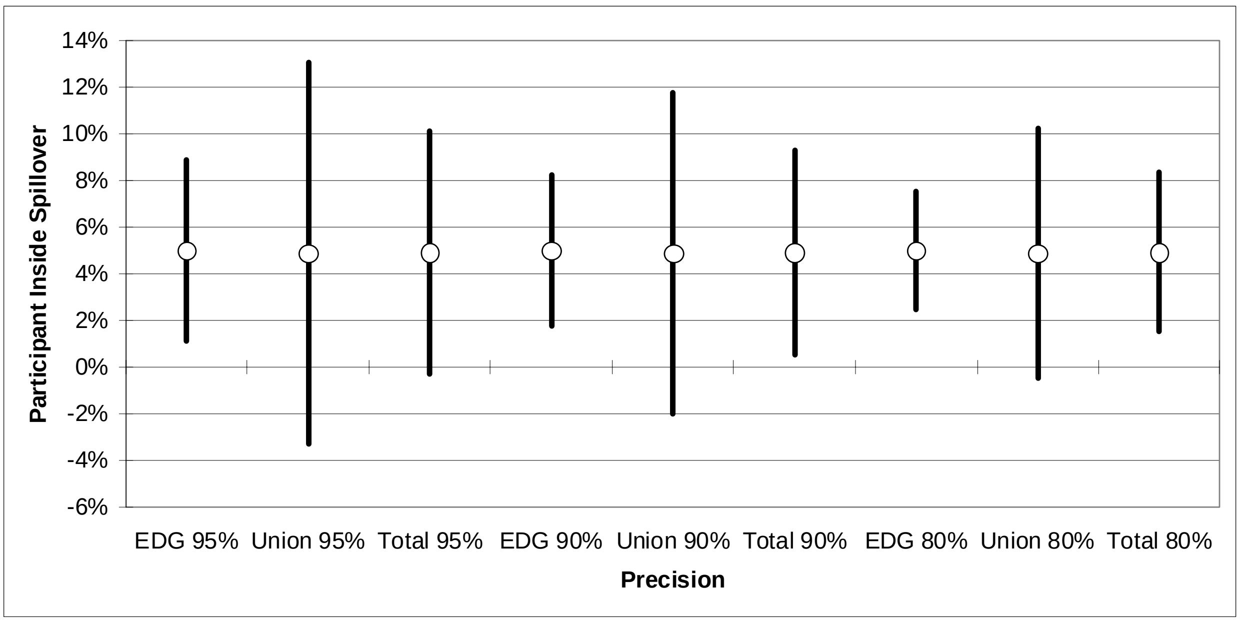
5.2 Spillover Results

Spillover represents energy savings that are due to the program but not counted in program records. Summit Blue estimated **participant inside and outside spillover** through questions in the participant and trade ally surveys and through the Audit-Only Survey. Summit Blue estimated non-participant spillover through the non-participant survey.

5.2.1 Participant Inside Spillover Results

Nine respondents for EGD and five for Union indicated that they had installed additional energy efficiency measures at the same facility without going through the program, those measures count as inside spillover. By extrapolating the m^3 savings from those measures to the population, we calculate that **inside spillover was 5% of gross reported savings for both EGD and Union**. The results for EDG are statistically significant at the 95% level. However, the results for Union are not statistically significant, even at the 80% level. The following figure shows the error bounds around the mean estimate. When the error bounds crosses zero, we cannot say with statistical precision that the results are not zero. The EDG-Union combined total is statistically significant at 90%. Given that the spillover numbers are based on a rather small number of respondents, it is appropriate to calculate spillover across the entire pool of respondents, for Union and EGD combined.

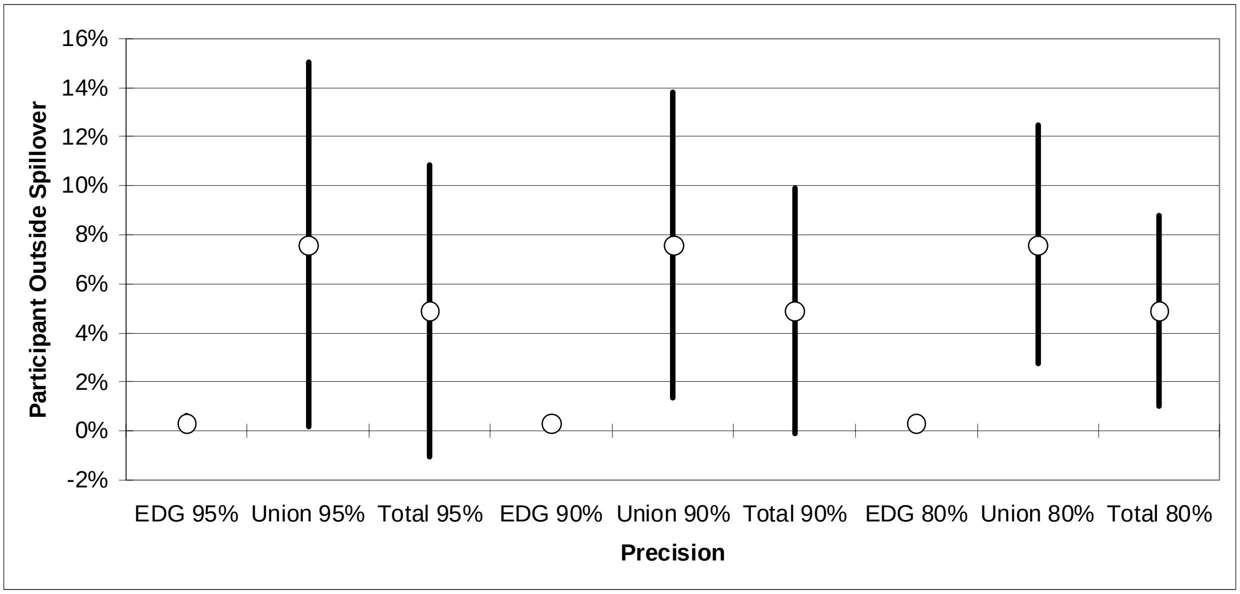
Figure 5-3. Participant Inside Spillover



5.2.2 Participant Outside Spillover Results

Four respondents for EGD and three for Union indicated that they had installed additional energy efficiency measures at *different* facilities without going through the program. Those measures count as outside spillover. By extrapolating the m^3 savings from those measures to the population, we calculate that **outside spillover for Union was 7.6% of gross reported savings, less than 1/2 percent for EGD, and 5% combined across both utilities.** The following figure shows the error bounds around the mean estimate. Given that the spillover numbers are based on a rather small number of respondents, it is appropriate to calculate spillover across the entire pool of respondents, for Union and EGD combined, which is statistically significant at the 80% confidence level.

Figure 5-4. Participant Outside Spillover



5.2.3 Participant Audit-Only Spillover Results

Customers who received an audit, implemented a recommended measure, but did not receive incentives through the program for that measure can be considered audit-only spillover. The audit-only spillover survey and analysis was completed for EGD only as Union Gas was unable to find any companies who had an audit in 2005 and had not implemented one of the recommended measures through the program. As a result, the savings inspired by the Union Gas audits will appear in the program tracking data rather than in spillover. EGD provided a sample of 37 customers who had an audit but did not appear in the tracking data as having implemented a relevant measure. We attempted to complete a survey with each of those customers to estimate spillover and completed 24 surveys (including one who did not recall the audit).

For each respondent, we calculated the share of the recommended measure savings that could be attributed to the influence of the program. 43% of the m^3 savings estimated in the audit were achieved by those who completed a survey. We then applied the 43% savings to parts of the population that can be assumed to follow the same pattern as the respondents (non-respondents and refusals) and assumed zero savings for those who did not recall the audit or whose business was sold or closed (one company was sold, 3 were closed). Summing spillover savings over the whole group then dividing by the sum of the recommended savings gives the final realization rate for spillover savings for the population, which was 35%. **Thus 35% of the gross recommended savings from energy audits are achieved, representing the audit-only spillover.** The total audit-only spillover savings (1,969,700 m^3) will be brought into the final calculation of the program's net-to-gross ratio.

Since the sample was a census of the eligible population there is no need to extrapolate beyond the calculation explained above.

5.2.4 Non-participant Spillover Results

Screening Survey Results. The utilities provided contact information for 1,228 non-participating customers and Global Target Marketing attempted to contact all customers for a screening interview (see Table 5-6). As expected, many respondents (32%) were screened out because they did not implement a measure since 2005. A further 10% were screened out because they were participants and 26% were screened out because they were not aware of the program. Just over one quarter (26%) had implemented a measure since 2005 and were aware of the program but the measure was not influenced by the program. Together, 94.6% of the respondents were screened out for the reasons stated above, leaving a total of 66 customers, or **5.4% of the total population, who were influenced by the program to implement measures** (and did not receive a financial incentive).

These 66 customers were asked to participate in a follow up interview to help quantify savings and 38 agreed (3.1% of the total). Three engineers attempted to contact all 38 customers and conducted interviews with 27 customers (2.2% of the total population and a 71% response rate). Of these, only 5 Union Gas customers (3 commercial and 2 industrial, representing 0.4% of the population) were able to provide enough information to the engineers to enable them to quantify savings. The engineers rated their confidence in the accuracy of their spillover estimates for each project, given the information the respondent was able to provide and the assumptions that they had to make given shortfalls in the data. None of the engineers felt more than modestly confident that the estimates were accurate and several estimates were rated “weak”.

Conclusion. Because of the large size of the sample submitted to the screening effort, the fact that **5.4% of the population had spillover measures** is a meaningful and important result. However, given that we were able to estimate m^3 savings for only 5 respondents, which was less than 10% of those with spillover, and that our engineers were not very confident in the accuracy of the savings calculations, we cannot extrapolate m^3 spillover savings to the population.

Our engineers reported that most respondents could not provide useful information about the equipment installed. As a result, any effort to improve on this effort should include on-site visits by evaluation engineers so that they can directly observe the equipment and collect the data they need to make the savings estimates. This will increase the accuracy of the site-specific savings estimates and will likely increase the number of sites for which estimates can be calculated.

Table 5-6. Non-participant Spillover Screening and Engineering Survey Disposition

	Total		Union Gas				Enbridge Large Volume			
			Commercial		Industrial		Commercial		Industrial	
Screened (Total)	1,228	100.0%	1,078	100.0%	41	100.0%	72	100.0%	37	100.0%
Unaware of Energy Efficiency Program	321	26.1%	297	27.6%	3	7.3%	11	15.3%	10	27.0%
Received Financial Incentives	124	10.1%	88	8.2%	20	48.8%	14	19.4%	2	5.4%
Did Not Install/Modify Equipment Since 2005	398	32.4%	354	32.8%	8	19.5%	26	36.1%	10	27.0%
Installed Measure and Aware Of But Not Influenced By Program	319	26.0%	284	26.3%	6	14.6%	16	22.2%	13	35.1%
Installed Measure and Influenced by Program	66	5.4%	55	5.1%	4	9.8%	5	6.9%	2	5.4%
Agreed To Follow-Up	38	3.1%	33	3.1%	3	7.3%	1	1.4%	1	2.7%
Total Follow-up Interviews	27	2.2%	22	2.0%	3	7.3%	-	0.0%	1	2.7%
Total Providing Savings Estimates	5	0.4%	3	0.3%	2	4.9%	-	0.0%		0.0%

5.2.5 Recommended Spillover Rates

Summit Blue recommends the utilities use following spillover rates:

Table 5-7. Spillover Results

Spillover Type	EGD	Union	Base
Participant Inside Spillover	5%	5%	Of gross reported savings
Participant Outside Spillover	5%	5%	Of gross reported savings
Audit-Only Spillover	35%	0%	Of gross audit-recommended savings
Nonparticipant Spillover	0%	0%	

5.3 Net-to-Gross Ratio

The net-to-gross ratio is defined as 1 - free ridership ratio + spillover ratio. As discussed above, spillover is in several parts: participant inside and outside spillover, audit-only spillover, and non-participant spillover. We know that 5.4% of the non-participants have spillover but cannot calculate its quantity so the calculation of net-to-gross presented below excludes it. Together participant inside and outside spillover amount to 10%. The audit-only savings were 1,969,700 m^3 for EGD, which represents 11% of EGD total gross savings (see Table 5-8). With zero Union audit-only savings, the total audit-only savings equals the EGD savings and the combined audit-only spillover rate is 5%. Subtracting free ridership and adding spillover produces a final **net-to-gross ratio of 79% for EGD, 56% for Union, and 67% across both utilities.** Summit Blue recommends that the utilities use the utility-specific total net-to-gross ratios, as they are based on larger sample sizes than the sector-specific results.

Table 5-8. Net-To-Gross Ratio

Utility	Sector	Gross m^3 Savings	Free Ridership	Participant Inside + Outside Spillover	Audit-Only m^3 Savings	Audit-Only Spillover %	Net-to-Gross Ratio
EGD	Agriculture	1,111,398	40%				
EGD	Commercial Retrofit	3,052,840	12%				
EGD	Industrial	10,028,771	50%				
EGD	Multifamily	1,575,482	20%				
EGD	New Construction	798,310	26%				
EGD	Total	18,588,008	41%	10%	1,969,700	11%	79%
Union	Agriculture	1,387,850	0%				
Union	Commercial Retrofit	1,406,897	59%				
Union	Industrial	14,874,847	56%				
Union	Multifamily	520,974	42%				
Union	New Construction	304,991	33%				
Union	Total	23,209,837	54%	10%	0	0%	56%
Total	Agriculture	2,499,248	18%				
Total	Commercial Retrofit	4,459,738	27%				
Total	Industrial	24,903,618	53%				
Total	Multifamily	2,096,456	26%				
Total	New Construction	1,103,302	28%				
Total	Total	41,797,844	48%	10%	1,969,700	5%	67%

Free Ridership Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

6 SUPPLEMENTARY RESULTS

The participant surveys included several questions that illuminate the customer's decision-making process, but do not necessarily feed directly into the free ridership calculation. This section will present some of those results, first for end users, next for trade allies, and then at the sector level. Following that will be a brief summary of free ridership, spillover, and net-to-gross results from other jurisdictions.

6.1 End Users

Most (35 out of 40 or 88%) EGD end user respondents have a policy that specifies energy efficiency requirements. 18 target specific energy efficiency levels.

For Union 12 out of 24 (50%) have a policy that specifies energy efficiency requirements (4 target energy efficiency levels).

Table 6-1. Company Has an Energy efficiency Policy

	Missing	Yes	No	Total
EGD	1	35	3	39
Union	0	12	12	24
Total	1	47	15	63

Those who had a policy were asked about the efficiency level stated in the policy. The results are shown in the following table.

Table 6-2. Efficiency Level Stated in the Policy

Efficiency Level Stated in the Policy	EGD	Union	Total
Missing	22	8	30
1	0	1	1
20	1	0	1
35	0	1	1
5 % reduction in energy cost per vehicle	2	0	2
8	1	0	1
80+	0	1	1
84 % efficiency on boilers	4	0	4
86 % for boilers	1	0	1
86 % for boilers; new school perspective specifies nature of any equipment	1	0	1
Better than code but no specific amount set.	2	0	2
Exceed National Building code by 25 % on new buildings	1	0	1
reduce fossil fuels by 15% per year, starting in 2002	0	1	1
Total	35	12	47

Virtually all respondents had criteria for energy efficient equipment.

Table 6-3. Do You Have Criteria For Energy Efficient Equipment?

	Yes	No	Total
EGD	39	0	39
Union	23	1	24
Total	62	1	63

The criteria for approving energy efficiency equipment is predominantly simple payback period (multiple respondents mentioned this). 95% of EGD respondents mentioned payback, 17% life cycle cost analysis, 14% internal rate of return (IRR).

78% of Union respondents mentioned payback, 22% mentioned IRR, 9% mentioned life cycle cost analysis.

Only 7 respondents (3 EGD, 4 Union) changed their energy efficiency policy since the project. The table below shows the changes they made.

Table 6-4. How has your energy efficiency policy changed since the project?

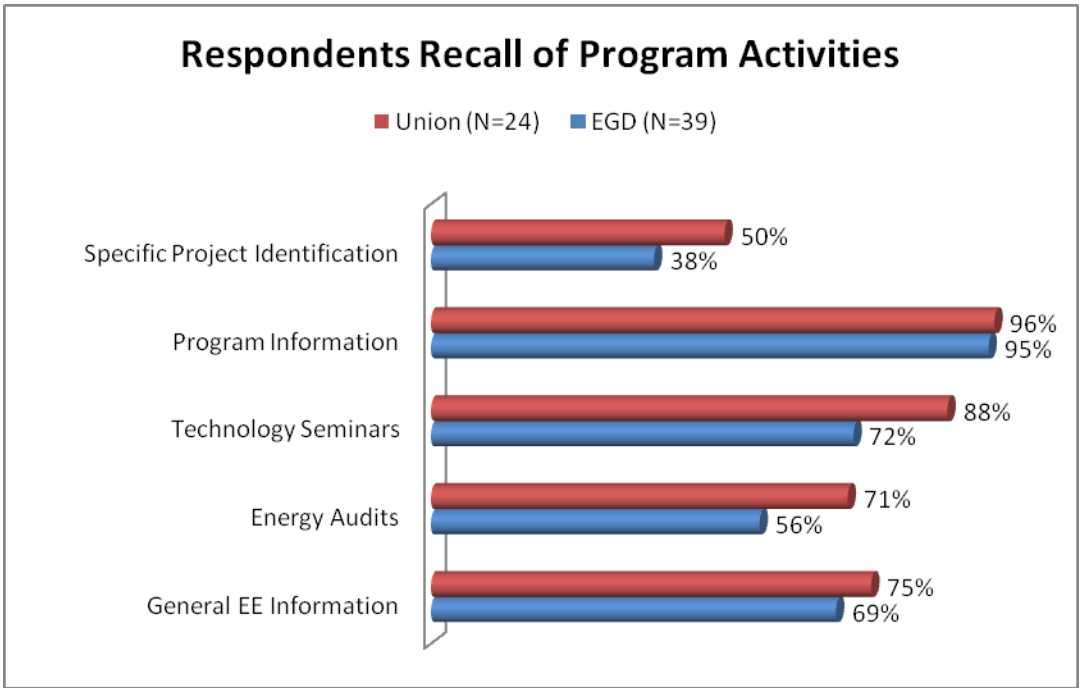
	EGD	Union	Total
EE is now part of their business plan, with a target reduction of 5% annually	0	1	1
Energy wise program has raised awareness of energy efficiency	0	1	1
Greater awareness of need to maintain energy efficiency	0	1	1
Payback has been extended to 5 years	1	0	1
Since the project, the end user has developed a corporate energy policy with a target of a 20% reduction by 2020	0	1	1
Total energy reduction of 6 %	2	0	2
Total	3	4	7

Table 6-5. Percent of respondents recalling program initiative by utility

	General energy efficiency Information	Energy Audits	Technology Seminars	Program Information	Specific Project Identification
EGD (N=39)	69%	56%	72%	95%	38%
Union (N=24)	75%	71%	88%	96%	50%
Total (N=63)	71%	62%	78%	95%	43%

Respondents were asked whether they recalled participating in various program activities. Almost all recalled getting program information (Figure 6-1). Approximately three-fourths remembered going to technology seminars and getting general energy efficiency information.

Figure 6-1. Respondents' Recall of Program Activities



Respondents were asked what the payback was for their project after figuring in the utility incentive. For EGD, 18 of 39 did not respond and 6 had paybacks under a year after incentive (Table 6-6 and Figure 6-2). For Union Gas, 19 of 24 did not respond. Of the 5 who responded, 1 had a payback period under a year.

Table 6-6. What was the project's payback after figuring in the utility incentive?

	EGD	Union	Total
Missing	18	19	37
LT 1 YR	6	1	1
1 to 3 Years	6	3	1
4 to 11 years	9	1	1
Total	39	24	63

6.2 Trade Allies

Consulting Engineers were the most common type of trade ally among the respondents followed by installation contractors (Table 6-7, Figure 6-2, and Figure 6-3). Among our respondents, Enbridge had no manufacturer or distributor/sales as business partners and Union had no property managers as allies.

Table 6-7. Primary Line of Business

	EGD	Union	Total
Consulting Engineer	17	21	38
Installation Contractor	8	6	14
ESCO	5	7	12
Manufacturer	0	8	8
Distributor or Equipment Sales	0	5	5
Property Manager	3	0	3
Other	2	0	2
Total	35	47	82

Figure 6-2. Types of Trade Allies

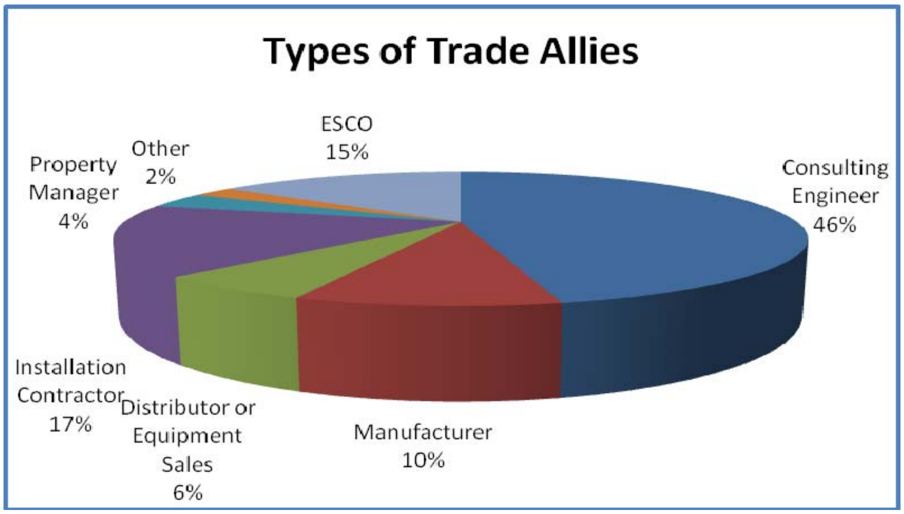
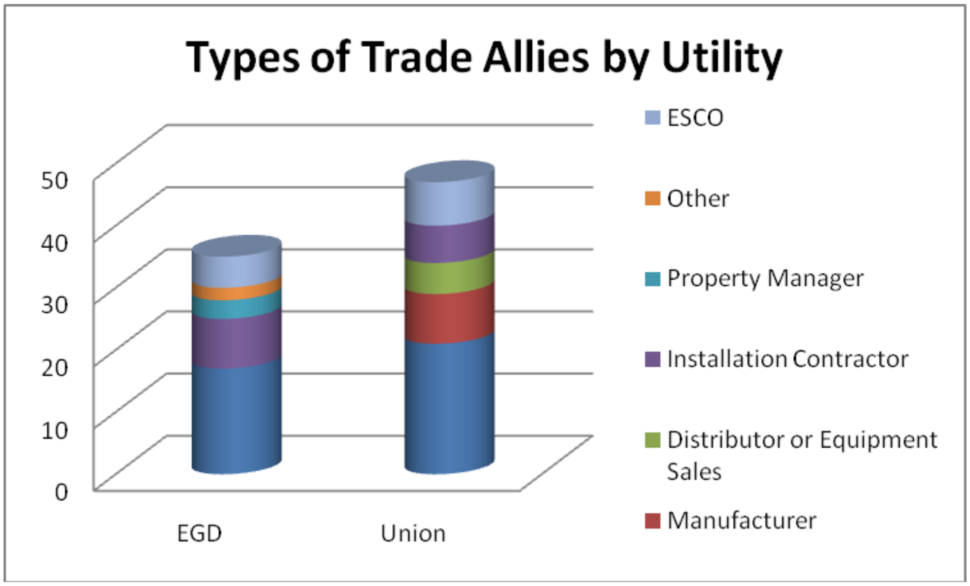
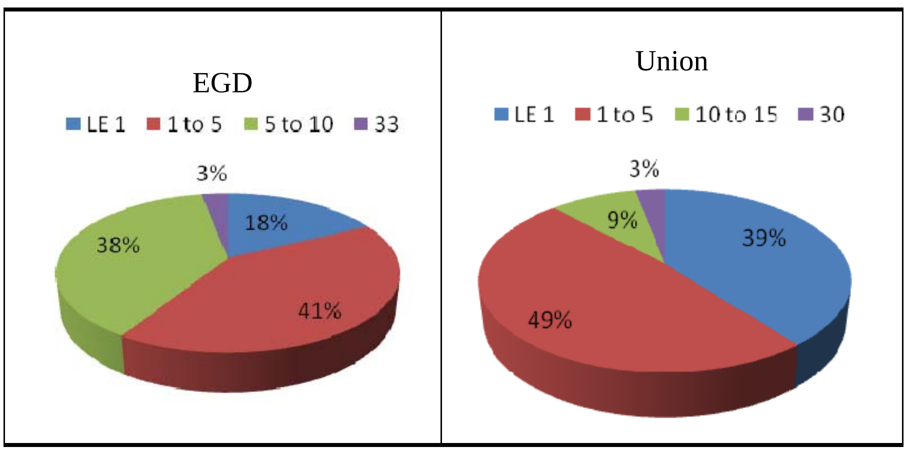


Figure 6-3. Types of Trade Allies by Utility



Respondents were asked to quantify the program incentives as a percent of total project costs. The most common answer was 1-5%, named by just under half of the respondents (Figure 6-4). Over one third of trade allies associated with Union Gas projects thought the incentives were less than or equal to 1%, compared to 18% of the EGD respondents.

Figure 6-4. Incentives as a % of Project Costs



According to the trade allies, all of Enbridge customers were aware of the utility role in the project but only 2/3 of the Union customers were aware.

Table 6-8. Customer Aware Of Utility Role

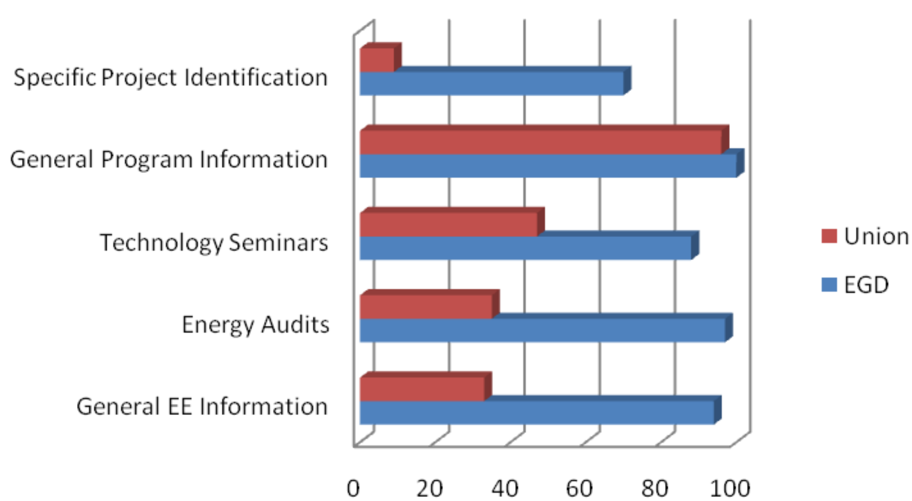
	Yes	Total	%
EGD	34	34	100
Union	27	40	68

Trade allies were asked "Do you recall receiving energy efficiency information and/or training in any of the following areas that was sponsored or delivered by Union Gas/Enbridge Gas Distribution?" Almost all remembered getting general program information (Table 6-9 and Figure 6-5). Among the EGD trade allies, almost all remembered getting information or training in energy audits and general energy efficiency information, compared to around one third for Union trade allies. Over two thirds of EGD respondents recalled getting "specific project identification" compared to nine percent for Union.

Table 6-9 % of Mentions by Utility

	EGD	Union
General Program Information	100	96
Energy Audits	97	35
General EE Information	94	33
Technology Seminars	88	47
Specific Project Identification	70	9
Software	0.38	0.20
Lunch N Learns	0.26	0.22

Figure 6-5. Percent Recall Information Etc. by Utility



6.3 Sector-Specific Answers to Key Questions

This section will present answers to the questions that carry the most weight in the free ridership calculations broken out by utility and sector. The results are presented as percentages after sector weights have been applied. This corresponds to the weighting used when the sector-specific free ridership results were calculated. The key questions that will be presented in this section are shown in the following table.

Table 6-10. Key Questions Influencing Free Ridership Calculation

Label in Text	Marker in Figure 5-1	Description and Survey Question
Direct Measure Level		
Likelihood and/or Share	[4] and [7]	Free Rider percentage based on likelihood (question E2a) and/or share (question E2b)
Months of Early Replacement	[6]	Number of months program caused the project to be moved forward, used to calculate the early replacement adjustment multiplier (question E1a)
Direct Project Level		
Best Estimate of Savings	[14]	Interviewee best estimate of the extra savings that would have been achieved without the program (question E3).
Program Influence Project Level		
Planning	[H]	Project planning interviewer score (question D3b)
Influence	[G]	Interviewer-assigned influence score (question D2b)
Importance	[F]	Program importance participant score (question D1)

The sector level free ridership results are shown in Tables E-1 and 5-1, which can be summarized as follows:

EGD: Industrial and Agriculture are relatively higher than Commercial Retrofit, Multifamily, and New Construction with Commercial Retrofit being particularly low.

Union: Commercial Retrofit and Industrial are relatively higher than Multifamily and New Construction with Agriculture being particularly low (zero).

The discussion of the question-specific results will address those sector differences. Those sectors that saw relatively high free ridership rates are shaded in the tables that follow.

6.3.1 Direct Measure Level

Likelihood and/or Share. Respondents were asked to estimate the *likelihood* that they would have incorporated measures "of the same high level of efficiency" if not for the financial and technical assistance of the program (Figure 5-1 [4]). In cases where respondents indicate that they may have incorporated some, but not all, of the measures, they are asked to estimate the *share of measures* that would have been incorporated anyway at the same level of high-efficiency. The answers they gave were converted into a free ridership percentage, which is shown in the following table.

EGD Notes: In the industrial sector, 67% of the respondents had free ridership scores of 70% or more based on this measure, which was significantly higher than the other sectors, and 89% of the agriculture respondents had free ridership scores at 50% or higher.

Union Gas Notes: Fully 84% of the commercial retrofit respondents had free ridership scores of 100% based on this measure. The industrial scores were somewhat better than multifamily and new construction on this measure. Most of the very largest industrial companies had very high free ridership rates in this area, which is the primary driver of the final free ridership score.

Table 6-11. Likelihood and / or Share – EGD

Free Ridership Percent	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	0%	29%	42%	25%	39%
10	0%	0%	0%	0%	0%
20	11%	0%	2%	0%	0%
25	0%	0%	5%	0%	3%
30	0%	0%	0%	8%	0%
40	0%	0%	0%	0%	0%
45	0%	0%	0%	0%	6%
50	44%	5%	14%	25%	0%
60	11%	0%	0%	0%	0%
65	0%	0%	0%	0%	3%
70	0%	10%	7%	0%	0%
75	11%	19%	2%	0%	0%
80	0%	14%	9%	0%	3%
85	11%	0%	0%	21%	0%
90	0%	0%	5%	4%	0%
100	11%	24%	14%	17%	47%
Total	100%	100%	100%	100%	100%
N	9	22	56	24	44

Table 6-12. Likelihood and / or Share – Union Gas

Free Ridership Percent	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	67%	6%	0%	0%	5%
30	0%	17%	0%	0%	0%
40	0%	0%	6%	0%	0%
50	0%	17%	13%	8%	0%
60	11%	0%	0%	0%	0%
70	0%	6%	0%	0%	0%
75	0%	0%	6%	0%	0%
80	22%	6%	6%	25%	5%
85	0%	6%	0%	0%	0%
90	0%	6%	13%	8%	5%
100	0%	39%	56%	58%	84%
Total	100%	100%	100%	100%	100%
N	8	19	17	12	20

Early Replacement Adjustment Multiplier. On a measure-by-measure basis, respondents were asked if the program influenced them to install the equipment more than one year earlier than they otherwise would have otherwise. If it had, they were asked when they would have installed the equipment without the program (Figure 5-1 [6]). That answer was converted to months and then converted to a percentage multiplier to discount the measure-specific free ridership rate. The answers given are shown below.

EGD Notes: Few projects were moved forward in time in most sectors except for the multifamily sector.

Union Gas Notes: Very few projects in any sector were moved forward by more than 12 months, with the exception of commercial retrofit.

Table 6-13. Months the Program Moved the Project Forward in Time – EGD

Months	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	67%	86%	14%	100%	82%
2	0%	7%	7%	0%	0%
6	0%	7%	7%	0%	0%
9	0%	0%	11%	0%	0%
12	17%	0%	29%	0%	0%
18	0%	0%	14%	0%	0%
24	17%	0%	4%	0%	6%
36	0%	0%	11%	0%	0%
240	0%	0%	4%	0%	12%
Total	100%	100%	100%	100%	100%
N	6	15	32	9	20

Table 6-14. Months the Program Moved the Project Forward in Time – Union Gas

Months	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	0%	92%	0%		50%
6	0%	8%	0%		0%
9	0%	0%	100%		0%
12	100%	0%	0%		0%
24	0%	0%	0%		50%
Total	100%	100%	100%		100%
N	1	13	6	0	3

6.3.2 Direct Project Level

Best Estimate of Savings. Respondents are asked to give an upper, lower and their best estimate [10] of the overall energy savings attributable to the program across all measure categories. If a “best estimate” is not provided, the midpoint between the lower and upper bound is used (Figure 5-1 [14]). Their answers are presented in the following two tables.

EGD Notes: Only two agriculture respondents answered this question, which minimized its effect on this sector, although both said 100% of the savings were attributable to the program. Industrial respondents attributed relatively more of the savings to the program, which would tend to *reduce* their free ridership score.

Union Gas Notes: Industrial and commercial retrofit respondents attributed relatively more of the savings to the program, which would tend to *reduce* their free ridership score.

Table 6-15. Respondent Estimate of Savings Attributable to the Program – EGD

Savings Attributable to the Program (%)	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	0%	6%	19%	8%	0%
10	0%	0%	0%	0%	0%
20	0%	0%	12%	17%	36%
25	0%	6%	0%	0%	0%
35	0%	0%	7%	0%	0%
50	0%	0%	17%	0%	8%
65	0%	0%	5%	0%	0%
70	0%	6%	10%	0%	0%
75	0%	11%	0%	0%	8%
80	0%	17%	14%	25%	6%
85	0%	11%	5%	21%	0%
90	0%	0%	2%	0%	0%
100	100%	44%	10%	29%	42%
Total	100%	100%	100%	100%	100%
N	2	20	56	24	44

Table 6-16. Respondent Estimate of Savings Attributable to the Program – Union Gas

Savings Attributable to the Program (%)	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
0	75%	6%	0%	0%	5%
20	0%	0%	0%	0%	0%
40	0%	0%	0%	8%	0%
50	0%	19%	14%	0%	0%
70	0%	0%	14%	0%	0%
80	0%	6%	7%	25%	0%
90	0%	0%	0%	17%	0%
100	25%	69%	64%	50%	95%
Total	100%	100%	100%	100%	100%
N	7	15	16	12	20

6.3.3 Program Influence Project Level

Planning. Point [H] in Figure 5-1 is an interviewer score of the amount of planning that went on for the measure before the program got involved, based on open-ended questions to the respondent and probing questions as appropriate. The planning score shown in the following tables is on a scale where 5 indicates that respondent had no plans at all and 1 indicates that respondent had documented plans and had budgeted for all of the efficient equipment.

EGD Notes: Compared to the other sectors, only commercial retrofit stands out as having respondents who had relatively far advanced plans prior to program involvement so this question does not contribute meaningfully to explaining the high free ridership scores for agriculture and industrial.

Union Gas Notes: Three quarters of the commercial retrofit respondents had planning scores of 2 or 1, significantly more than the other sectors. The 42% of industrial respondents having a planning score of 1 is significantly higher than agriculture and multifamily, but less than new construction. Most of the very largest industrial companies had planning scores of 1 or 2.

Table 6-17. Project Planning Score – EGD

Planning Score	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	11%	13%	18%	17%	22%
2	11%	9%	7%	0%	14%
3	0%	0%	4%	0%	8%
4	11%	48%	31%	25%	44%
5	67%	30%	40%	58%	11%
Total	100%	100%	100%	100%	100%
N	9	23	56	24	41

Table 6-18. Project Planning Score – Union

Planning Score	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	22%	42%	7%	50%	58%
2	0%	0%	27%	0%	16%
3	0%	16%	53%	0%	16%
4	0%	26%	0%	25%	0%
5	78%	16%	13%	25%	11%
Total	100%	100%	100%	100%	100%
N	8	19	16	12	19

Influence. Point [G] Figure 5-1 is an interviewer score of the program's influence on the type, efficiency and quantity of the equipment installed. The driving question at [G] was as follows: "Did the assistance you received from [Enbridge/Union] in any way influence your capital funding acquisition process, the type or efficiency level of the equipment or the amount of high efficiency equipment you installed or process changes implemented?" After asking probing questions to understand the answer, the interviewer assigns a 1-5 score where "1" indicates that the program had no influence and "5" indicates that the program was the primary reason that energy efficient equipment was installed. The results are in the following tables.

EGD Notes: Agriculture and industrial respondents are somewhat more likely to score low on this question than multifamily and commercial retrofit (33% agriculture and 29% industrial at 3 or lower compared to 16% multifamily and 25% commercial retrofit) with a low score being correlated with a higher free ridership score.

Union Gas Notes: All commercial retrofit respondents got a program influence score of 3 or lower, which was significantly lower than the other sectors. The industrial respondents had lower program influence scores than the agriculture respondents but higher than the other sectors.

Table 6-19. Program Influence – EGD

Program Influence	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	0%	0%	0%	0%	4%
2	0%	6%	0%	25%	7%
3	33%	24%	16%	42%	14%
4	67%	35%	35%	0%	4%
5	0%	35%	48%	33%	71%
Total	100%	100%	100%	100%	100%
N	3	17	35	24	35

Table 6-20. Program Influence – Union Gas

Program Influence	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	0%	0%	0%	0%	50%
2	0%	10%	0%	20%	25%
3	0%	30%	67%	60%	25%
4	0%	50%	0%	20%	0%
5	100%	10%	33%	0%	0%
Total	100%	100%	100%	100%	100%
N	6	11	3	5	5

Importance. Point [F] in Figure 5-1 represents several questions on the importance of several program components or types of assistance in the participant's decision to install energy efficiency equipment. The maximum score among those questions is carried forward in the calculation where 1 is "not at all important" and 5 is "very important". The maximum score by sector is shown in the following tables.

EGD Notes: Over half of the Agriculture respondents had an importance score of 3 or less, with lower numbers correlated with higher free ridership. This was significantly lower than the other sectors. The industrial scores were lower than multifamily and new construction.

Union Gas Notes: Commercial retrofit importance scores were significantly lower than the other sectors. Industrial importance scores were higher than the other sectors.

Table 6-21. Program Importance – EGD

Importance	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	11%	0%	0%	0%	3%
2	11%	0%	0%	0%	3%
3	33%	22%	0%	4%	16%
4	22%	26%	14%	38%	3%
5	22%	52%	86%	58%	76%
Total	100%	100%	100%	100%	100%
N	9	23	56	24	44

Table 6-22. Program Importance – Union Gas

Importance	Agriculture	Industrial	Multifamily	New Construction	Commercial Retrofit
1	0%	0%	7%	0%	37%
2	22%	0%	7%	8%	21%
3	0%	6%	13%	17%	5%
4	0%	50%	13%	75%	16%
5	78%	44%	60%	0%	21%
Total	100%	100%	100%	100%	100%
N	8	19	17	12	20

6.3.4 Summary

The following table summarizes the top-level information from the previous tables. It indicates which questions are driving the results for each of the sectors with relatively high free ridership rates.

Table 6-23. Summary of Sector-Specific Questions on High Free Ridership Sectors

Label in Text	EGD Industrial	EGD Agriculture	Union Gas Industrial	Union Gas Commercial Retrofit
Direct Measure Level				
Likelihood and/or Share	High	High	High*	High
Months of Early Replacement				
Direct Project Level				
Best Estimate of Savings	Low	Low	Low	Low
Program Influence Project Level				
Planning			Medium High*	High
Influence	Medium	Medium	Low	High
Importance	Medium	High	Low	High

High = Answers strongly supported the relatively high free ridership scores for these sectors.
High = High for the very largest industrial participants.*
Medium = Answers somewhat supported the relatively high free ridership scores for these sectors.
Low = Answers tended to bring down the free ridership scores for these sectors compared to other sectors.
Blank = Answers neither support nor contradict the free ridership scores.

EGD Summary. The high EGD industrial free ridership results are driven by high scores in the Likelihood and/or Share questions with support from the Influence and Importance questions. The high EGD agriculture free ridership results are driven by high scores in the Likelihood and/or Share and Importance questions with support from the Influence questions.

The EGD commercial retrofit has a relatively low free ridership rate at 12%. This sector had scores corresponding to low free ridership rates on four of the six main questions examined:

- Likelihood and/or Share: One of the lowest free ridership scores.
- Best estimate of savings: One of the highest estimates with 42% saying 100%
- Influence: The highest score (corresponding to a low free ridership rate), with 71% with a score of 5
- Importance: The second to the highest score (corresponding to a low free ridership rate), with 76% with a score of 5.

Union Gas Summary. The Union Gas commercial retrofit respondents show answers correlated with high free ridership results across most questions examined, except the Best Estimate of Savings.

The Union Gas industrial free ridership results are driven by the responses of a small number of very large industrial participants, who are significantly larger than the other Union Gas industrial participants (based on gross m^3 savings). The scores of these large participants on the Likelihood and/or Share and Project Planning questions were the primary drivers in their high free ridership scores.

6.4 Free Ridership, Spillover, and Net-to-Gross from Other Jurisdictions

Free ridership, spillover, and net-to-gross ratios from other jurisdictions can put the Union and EGD results in context.

The Database for Energy Efficiency Resources (DEER) is one commonly-cited source for free ridership numbers. DEER developed by the California Public Utilities Commission and the California Energy Commission, with support and input from the Investor-Owned Utilities and other interested stakeholders. The net-to-gross ratios in DEER take only free ridership into account and not spillover. As of late 2006 the DEER net-to-gross rates were as follows:[40]

0.83	Commercial and agricultural information, tools, or design assistance services
0.80	Default
0.96	Express Efficiency (rebates)
0.83	Energy Management Services, including audits (for small and medium customers)
0.74	Industrial Information and Services
0.70	Large Standard Performance Contract
0.80	All other nonresidential programs

[40] DEER is currently being updated and is off-line as of this writing. The original source of these numbers was : http://eega.cpuc.ca.gov/deer/Ntg.asp.

In 2006, Summit Blue researched the free ridership and spillover rates that have been found in studies in recent years. The results of that benchmarking exercise are presented in the following pages (with some slight updates from studies we are aware of that occurred since 2006). The 79% net-to-gross ratio for EGD is in the same range as several of the programs examined. The 56% ratio for Union Gas is lower than those found in this research.

Table 6-24. Results from Other Jurisdictions

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
California	PG&E	Advanced Performance Options (All Measures)	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: HVAC Technologies PG&E Study ID number: 333B	1999		Commercial	Adjustable Speed Drives, Water Chillers, Customized EMS, Convert to VAV, Other Custom Equipment, Other HVAC Technologies	0.46	0.21	0.75
California	PG&E	Commercial Energy Efficiency Incentives Program: Lighting Technologies	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: Lighting Technologies PG&E Study ID number: 333A	1999	This evaluation covers indoor lighting technology retrofits that were rebated during 1997. These retrofits were performed under three different PG&E programs: the Retrofit Express (RE), Customized Efficiency Options (CEO) and Advanced Performance Options (APO) Programs.	Commercial	Lighting	0.24	0.05	0.82
California	Southern California Edison	Non-Residential Financial Incentives Program	Evaluation of the Southern California Gas Company 2004-05 Non-Residential Financial Incentives Program June 7, 2006	2006	The program focuses on small to medium nonresidential gas customers served under core rate schedules. The program incorporates technical support, education, training, outreach, contractor referral, prescriptive rebates and equitable financial incentives through three program elements.	Small and Medium Commercial, Agricultural, and Industrial		0.3	10% (not evaluated, just an estimate)	0.8
California	PG&E	Retrofit Efficiency Options Program	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: HVAC Technologies PG&E Study ID number: 333B	1999	The REO program targeted commercial, industrial, agricultural, and multi-family market segments. Customers were required to submit calculations for the projected first-year energy savings along with their application prior to installation of the high efficiency equipment. PG&E	Commercial, Industrial, Agricultural, and Multifamily	Adjustable Speed Drives, Water Chillers, Cooling Towers	0.46	0.21	0.75

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
					representatives worked with customers to identify cost-effective improvements, with special emphasis on operational and maintenance measures at the customers' facilities. Marketing efforts were coordinated amongst PG&E's divisions, emphasizing local planning areas with high marginal electric costs to maximum the program's benefits.					
California	PG&E	Retrofit Express Program	Evaluation of Pacific Gas and Electric Company's 1997 Commercial Energy Efficiency Incentives Program: HVAC Technologies PG&E Study ID number: 333B	1999	The RE program offered fixed rebates to customers who installed specific electric energy efficient equipment. It covered covers lighting, air conditioning, refrigeration, motors, and food service. Customers were required to submit proof of purchase with their applications in order to receive rebates. The program was marketed to small- and medium-sized commercial, industrial, and agricultural (CIA) customers.	Small and Medium Commercial, Industrial, and Agricultural Customers	Central A/C, Adjustable Speed Drives, Package Terminal A/C, Set-Back Thermostat, Reflective Window Film, Water Chillers, Other HVAC Technologies	0.39	0.21	0.82
California		SPC	2003 Statewide Nonresidential Standard Performance Contract (SPC) Program Measurement And Evaluation Study	2005	The program offered fixed-price incentives to project sponsors for kWh energy savings achieved by the installation of energy-efficiency measures. The fixed price per kWh, performance measurement protocols, payment terms, and other operating rules of the program were specified in a standard contract. PG&E and SDG&E also offer incentives for energy efficient gas measures.	Nonresidential	Lighting, lighting controls, VSDs, HVAC	49% / 59% / 35% / 55% / 41% (1999-2003)	5% (not evaluated, just an estimate)	63% (for 2002-2003)
Colorado	Xcel	Bid 2001 Program	Impact and Process Evaluation of the Bid 2001 Program	2003	Demand-side bidding program that acquires demand reductions by	Commercial and Industrial		0.36	0.06	0.7

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
					soliciting proposals for demand reduction projects from customers, and third-party bidders contractors. This program has subsequently been succeeded by the Custom Efficiency program.					
Colorado	Xcel	Custom Efficiency	Colorado Demand-Side Management Programs Impact, Cost-Effectiveness, Process, and Customer satisfaction Evaluations	2005	Launched on December 1, 2001, this program is a C&I DSM bidding program and successor to Bid 2001. The program's goal is to obtain reliable and verifiable electric demand reduction in Company's Front Range service territory. To participate, eligible customers and qualified providers of energy related services respond to RFPs seeking electric demand reduction projects within eligible facilities.	Commercial and Industrial		0.398	0.139	0.741
Massachusetts/ New Hampshire	National Grid	Accelerated Application Process	National Grid 2001 Commercial and Industrial Free-ridership and Spillover Study	2002				0.121	0.146	1.025
Massachusetts/ New Hampshire	National Grid	Comprehensive Project	National Grid 2001 Commercial and Industrial Free-ridership and Spillover Study	2002				0.154	0.109	0.955
Massachusetts/ New Hampshire	National Grid	Design 2000plus	National Grid 2001 Commercial and Industrial Free-ridership and Spillover Study	2002	The program offers technical assistance and financial incentives to large commercial and industrial customers who are building new facilities, adding capacity for manufacturing, replacing failed equipment or undergoing major renovations.	Large Commercial and Industrial	Motors, VFD, HVAC, Lighting, Custom	0.307	0.188	0.881
Massachusetts/ New Hampshire	National Grid	Energy Initiative Program	National Grid 2001 Commercial and Industrial Free-	2002	The program offers technical assistance and incentives to help large C&I customers	Large Commercial and Industrial	Motors, VFD, HVAC, Lighting,	0.096	0.111	1.015

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
			ridership and Spillover Study		purchase energy-efficient measures for their existing facilities.		Custom			
Massachusetts	NSTAR	Business Solutions	PY2002 Business Solutions Impact Evaluation for NSTAR Electric	2004	The program provides technical and financial assistance to NSTAR Electric's commercial, industrial, and institutional customers (except in Cape Light Compact territory) to facilitate the installation of energy saving equipment in existing buildings.	Commercial, Industrial, Institutional	Lighting, lighting controls, VSDs, HVAC, EMS, Refrigeration, Compressed Air, Motors	0.277	0.103	0.854
Massachusetts	NSTAR	Construction Solutions	Construction Solutions Program Year 2002 Impact Evaluation Final Report	2004	The program (previously the C&I New Construction Program) offers technical and financial assistance to design professionals and developers to promote the use of efficient design measures and electrical equipment in the construction, remodeling, or renovation of commercial and industrial buildings. The program also offers incentives to encourage the installation of energy efficient replacement equipment when existing systems fail during operation or at the time of purchasing new equipment.	Commercial and Industrial	Chillers, VSDs, Refrigeration, Lighting, Lighting Controls, Controls, Compressed Air	0.173	0.003	0.848
New York	NYSERDA	CIPP	Commercial/Industrial Performance Program (CIPP) Market Characterization, Market Assessment and Causality Evaluation	2006	CIPP began in June 1998. It provides financial incentives to energy service companies (ESCos) and other contractors to promote energy efficiency capital improvement projects. Program objectives are to: 1) foster the growth of the ESCO industry in New York State and 2) encourage end-use customers to invest in energy-efficient equipment based on the potential	Commercial and Industrial	Lighting, EMS, motors and VSDs, unitary HVAC and chiller replacements, heat pump water heaters, Energy Star vending machines, custom measures with paybacks of greater than one year, including	0.35	0.58	1.04

State/Region	Utility	Program Name	Report Title	Year of Research	Program Description	Market Sector	Measures Covered	Free ridership values	Total Spillover Value	NTG Ratio
					energy cost savings. Eligible energy efficiency measures must reduce electric energy consumption at the project site and this reduction must be measurable and verifiable. In addition, cost effective renewable energy measures and measures that reduce summer peak demand are eligible for funding consideration as custom measures whether or not electric energy consumption is reduced.		renewable measures and measures that reduce peak summer demand.			
New York	NYSERDA	New Construction Program (NCP)	New Construction Program (NCP) Market Characterization, Market Assessment, and Causality (MCAC)	2006	This comprehensive evaluation covered the period from program inception through year-end 2005. In late 2006, the MCAC Team was tasked with updating certain aspects of the earlier comprehensive evaluation effort. This report discusses the results of the update work.	Commercial and Industrial		0.40	0.85	1.22
New York	NYSERDA	Technical Assistance Program	Technical Assistance Program Market Characterization, Market Assessment And Causality Evaluation	2007	The Program provides customers with objective, customized information by funding detailed energy studies capable of facilitating better energy efficiency, energy procurement, and financing decisions.	Commercial and Industrial		0.27	0.44	1.17

7 CONCLUSIONS

The total free ridership rate across both utilities and all sectors is 48% as shown in Table 7-1. The free ridership rate for EGD is 41% and it is 54% for Union Gas. Summit Blue recommends that the utilities use the utility-specific total free ridership values of 41% and 54% as the best estimate of free ridership. Those results are based on larger sample sizes than the sector-specific results and proved more stable in the sensitivity analysis. The sector-specific results are based on smaller sample sizes and should only be used to support program management, for example to support targeting and marketing decisions.

Table 7-1. Free Ridership Results

Sector	EGD	Union	Total
Agriculture	40%	0%	18%
Commercial Retrofit	12%	59%	27%
Industrial	50%	56%	53%
Multifamily	20%	42%	26%
New Construction	26%	33%	28%
Total	41%	54%	48%

Assumptions (See Figure 2.1 for the interpretation of these assumptions):

Weight of Participant Reported Importance [F] in [K] compared to the planning [H] and influence [G] scores	Triple weight
Weight of Project-based estimate [14] in [20] compared to the measure-specific scores [9]	Triple Weight
Weight of Program Influence Score [L] compared to the Project-Based score [21]	Equal Weight

Summit Blue recommends the utilities use following spillover rates:

Table 7-2. Spillover Results

Spillover Type	EGD	Union	Base
Participant Inside Spillover	5%	5%	Of gross reported savings
Participant Outside Spillover	5%	5%	Of gross reported savings
Audit-Only Spillover	35%	0%	Of gross audit-recommended savings
Nonparticipant Spillover	0%	0%	

Summit Blue recommends the utilities use the following net-to-gross ratios, reflecting both free ridership and spillover:

Table 7-3. Net-to-gross Results

	EGD	Union
Net-to-gross ratio	79%	56%

Appendix A. Revised Analysis Plan

Appendix B: Survey Instruments

APPENDIX A

CUSTOM PROJECT FREE RIDERSHIP AND SPILLOVER STUDY ANALYSIS PLAN

FINAL

Submitted To:

Union Gas Ltd.

Enbridge Gas Distribution Inc.

January 15, 2008
Annotated July 28, 2008 to reflect decisions made for the final calculations.

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Note: The analysis plan presented here has changed from the original approved plan in two ways:
1. Assumptions left undefined in the original plan were finalized.
2. Some details of the free ridership calculation had to be changed to appropriately adjust to realities in the actual data.

INTRODUCTION

This document presents the detailed analysis plan that will govern the free ridership and spillover study for the Custom Projects programs implemented by Enbridge Gas Distribution and Union Gas. This document will present the planned survey and analysis approach and sample design for three surveys:

1. Participant and Trade Ally survey covering free ridership and spillover

2. Participant Audit-Only survey covering spillover

3. Nonparticipant Survey covering spillover.

Finally, this document will outline the final report.

Approach Overview

Free ridership and spillover will be estimated using data from surveys with participants, nonparticipants, trade allies, and utility staff. This approach is based primarily on participant self-reported information along with other perspectives to triangulate the net-to-gross estimates. It is the most common and generally accepted approach to measuring free ridership and spillover in a commercial and industrial energy efficiency program.

Experienced utility industry consultants will personally conduct the interviews and most will be done on-site. This is standard practice for our firm where estimating attribution[1] is a primary objective of the research. Typically the internal champion in an industrial firm will have the most complete information on influences, and this information can best be extracted in an in-person interview which encourages the free flow of significant information.

To address the possibility of respondent bias, the interviews will approach each topic from a variety of directions. The interviewer has the discretion to probe for supporting information and the analysis process checks for consistency across answers. Interviewees will be promised confidentiality and assured that their answers will not affect the incentives or support they have received from the program. To address the possibility of interviewer bias, each interviewer will be trained in the purpose of the research and the importance of objectively probing and recording responses. Three different interviewers will perform the interviews and the data from their interviews will be compared to look for uneven application of the methodology. The interviewers chosen for this effort each have a long history of tackling evaluation projects from an objective point of view.

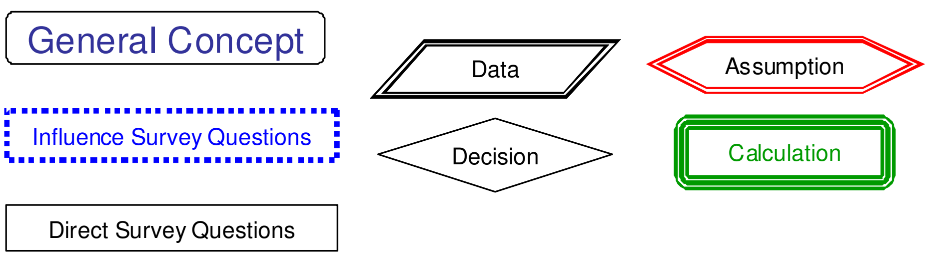
[1] In this study and Analysis Plan, "attribution" is defined as the combined program market influence of free ridership and spillover.

Introduction to the Flow Diagrams

The description below contains references to diagrams of the flow of survey questions and analysis logic shown after page 7. The first diagram (Figure 3) shows a high-level overview of the analysis and survey logic. The revised version of Figure 3 shows revisions to the general approach and the weights given to various parts of the analysis in the calculations used to produce the final, recommended results. Figures 4 through 6 show the direct question sequence with Figure 4 showing the measure-level approach, Figure 5 the project-level approach, and Figure 6 the combined approach. Figure 7 shows the program influence sequence, and Figure 8 shows the combination of the direct and program influence sequences to produce the final results.

Key points in the diagrams are labeled with bold, large numbers and letters. Those labels are referred to in the text in brackets, e.g., [1] [2] [A] [B]. Key assumptions in the logic are noted in the text with bold, italics set off by < > symbols (e.g., ***<Average>***). Key assumptions in the diagrams are noted with the figure labeled "Assumption" shown in the key in Figure 1.

Figure 1. Key to Symbols in the Analysis Diagrams



PARTICIPANT SURVEY – FREE RIDERSHIP

This section will first outline the survey and analysis approach for the participant and trade ally survey, covering the free ridership aspect, and then discuss the sample design.

Participant and Trade Ally Survey and Free Ridership Analysis Approach

We will design and implement surveys with participating end users and trade allies (Channel Partners for Union Gas and Business Partners for Enbridge) to measure free ridership and spillover. The discussion that follows is largely written with the participants in mind. The survey for the trade allies follows the same general logic and they will be asked for their opinion on the impact of the program on specific participants. (The spillover approach will be discussed in the following section.)

Figure 3 presents an overview of the survey and analysis approach. Free ridership will be discussed with each respondent in both **direct questions** aimed at obtaining respondent estimates of the appropriate (full or partial) free ridership rate to apply to them, and in **supporting or influencing questions** used to verify whether direct responses are consistent with participants' views of the program's influence on their equipment investment decisions. The direct questions will be asked at the measure level and at the whole project level. They will then be combined into a single, project-level direct free ridership score. Direct and program influence scores are combined into the final project-level free ridership score. That project-level score is weighted by program-reported savings to calculate the final savings-weighted free ridership percentage. Each of these steps is explained in more detail below, corresponding to the diagrams following Figure 3.

Direct Free Ridership Questions

The direct free ridership questions are posed first for each major category of measures that were reported to the program (*e.g.,* HVAC, building controls, process technologies) (Figure 4), and then for the project as a whole (Figure 5). The measure-level and project-level results are combined in the analysis (Figure 6). For the measure-specific questions, respondents are first asked when, if at all in the foreseeable future, they would have replaced existing equipment or installed new equipment if not for the technical and financial assistance of the program (Figure 4 [1]).

Respondents are then asked to estimate the *likelihood* that they would have incorporated measures "of the same high level of efficiency" if not for the financial and technical assistance of the program (Figure 4 [4]). In cases where respondents indicate that they may have incorporated some, but not all, of the measures, they are asked to estimate the *share of measures* that would have been incorporated anyway at the same level of high-efficiency. This flexibility in how respondents could conceptualize and convey their views on free ridership allows respondents to give their most informed answer, thus improving the accuracy of the free ridership estimates.

Additional direct project-level free ridership questions are then asked to obtain a lower bound, an upper bound, and a best estimate of overall energy savings attributable to the program across all measure categories (Figure 5 [10, 11, 12]). These questions focus on incremental savings from incorporating high-efficiency equipment or controls instead of standard-efficiency equipment and controls. The questions are asked after measure-specific questions so respondents have the decisions they made on individual measures fresh in their minds. Asking respondents about a lower and an upper bound has been successfully used by Summit Blue in several past net-to-gross studies to help respondents narrow down the possible range of free ridership values before making a best estimate.

Program Influence Questions

The **"program influence"** questions (Figure 7) are designed to clarify the role that program interventions (*e.g.*, technical assistance and financing) played in decision-making, and to provide supporting information on free ridership. Questions address the following topics:

- Figure 7 [A] – The importance of features of the program in the decision to incorporate high-efficiency measures in the project. The dimensions include the following:
  - program technical assistance
  - program financial assistance
  - ongoing relationship with the utility (providing impartial advice and facilitating unbiased contacts, e.g., business partners)
  - utility education activities
    - providing best practice information through case studies, as well as specific industry adoption, proven track records, operating experience to help instill confidence etc.
    - training, workshops, and seminars to improve the general or specific knowledge and competencies of customers
    - on-going advertisements re: energy efficiency to heighten customer awareness and concerns

  - promotion of energy efficiency at conferences, trade shows and other industry events

- Figure 7 [B] – The influence of the program on the type or efficiency level of the measures, or the amount of high-efficiency measures, incorporated into the project.
  - Figure 7 [B1] – Each respondent indicating some degree of program influence was asked to describe how the program influenced the decision to install high-efficiency equipment in the project.

- Figure 7 [C] – The customer's plans (or lack thereof) to incorporate the energy efficiency measures included in the project prior to participating in the program.
  - Figure 7 [C1] – Each respondent indicating any degree of planning for high efficiency prior to participating in the programs is asked to describe these plans in detail and is asked for the equipment type, timing, quantity, and efficiency, as well as for any prior budgeting for the high efficiency equipment.

Program influence questions are both closed-ended and open-ended and may require probing by experienced interviewers to elicit complete responses that accurately reflect the level of program influence. If the responses are inconsistent across the three types of questions, the interviewer will probe to attempt to resolve the inconsistency (Figure 7 [J]). Some responses to open-ended questions are quantitatively scored by interviewers using a pre-prepared scoring guide (Figure 7 [G][H]), while other questions ask respondents directly to quantify program influence (Figure 7 [F]).

Using the Participant and Trade Ally Survey Responses to Estimate Free Ridership

Direct Free Ridership Estimate

The direct free ridership estimate is based on both the measure-specific questions and the "whole project" questions. For each measure category for which the respondent had installed equipment through the program, the survey collects information on when, if ever, the equipment would likely have been installed (Figure 4 [2]) and the *likelihood* that the same high efficiency equipment would have been used, or the *share of high-efficiency measures* that would have been installed (Figure 4 [4]). The response to the likelihood/share-of-measures questions are used as the initial free ridership value for the measure category (Figure 4 [7]). This value is then discounted if the respondent indicated that the program influenced them to install the equipment more than one year earlier than they otherwise would have (Figure 4 [6]). The specific discount values (*i.e.,* adjustment multipliers), when defined, will likely follow the outline presented in Table 1.

Options for the specific discount values (*i.e.,* adjustment multipliers) have not yet been determined. The history and critique task will look for precedents in the field in this area and specific values will then be developed.

Enbridge Gas Distribution designates some projects as "advancement". For "advancement" projects, the TRC calculation already discounts the TRC benefits to account for the period which the program has moved projects forward in time. However, there is no need to modify the survey and analysis to take this into account and Enbridge and Union customers will be asked the same questions, including the timing questions.

Table 1. Early Replacement Adjustment Multipliers

Early Replacement ***Within ____ years of program participation***	Adjustment Multiplier <Assumption>	Early Replacement ***Within __ months of program participation***	Adjustment Multiplier <Final>
Within ___ Months	100%	Within 12 Months	100%
__ Months to __ years	__%	13 to 24 months	75%
__ to __ years	__%	25 to 36 Months	50%
__ to __ years	__%	37 to 48 Months	25%
More than __ years	0%	More than 48 Months	0%

Each measure category is also assigned an energy savings value (in cubic metres (m^3)) from the gas savings recorded for that respondent in the program database (Figure 6 [16]). The direct free ridership estimate for each measure category (after any adjustment for early replacement) is weighted according to the relative savings from the category to determine a weighted average free ridership estimate across all measures (Figure 6 [17]). As it turned out, measure-specific gas savings values were not available for the sample period under examination so this adjustment could not be made and the measure adjusted free ridership value [9] fed straight through to the weighting calculation in [18].

A second direct free ridership estimate is determined based on answers to the direct free ridership questions regarding the lower bound (Figure 5 [12]), upper bound [11], and best estimate [10] of the overall energy savings attributable to the program across all measure categories. If a "best estimate" is provided, this value is used as a second direct free ridership estimate (Figure 5 [14]) in addition to the measure-based estimate discussed above. If a "best estimate" is not provided, the midpoint between the lower and upper bound is used (Figure 5 [13]).[2] The final direct free ridership estimate (Figure 6 [21]) is the ***<weighted average>*** (Figure 6 [20]) of the measure-based estimate [17] and the "best estimate" [14]. If sufficient information is available for only one of these values, then this value is used as the final direct free ridership estimate. ***<Equal weight>*** will be given to the measure-specific and best estimate values to calculate the final direct free ridership estimate (Figure 6 [18][19]). In the final approach, the best estimate values were given three times the weight of the measure-specific estimates.

Program Influence Free Ridership Estimate

As previously discussed, additional questions are included in the surveys to support an analysis of the consistency of responses. Responses to these "program influence" questions are used to adjust the direct free ridership estimates using objective criteria described below. Adjustments are made to individual respondents' free ridership estimates—not to the aggregate free ridership value across respondents. **Adjustments are only made if the respondent's direct free ridership score is beyond the bounds that could reasonably be expected based on responses to the influence questions.** Specifically, the process for whether and by how much to adjust a respondent's direct free ridership estimate is as follows:

Step 1. Calculate an *<average>* program influence score (Figure 7 [L]) (on a 5-point scale) from the scores assigned to the three sets of program influence questions regarding program's importance (Figure 7 [A]), influence of the program [B], and project planning [C]. In the final approach, the importance score [F] was given three times the weight of the Influence [G] and Planning [H] scores (as shown in the revised Figure 3). The ***<maximum score>*** [E] for the program influence dimensions is carried forward in the calculation [F]. A higher score for program influence and importance suggests greater program

[2] Previous research showed that the average "best estimate" was within 3 percentage points of the midpoint.

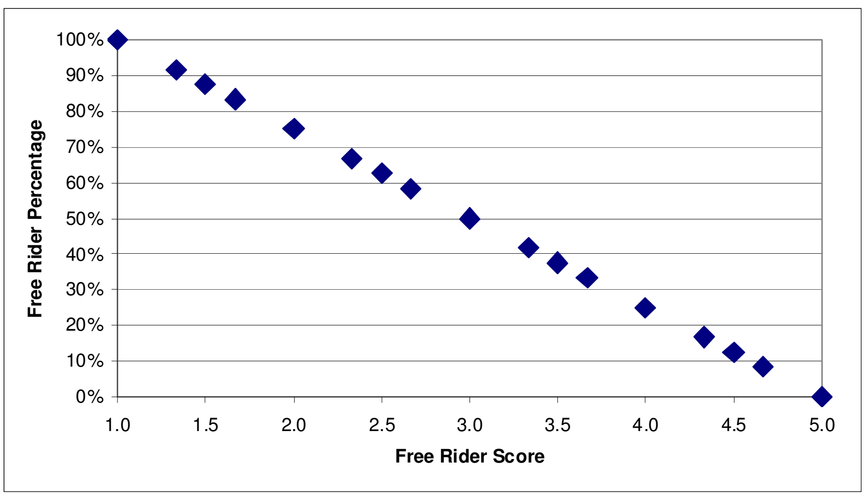
impact, but a higher score for planning indicates lower impact. Therefore, prior to calculating an average score across the three sets of questions, the planning score is inverted so that 1=5, 2=4, etc. In this way, a higher average score across these questions unequivocally represents greater program impact. If the participant's contractor was the most significant influence [D], ***<the results of the trade ally survey will determine the free ridership score>*** [I].

Step 2. Translate the program influence score into a free ridership rate. The influence score has to be converted into a free ridership rate (Figure 7 [M] to [N]) to be used in subsequent calculations. The assumption governing the conversion is that ***<the relationship should be linear>*** with an influence score of 5 converting to 0% free ridership and an influence score of 1 converting to 100% free ridership (see Table 2 and Figure 2).

Table 2. Translate Influence Score to Free Ridership Percentage *<Assumptions>*

Average Influence Score	1.00	1.33	1.50	1.67	2.00	2.33	2.50	2.67	3.00	3.33	3.50	3.67	4.00	4.33	4.50	4.67	5.00
Free ridership	100%	92%	88%	83%	75%	67%	63%	58%	50%	42%	38%	33%	25%	17%	13%	8%	0%

Figure 2. Translate Influence Score to Free Ridership Percentage



Step 3. 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

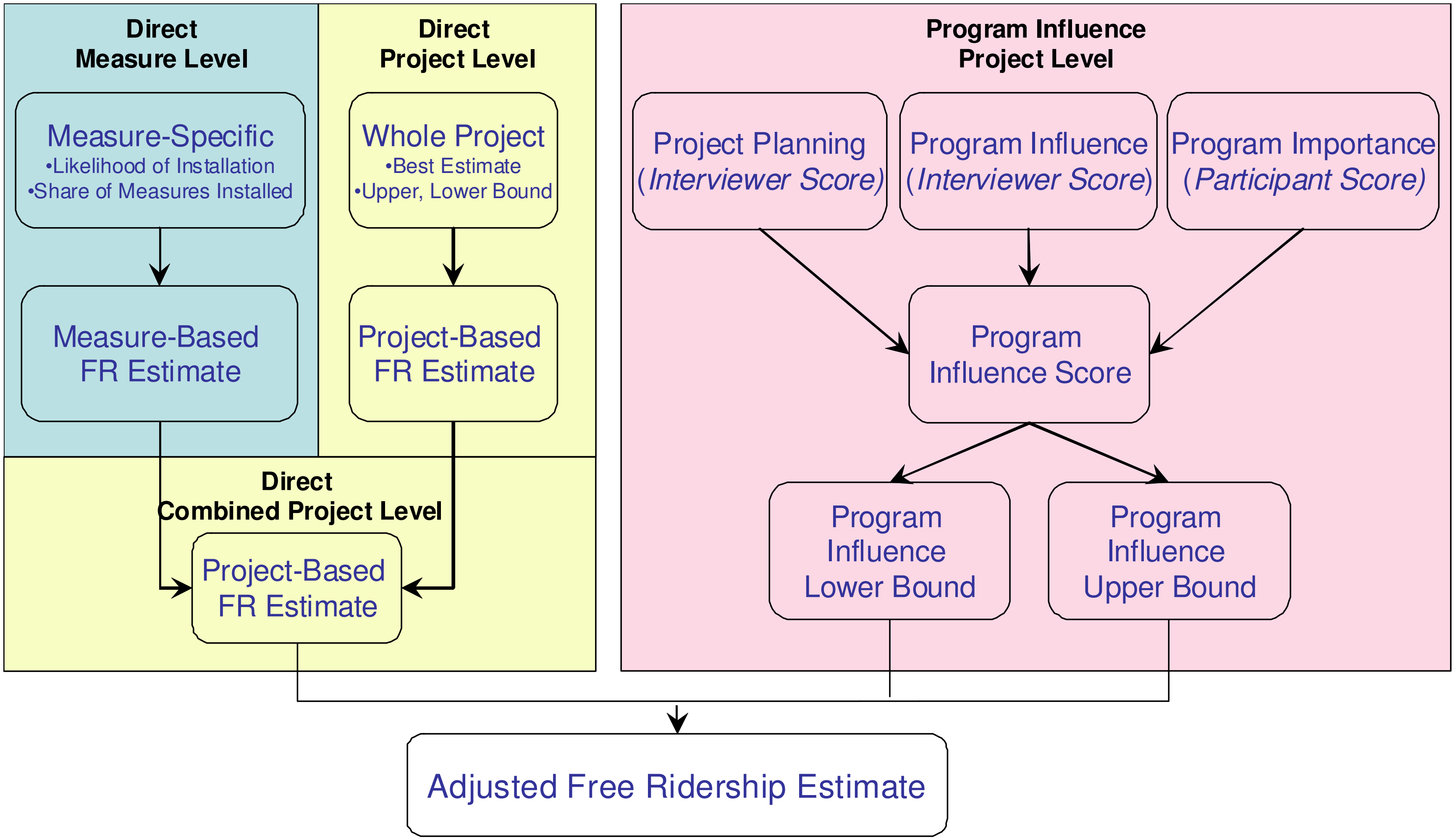


Figure 3. Free Ridership Analysis – Overview – Final Approach

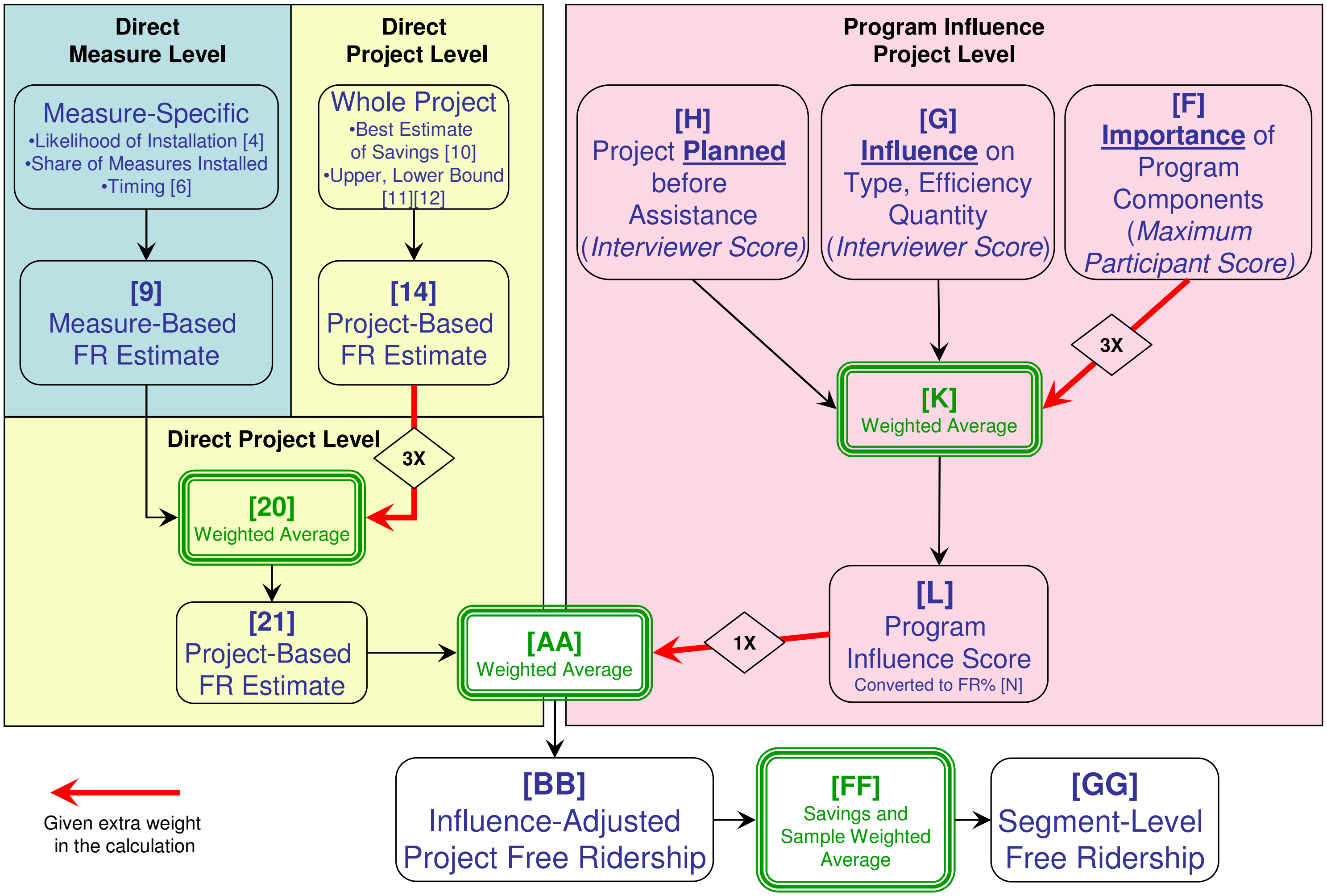


Figure 4. Free Ridership Analysis – Direct, Measure Level

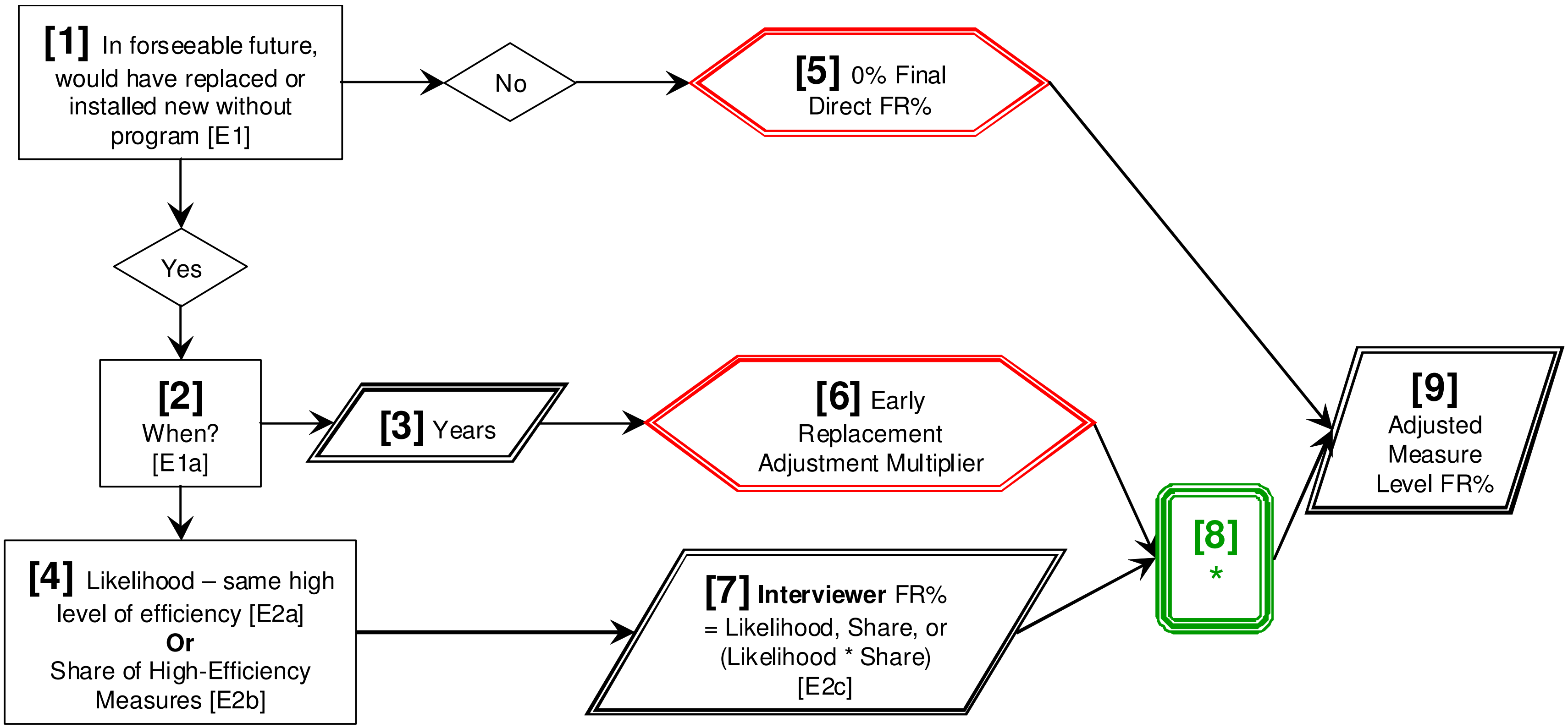


Figure 5. Free Ridership Analysis – Direct, Project Level

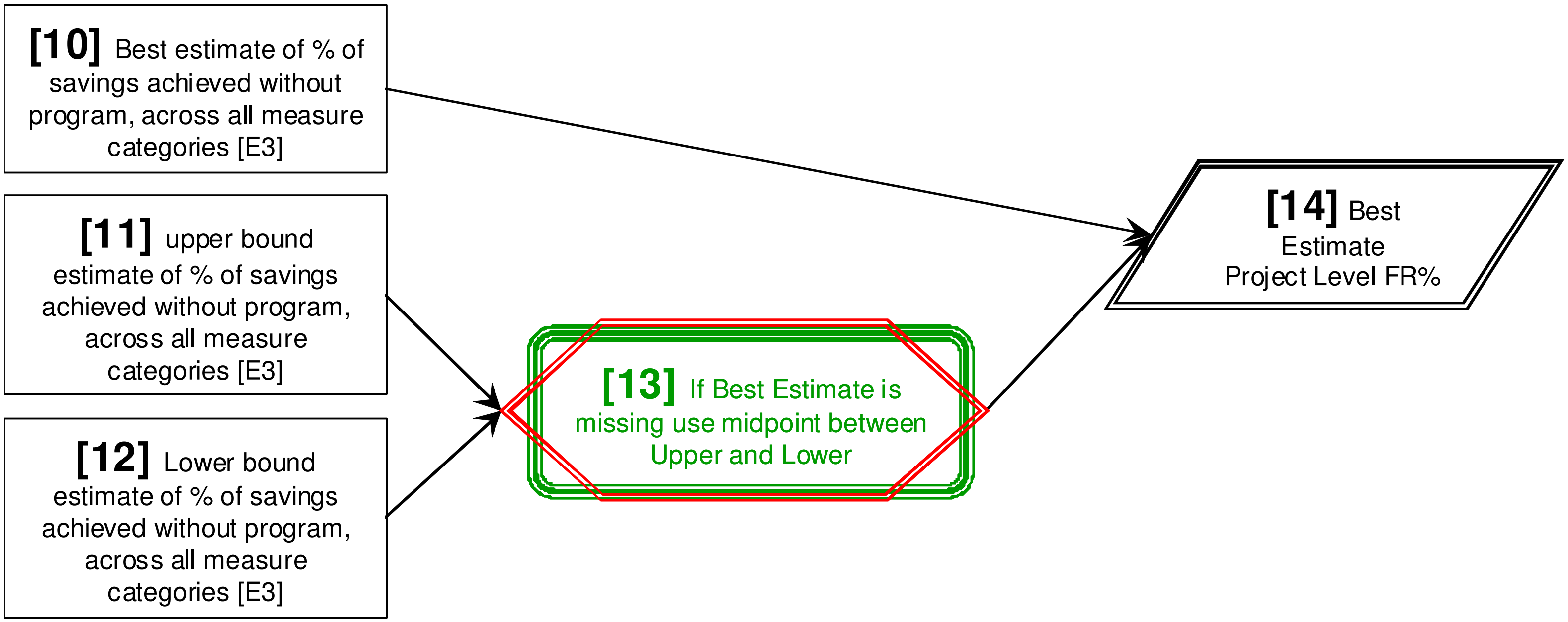


Figure 6. Free Ridership Analysis – Direct, Combined Project Level - Original

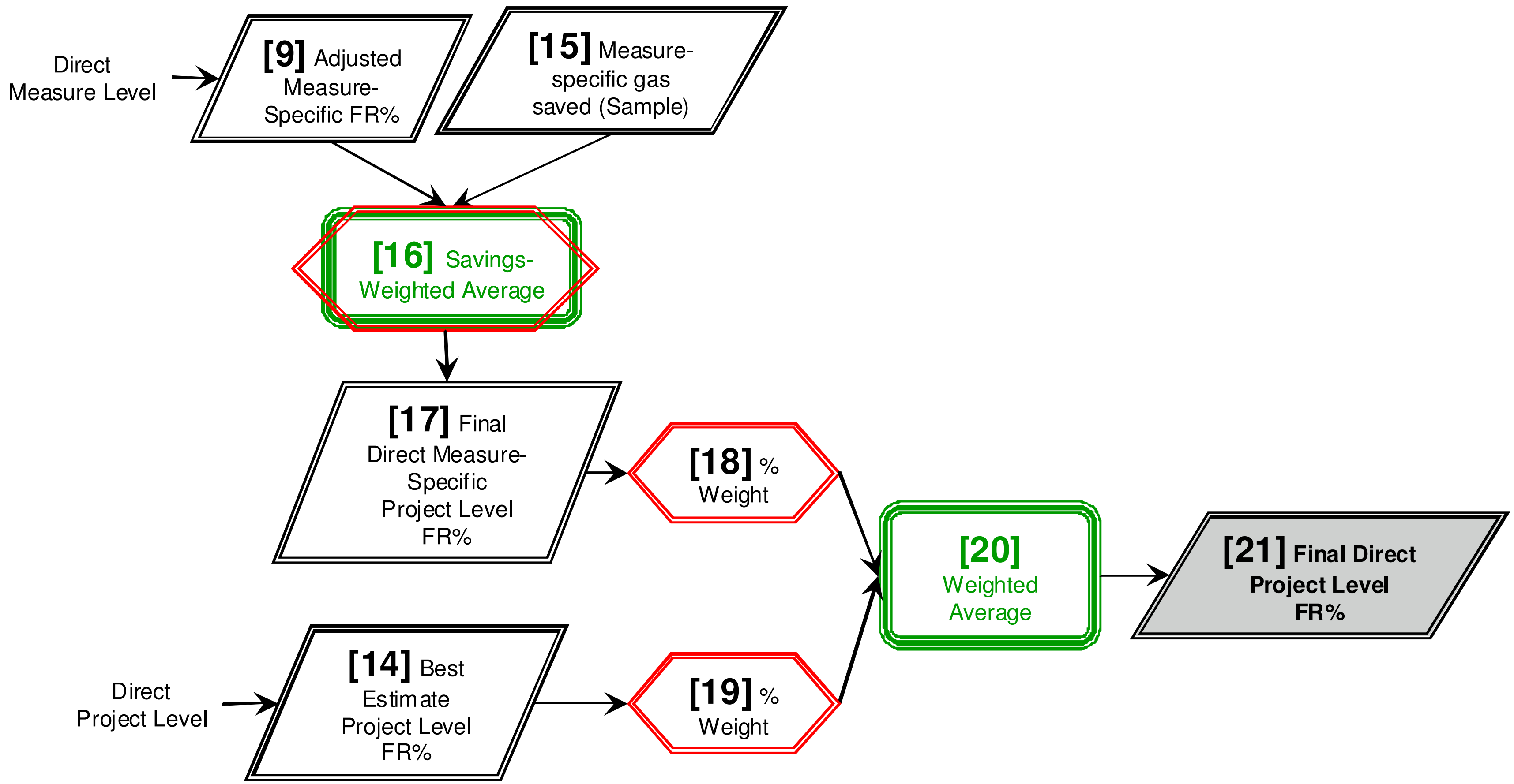
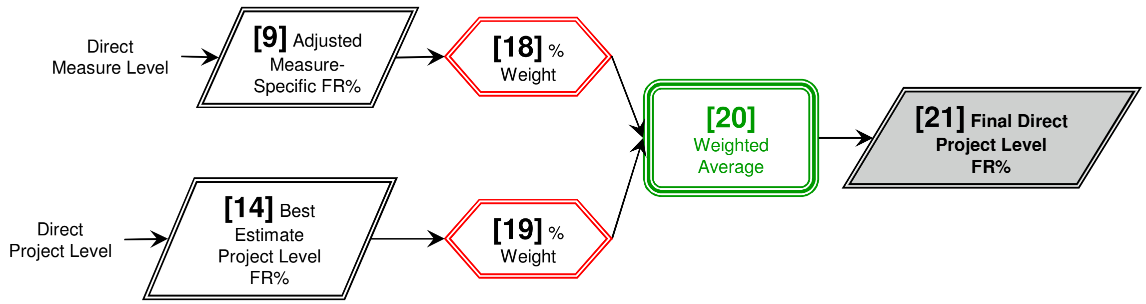
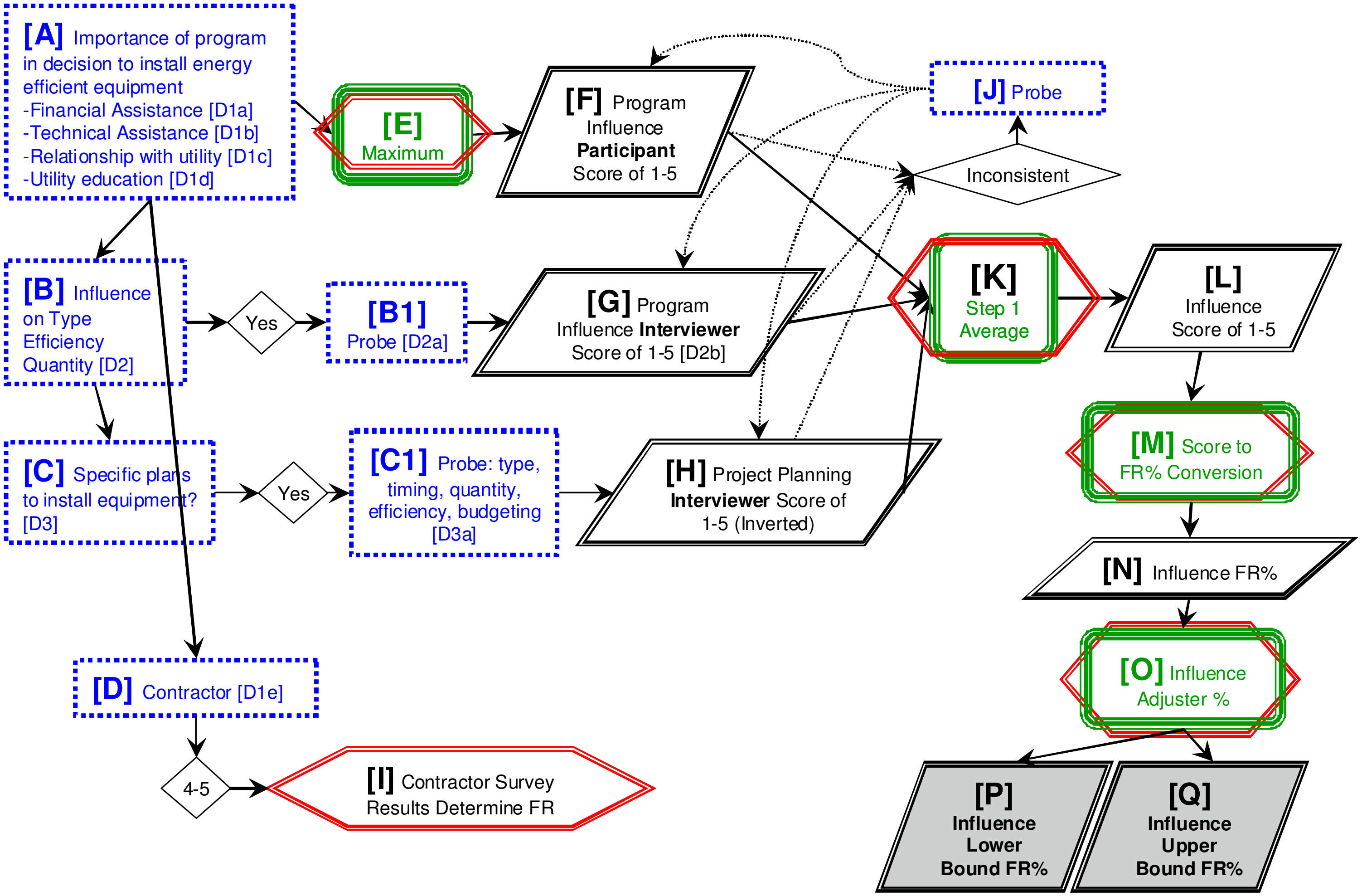


Figure 6. Free Ridership Analysis – Direct, Combined Project Level – Revised



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

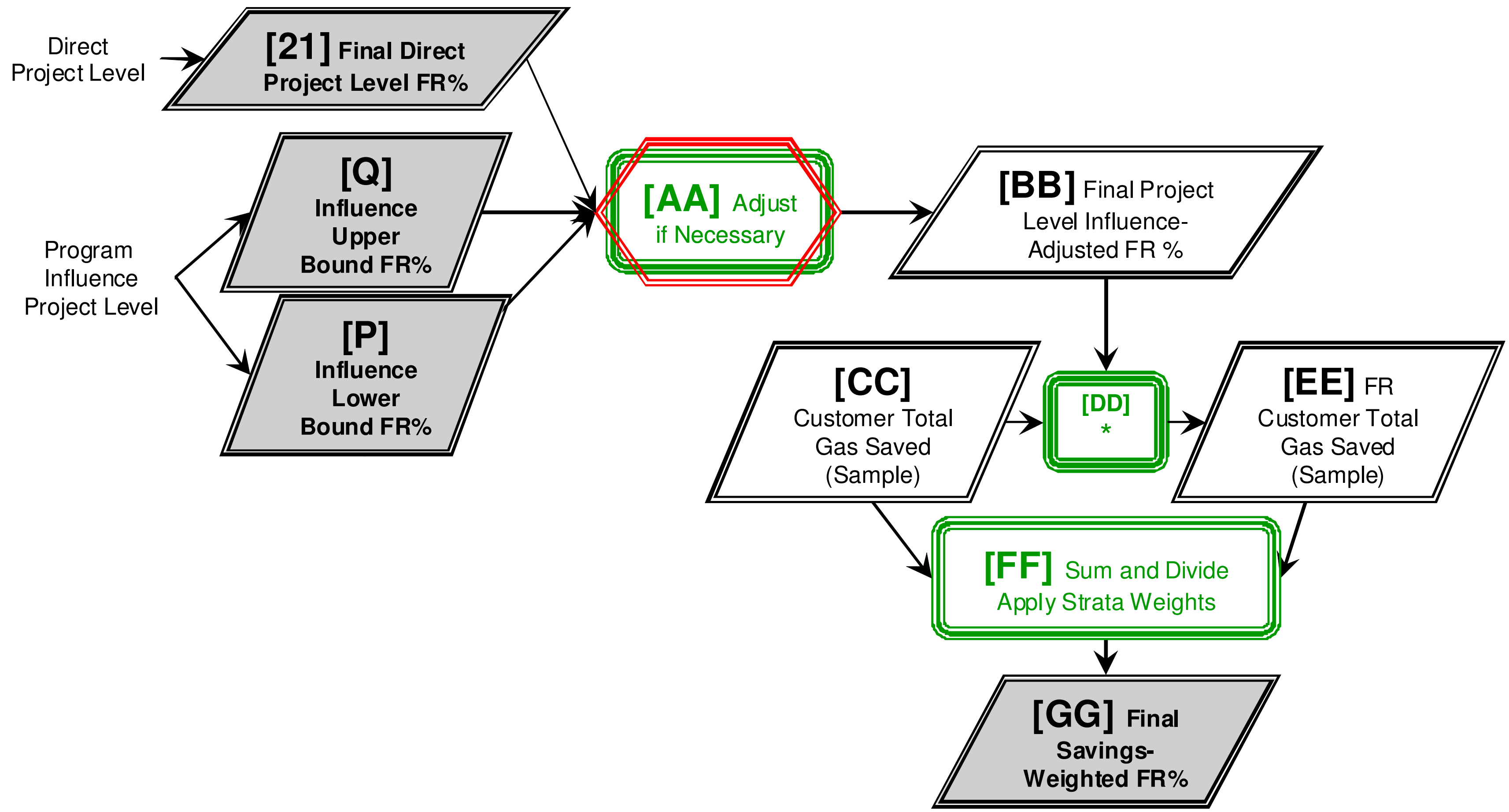
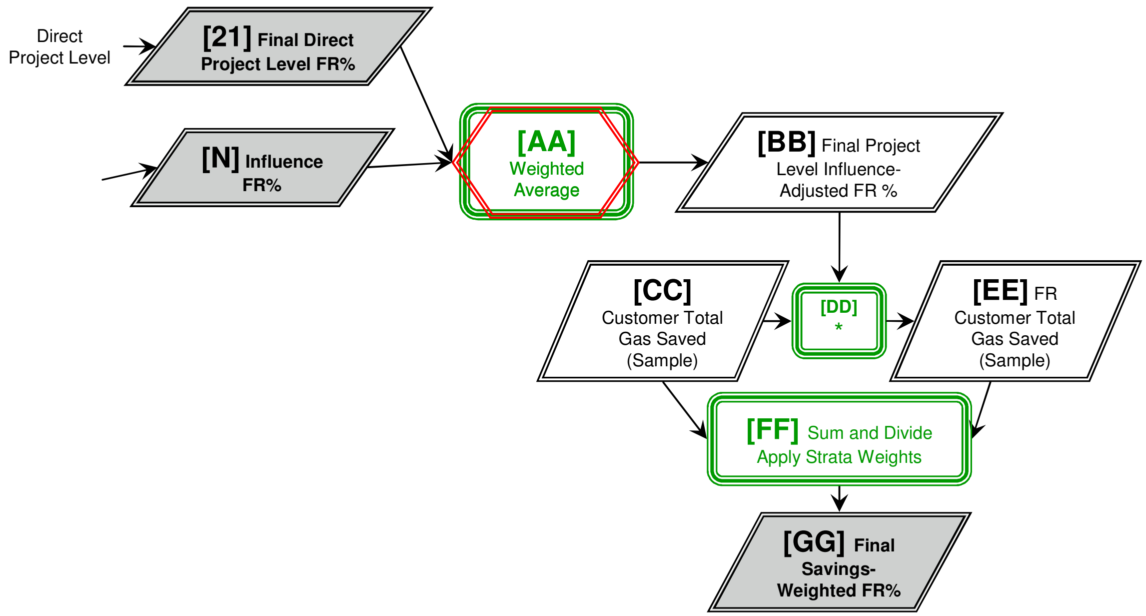


Figure 8. Free Ridership Analysis – Combined Direct and Program Influence Results - Revised



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.

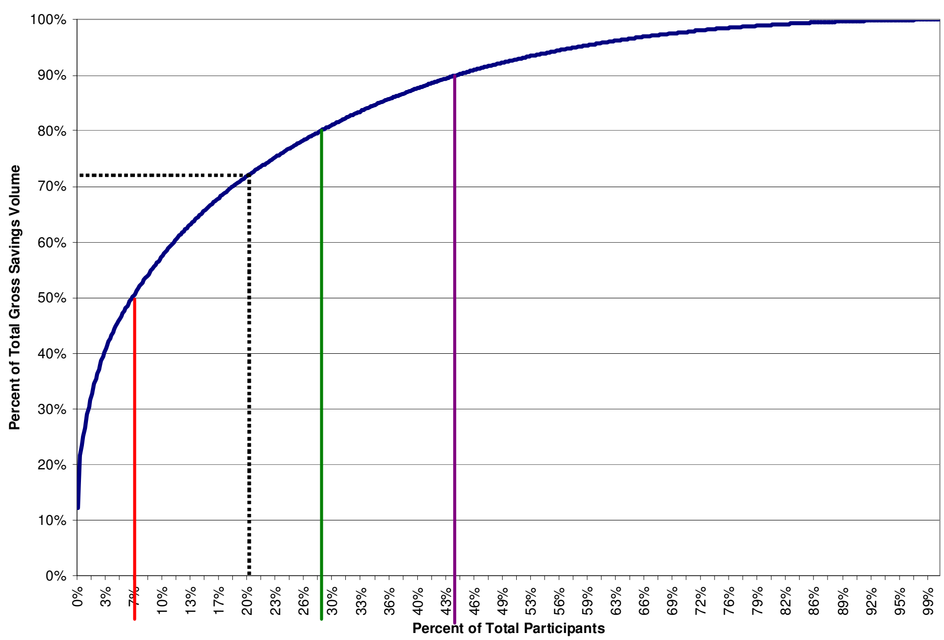
One half of the savings reported by Enbridge from the last quarter of 2006 and the first three quarters of 2007 was achieved by 6.4% of the participants, the largest 20% of projects represent 72% of the program savings, and the top 44% of participants represent 90% of the savings (Table 5 and Figure 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____________________________________ Interviewer Initials ________________________

Firm Name ______________________________ Survey Date ______________________________

Address ________________________________ Sample ID # ______________________________

Phone Number ___________________________ Project ID #_______________________________

Project Completion Date____________________

Equipment installed: ____

Channel Partner involved: ____

Program activity: ____

2.2. Project Briefing Information – Union Gas sales/marketing staff input:

2.2.1. Month/year of initial Union Gas involvement with the project or its precursors

2.2.1a Month_______

2.2.1b Year_______

2.2.2. General context of Union Gas relationship with customer:

a. Historical education effort with customer on efficiency opportunities & Union Gas programs (high, medium, low level of effort):

____

____

b. Facility energy audits performed (steam traps, boilers, etc)

____

____

c. Distribution and merchant services support provided (general credibility & relationship building)

____

____

d. Other (describe) ____

____

____

2.2.3. Services provided to customer in project-related contacts:
a. Gas bill histories (usage, cost) ____

b. Approximate number of project-related contacts with customer ________________

c. General information on program ____

____

____

d. Project-specific technical information or analysis: technical/engineering, financial, vendor/technology alternatives, etc.

____

____

e. Project/technology recommendations____

____

____

f. Other (describe)____

____

____

ga. Low/medium/high intensity of support to customer generally

____

____

gb. Low/medium/high intensity of support to project specifically

____

____

h. Low/medium/high effect of on project's efficiency level

____

____

1.3 IDENTIFY CORRECT RESPONDENT

[Note: These questions may be covered on the phone while setting up an appointment.]

A1. Are you the most appropriate person to talk to about the decision to install that equipment and about the selection of the specific energy efficiency equipment?

1. YES Continue to Question A3

2. NO ➔ "May I ask who would be the best person to talk to?"
   [obtain names and phone numbers] ______________________________
   ____
   ____
   [Ask to speak with this person. Start again at the beginning.]
3. DO NOT REMEMBER PROJECT ➔ Ask Question A2

A2. Do you recall participating in <u>any</u> programs through Union Gas/Enbridge Gas Distribution in the past few years regarding this location?

1. YES
   A2A. Did the program involve assistance from Union Gas/Enbridge Gas Distribution in identifying energy efficient equipment or process changes and financing toward the initial capital costs?
   1. YES *Continue to Question A3*
   2. NO➔ "Can you provide me…" *[See text for "NO" above]*
2. NO ➔ "Can you provide me with a contact name and phone number for a person who might be familiar with the work that was done?" *[Get contact information and call this person; Start again at the beginning.]*

[If they express hesitation, use an appropriate combination of the following.]
Confidentiality. We are an independent research firm and will not report your individual responses in any way that would reveal your identity, as your response only will be presented in aggregate along with responses from other survey participants.
Security. Your responses will not affect your ability to participate in the program in the future.
Sales concern. I am not selling anything. I simply want to understand what factors were important to your company when deciding to install energy efficient equipment with assistance from this program.
Contact. If you would like to talk with someone about this effort from
–Union Gas, you can call your account manager.
–Enbridge Gas Distribution, the Enbridge Industrial contact is Peter Goldman at 416-495-6348, the Enbridge Commercial contact is Stefan Surdu at 416-495-5917, or you may contact your Energy Solutions Consultant.

1.4 Confirmation Of Equipment Installed

B1. Prior to calling, review program records for the project. In Table 1 below under "Program Records," check off each measure category for which energy efficient equipment was installed.

B2. Just to make sure that we're talking about the same project, I show that you installed *[list major equipment or equipment categories]***. To your recollection, was all this equipment installed?**
[Check off each category for which respondent recalls installing equipment. If information is not available from program records, ask the respondent to recall what measures were undertaken.]

B3. Did Union Gas/Enbridge Gas Distribution provide financial assistance for installing this equipment?
[Ask of only those checked in B2. Check off each category for which respondent recalls that Union Gas/Enbridge Gas Distribution provided financial assistance.]

B3b. Approximately how much was the incentive as a percent of the total project cost?
[Ask of only those checked in B3.]

B4. Did you receive any technical assistance from Union Gas/Enbridge Gas Distribution staff with any of this equipment?
[Ask of only those checked in B2. Check off each category for which respondent recalls that Union Gas/Enbridge Gas Distribution provided technical assistance for the measure.]

Table 1. Equipment in program records and recalled by respondent

[Check if Yes]

Measure Category	**B1.** Program Records	**B2.** Respondent Recollection	**B3.** Union Gas/Enbridge Gas Financial Assistance	**B3b.** Incentive as % of Project Cost	**B4.** Union Gas/Enbridge Gas Distribution Technical Assistance	**Notes/Caveats**
a. Machine/Process	❐	❐	❐	%	❐	
b. HVAC (incl. furnaces, all boilers, A/Cs, chillers, EMS, etc.)	❐	❐	❐	%	❐	
c. Lighting	❐	❐	❐	%	❐	
d Controls (boiler controls, variable frequency drive controls	❐	❐	❐	%	❐	
e. Building envelope (incl. insulation, windows)	❐	❐	❐	%	❐	
f. Domestic hot water	❐	❐	❐	%	❐	
g. Refrigeration	❐	❐	❐	%	❐	
h. Agriculture	❐	❐	❐	%	❐	
i. Converted equipment from electricity to gas (fuel substitution)	❐	❐	❐	%	❐	
j. Other: _______________	❐	❐	❐	%	❐	

1.5 Set the Context

C1. Prior to the project being discussed, did your organization have a general policy regarding the energy efficiency specification of projects involving new construction and equipment retrofits, replacements or building remodeling generally?
1. Yes 2. No -8. Do not know -9. Refused

C2. [If yes] Did your policy target a specific standard of efficiency levels?
1. Yes 2. No -8. Do not know -9. Refused

C2a. [If yes] Can you specify what those efficiency levels are?
-8. Do not know -9. Refused

C3. Since the project, has your energy efficiency policy changed
1. Yes 2. No -8. Do not know -9. Refused

C4. [If Yes] How?

____

C5. Does your organization have specific criteria for selecting energy efficient equipment based on payback periods, life cycle costs, or internal rate of return?
1. Yes 2. No -8. Do not know -9. Refused

C6. [If C5=1 (yes)] Which?
1. Simple payback period
2. Life-cycle cost analysis
3. Internal rate of return
4. Other [Record verbatim] C6B. ____

-8. Don't know
-9. Refused

C7. [If C6=1 (simple payback period)] How many years or less must the project payback be?
-8. Do not know -9. Refused

C8. [If C6=2 (internal rate of return)] What is the minimum percent rate of return required for energy-efficiency related projects? [Record 10% as “10” not “0.10”]
-8. Do not know -9. Refused

C9. What was simple payback period for this project prior to any financial assistance from Enbridge/Union?
-8. Do not know -9. Refused

C10. What was simple payback period for this project after 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…**	**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, <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 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 <u>type</u> or <u>efficiency level</u> of the equipment, the <u>amount</u> 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 same level of energy efficiency 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 same level of energy efficiency 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… …would have been installed without the program	E2c. *[Entered by interviewer]* Free Ridership Value
a. Machine/Process	Y N DK R	F S	Months Yrs	%	and/or	%	%
b. HVAC (incl. furnaces, all boilers, A/Cs, chillers, EMS, etc.)	Y N DK R	F S	Months Yrs	%	and/or	%	%
c. Lighting	Y N DK R	F S					
d Controls (boiler controls, variable frequency drive controls	Y N DK R	F S	Months Yrs	%	and/or	%	%
e. Building envelope (incl. insulation, windows)	Y N DK R	F S	Months Yrs	%	and/or	%	%
f. Domestic hot water	Y N DK R	F S	Months Yrs	%	and/or	%	%
g. Refrigeration	Y N DK R	F S	Months Yrs	%	and/or	%	%
h. Agriculture	Y N DK R	F S	Months Yrs	%	and/or	%	%
i. Converted equipment from electricity to gas (fuel substitution)	Y N DK R	F S	Months Yrs	%	and/or	%	%
j. Other: ______________	Y N DK R	F S	Months Yrs	%	and/or	%	%

E2d. *[Additional notes/caveats (e.g., explaining how/why free ridership value was chosen, if necessary)]*

____

E3. Overall, across all equipment, that is the entire project, how much of these extra energy savings would have been achieved anyway, even without the assistance from [Enbridge/Union]. Please provide a lower and upper bound, and then your best estimate. {VIP}

[If needed for clarification:] **For example, 50% means that half of the extra savings from the energy efficient equipment would have been achieved anyway. Remember, I'm asking only about the extra savings from installing energy efficient equipment instead of standard equipment.**

E3A. Lower bound ➔ _____ % E3B. Upper bound ➔ _____ % E3C. Best estimate ➔ _____ %

2.9 Participant Inside Spillover

G1. Did the assistance from [Enbridge/Union] in any way influence you to help the customer install additional energy efficient equipment *at the same site* **that did not get reported to the program** (i.e., *equipment that would not have been installed without the influence of the program)***?**

1 Yes➔ Continue to Question G2
2 No ➔ Skip to next section
-8 Don't know ➔ Skip to next section
-9 Refused➔ Skip to next section

G2. [*If G1 = "yes"]* **What year did this equipment get installed?**
-8 Don't know
-9 Refused

G3. *[If G1 = "yes"]* **Please briefly describe how the program assistance from [Enbridge/Union] influenced the decisions to install additional energy efficient equipment at the same site.**
[Identify the types of equipment affected.]

G4. Would you estimate the energy savings from this additional equipment to be less than, similar to, or more than the savings from the energy efficient equipment from the original project?
1 Less than the original project ➔
G4a. About what percentage of the savings from the original project?
____% *[Enter a number less than 100%]*
2 About the same savings
3 More than the original project ➔
G4b. About what percentage of the savings from the original project?
____% *[Enter a number greater than 100%]*
-8 Don't know
-9 Refused

G5. What share of the savings from this additional equipment can reasonably be attributed to the influence of the assistance from [Enbridge/Union]?
______% *[100% or less]*
-8 Don't know
-9 Refused

[Interviewer may be able to complete this based on response to G3, or at least use G3 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question.]

2.10 Participant Outside Spillover

H1. Did the assistance from [Enbridge/Union] in any way influence you to help the company to install any additional energy efficient equipment *at other jobs or facilities in Union Gas/Enbridge's Service Territory* beyond what they would have done otherwise?
[Don't include projects that participated in another Union/Enbridge program.]

1 Yes ➔
H1a. How many other facilities were influenced (that did not participate in Union Gas/Enbridge programs)? ___________________________ (-8 Don't know, -9 Refused)

2 No ➔ Skip to next section
-8 Don't know ➔ Skip to next section
-9 Refused ➔ Skip to next section

H2. *[If H1 = "yes"]* **Please briefly describe how the assistance has influenced the decisions to install this equipment. (Probe to identify the types of equipment affected.)**

____

____

H3. On average, would you estimate the energy savings from these other non-program projects to be less than, similar to, or more than the savings from the energy efficient equipment from the program-supported project that we've been discussing?
[E.g., if the same equipment was implemented in a facility twice as big, then savings would be 200%. Be sure to emphasize that this is savings "on average" not in aggregate across the many buildings that might be affected.]

1. Less than the Custom Projects project
   H3A. About what percentage of the savings from the Custom Projects project? ____% *[Enter a number less than 100%]*
2. About the same savings
3. More than the Custom Projects project
   H3B. About what percentage of the savings from the Custom Projects project? ____% *[Enter a number greater than 100%]*

-8 Don't know
-9 Refused

H4. What share of the savings from energy efficient equipment at these facilities can reasonably be attributed to the influence of the assistance from [Enbridge/Union]?
[Interviewer may be able to complete this based on response to H2, or at least use H2 to check for consistency. Probe if inconsistent to ensure that respondent is correctly interpreting the question.]
______% [100% or less]
-8 Don't know
-9 Refused

2.11 CLOSING

Those are all the questions I had.

Z9. Do you have any final comments you would like to make?

____

____

____

Thank you very much for your time!

Z10. Record all additional or supporting comments here.

____

____

____

2. CUSTOM PROJECTS AUDIT-ONLY SURVEY

2.1 CONVENTIONS

- Blue text is spoken.
- *Italics text is instructions for the interviewer.*
- Arial, bold font in brackets is skip instructions **[skip instructions]**
- Underlined in brackets are data from the sample: [<u>sample data</u>]

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!

DNV·GL

ONTARIO GAS DSM EVALUATION CONTRACTOR

CPSV Participant Spillover Results

Ontario Energy Board

Date: May 23, 2018

Table of contents

GLOSSARY OF TERMS AND KEY CONCEPTS

Term	Definition
Action	A DSM measure that generates savings through optimization, maintenance or repair of existing systems. Actions (vs. equipment) were categorized for the populations of measures based on tracking database information provided by the utilities for sample design.
Attribution	The portion of a measure that is attributable to the program being evaluated, which is the complement of free ridership (1-FR) for that program.
C&I	Commercial and Industrial
CCM	Cumulative Cubic meters (cumulative m3)
Computer-aided technical interviews (CATI)	Structured surveys administered by a third-party survey firm that require clearly defined skip logic and structured formats, CATI surveys are a lower cost data collection approach suitable for structured gathering of information from large samples of respondents
Confidence Interval	If the evaluation were re-done several different times, such that all possible sample combinations were selected, the calculated confidence intervals would include the true population parameter, in this case, our ratio estimate at the percentage used to define the confidence interval. When using a 90 percent confidence interval, the calculated confidence intervals would include the true population parameter in 90 percent of the selected samples. See the finite population correction about how it affects confidence intervals.
Custom Program savings verification (CPSV)	Activities related to the collection, analysis, and reporting of data for purposes of measuring gross custom program impacts.
Customer - Enbridge	DNV GL identified unique customers based on the Con_acc_num variable in the tracking data and the contact information provided by Enbridge. A customer may have multiple site addresses, decision makers, Con_acc_nums, and utilities. Customers could only be identified for records for which we received contact information.
Customer - Union	DNV GL identified unique customers based on the AIMS ID variable in the tracking data and the contact information provided by Union. A customer may have multiple site addresses, decision makers, AIMS IDs, and utilities. Customers could only be identified for records for which we received contact information.
Customer Incentive	An incentive is a transfer payment from the utility to participants of a DSM program. Incentives can be paid to customers, vendors or other parties as part of a DSM program.
Domain	Grouping of like projects. A domain may be defined as projects within a specific sector or a category of measure types, end uses or other.
Error Ratio	The error ratio is a measure of the strength of the association between the tracked value and the measured value and is used in statistical sampling as an estimate of the coefficient of variation (cv). An error ratio of 0.75 implies that the measured savings is typically within ± 75 percent of the tracking estimate of savings.

Term	Definition
Finite Population Correction (FPC)	The finite population correction is used when the population used to generate the sample is the same population for which the ratio will be applied. As an example, this would mean the sample was drawn for a given year, program, and utility and the ratios calculated from the sample will be applied to measures in that same year, program, and utility. FPC changes the confidence interval by reducing the population from which all possible sample combinations would be selected to the finite population used to draw the sample. The effect of the finite population correction is to reduce the estimated error and related statistics.
Free riders (FR)	Program participants who would have installed a measure on their own initiative without the influence of the program. The free ridership rate is the percentage of savings that are not attributable to the program.
Frequency of spillover observed	The observed percentage of customers who completed a gas project for which they did not receive an incentive and was attributable to the program.
Gross savings	Gross savings are changes in energy consumption and/or demand resulting from program-related activities by participants, regardless of reasons for participation
In-depth interviews (IDI)	Structured technical interviews administered by study engineers and market researchers either in person or, more frequently, over the phone; IDIs offer more flexibility than CATIs and are best leveraged for complex projects and topics.
Lifetime cumulative savings	Total natural gas savings (CCM) over the life of a DSM measure. Sometimes referred to as just “cumulative” or “lifetime.”
Maintenance (Maint.)	Repair or maintain, restore to prior efficiency
Measure – Enbridge	Measures are identified in the tracking data as a unique combination of the database fields <project code>, <project sub code>, and <ESM project ID>. Multiple measures may belong to the same project.
Measure – Union	Measure refers to a single row in the tracking data. When referring to Union programs, measure and project are used interchangeably, as the projects in the tracking data typically have only one measure each.
MF	Multifamily
Net savings	Net savings are changes in energy consumption or demand that are attributable to an energy efficiency program, taking into consideration whether or not the program influenced a customer’s decision to undertake an energy efficiency measure.
Net-to-gross ratio (NTG)	An adjustment factor that reduces gross savings due to net savings, considering both free riders and spillover, the NTG ratio can be less than or greater than 1.0 (100%)
Plus/Minus (Absolute Precision (+/-)	The absolute error difference between the estimated ratio and the upper or lower confidence bound. It is a function of the standard error and the t-statistic for the desired confidence limit.
Project - Enbridge	Projects are identified in the tracking data based on the project code. A project may have multiple measures.
Project – Union	Projects are identified in the tracking data based on project ID. When referring to Union programs, measure and project are used interchangeably the projects in the tracking data typically have only one measure each.
Relative Precision	Relative precision is calculated as the absolute precision divided by the estimated ratio.

Term	Definition
Segment	Segments are account groupings that are more detailed than program. For this study, the Union Custom C&I program segments include Custom Industrial and Custom Commercial and Multi-family, while the Enbridge Custom C&I program segments include Custom Industrial, Custom Commercial, and Custom Multi-Residential. For Union Large Volume and Enbridge RunitRight programs, this study does not have results for segments other than the overall program.
Site	Sites are identified based on unique site addresses provided by Union and Enbridge through the contact information data request. A site may have multiple units of analysis, measures, and projects. Sites are identified only for records for which we received contact information.
Spillover - Inside	Spillover at the same facility where program-incented measures were installed due to influence from the utility program. Inside spillover can be Like or Unlike.
Spillover - Like	Spillover measures that are similar to program-incented measures installed by the participant due to influence from the utility program. Like spillover can be Inside or Outside.
Spillover - Outside	Spillover measures at a different facility than where program-incented measures were installed due to influence from the utility program. Outside spillover can be Like or Unlike.
Spillover - Unlike	Spillover measures that are different than program-incented measures the participant installed due to influence from the utility program. Unlike spillover can be Inside or Outside.
Spillover (SO)	Effects of customers that adopt energy efficiency measures because they are influenced by a utility's program-related information and marketing efforts, but do not actually participate in the program."[1] Non-participant spillover is not included in this study.
Unit of Analysis – Enbridge	The level at which the data are analyzed, which is an aggregation of tracked measures by the tracking data variables con_acc_num, year (2015), and measure type (building shell, controls, greenhouse, heat recovery, HVAC, operational improvements, other equipment, process heat, and steam and hot water).
Unit of Analysis - Union	The level at which the data are analyzed, which is an aggregation of tracked measures by the tracking data variables AIMS ID, year (2015), and measure type (agriculture and greenhouse, building shell, controls, cogeneration, HVAC, heat recovery, maintenance, new construction, optimization, other equipment, process heat, and steam and hot water).

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

1 Executive Summary

This document has been prepared for the Ontario Energy Board (OEB). It provides the participant spillover for the Custom Commercial and Industrial (C&I) programs in Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) portfolio, plus Enbridge's RunitRight program and Union's Large Volume program. The results are based on surveys of 2013 and 2014 program year participants. Table 1 through Table 4 include the attribution ratios (which were referred to as Net-to-Gross (NTG) and only included free ridership effects) in the 2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation[2] report and the participant spillover ratios from this study. To illustrate how the spillover ratios would be combined with free ridership to produce NTG ratios, the table includes a combined NTG ratio with both attribution and participant spillover included. The tables also show the absolute precision at the 90% confidence interval for the 2015 attribution, the spillover result, and the combined illustrative value. Table 1 shows Union Custom C&I, Table 2 shows Union's Large Volume, Table 3 shows Enbridge's Custom C&I, and Table 4 shows Enbridge's RunitRight results. No Participant spillover was found for Enbridge's RunitRight program.

Table 1: Union Custom Commercial and Industrial Program Participant Spillover and Illustrative Net-to-Gross Results

Sector	Domain	Ratios			+/- at 90% Confidence (FPC off)[3]		
		2015 Attr	SO	NTG	2015 Attr	SO	NTG
Custom Industrial	Greenhouse	40.40%	0.89%	41.29%	26.50%	0.56%	25.89%
	Heat Recovery	59.14%	0.89%	60.03%	15.21%	0.56%	14.99%
	Leak Repair and Hydronic Insulation	39.71%	0.89%	40.60%	17.45%	0.56%	17.26%
	Operational Improvements	10.15%	0.89%	11.04%	14.35%	0.56%	13.55%
	Controls	18.21%	0.89%	19.10%	7.92%	0.56%	7.75%
	Steam Trap	28.74%	0.89%	29.63%	19.44%	0.56%	18.76%
	Other	20.57%	0.89%	21.46%	18.47%	0.56%	18.22%
Custom Commercial and Multi-Family	Controls	78.05%	0.00%	78.05%	39.03%	0.00%	33.82%
	Other	38.02%	0.00%	38.02%	30.75%	0.00%	30.06%

[2] *2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation.* Prepared for The Ontario Energy Board by DNV GL, August 15, 2017

[3] Confidence intervals are reported without the finite population correction because the participant spillover will be applied prospectively.

Table 2: Union Large Volume Participant Spillover and Illustrative Net-to-Gross Results

Domain	Ratios			+/- at 90% Confidence (FPC off)[4]		
	2015 Attr	SO	NTG	2015 Attr	SO	NTG
Greenhouse	5.67%	0.82%	6.49%	12.33%	1.12%	11.56%
Heat Recovery	12.55%	0.82%	13.37%	12.03%	1.12%	11.61%
Leak Repair and Hydronic Insulation	6.59%	0.82%	7.41%	8.82%	1.12%	8.60%
Operational Improvements	20.65%	0.82%	21.47%	16.63%	1.12%	16.01%
Controls	0.08%	0.82%	0.90%	0.20%	1.12%	1.32%
Steam Trap	9.31%	0.82%	10.13%	11.30%	1.12%	10.91%

Table 3: Enbridge Commercial and Industrial Program Participant Spillover and Illustrative Net-to-Gross Results

Sector	Domain	Ratios			+/- at 90% Confidence (FPC off)[5]		
		2015 Attr	SO	NTG	2015 Attr	SO	NTG
Custom Industrial	Etool Ventilation	14.90%	1.45%	16.35%	21.68%	1.10%	20.78%
	Heat Recovery	55.25%	1.45%	56.70%	28.59%	1.10%	27.64%
	Other	31.04%	1.45%	32.49%	16.79%	1.10%	16.75%
Custom Commercial	Etool Boiler and Boiler Add-on	24.09%	1.36%	25.45%	15.08%	1.52%	14.98%
	Etool Ventilation	4.93%	1.36%	6.29%	4.51%	1.52%	4.77%
	Steam Trap	27.42%	1.36%	28.78%	14.18%	1.52%	12.50%
	Other	18.22%	1.36%	19.58%	17.97%	1.52%	16.99%
Custom Multi-Residential	Etool Boiler	26.18%	8.24%	34.42%	16.98%	6.35%	17.46%
	Etool Ventilation	19.70%	8.24%	27.94%	21.22%	6.35%	21.89%
	Other	97.10%	8.24%	105.34%	4.23%	6.35%	7.57%

Table 4: Enbridge RunitRight Program Participant Spillover and Illustrative Net-to-Gross Results

Domain	Ratios			+/- at 90% Confidence (FPC off)[6]		
	2015 Attr	SO	NTG	2015 Attr	SO	NTG
RunitRight	50.06%	0.00%	50.06%	19.63%	0.00%	19.23%

Based on the activities completed and results produced under this study, DNV GL offers key findings and recommendations shown in Table 5.

[4] Confidence intervals are reported without the finite population correction because they will be applied prospectively.
[5] Confidence intervals are reported without the finite population correction because they will be applied prospectively.
[6] Confidence intervals are reported without the finite population correction because they will be applied prospectively.

Table 5: Findings and Recommendations

Finding	Recommendation	Applicable Utilities and Programs
The participant spillover estimates have high statistical uncertainty. We have a high level of certainty that the incidence of spillover is low, based on our large sample size. We have less certainty of the exact magnitude of spillover per incident, both because the sample of projects that indicate spillover is low and because the magnitude of identified spillover is highly variable. Despite the uncertainty, the study provides a thorough, reasonably accurate estimate of the participant spillover occurring as a result of participation in the 2013/2014 programs.	DNV GL recommends using the reported participant spillover rates on a go forward basis as a component of the net-to-gross ratio.	All
Participant spillover for the Ontario Gas custom programs was found to be less than 2 percent with the exception of one segment, Enbridge Multi-residential.	No action recommended. Note that low participant spillover is not a negative indicator of the health of a program. It can mean that a program or programs are effective at capturing all DSM opportunities at participant facilities. It is typical for programs with the following characteristics to have low levels of participant spillover. ▪ Comprehensive programs with few energy saving options not incentivized by the program ▪ Low barriers for participation ▪ Programs for which utilities have strong relationships with customers (customers are more likely to come to the program) ▪ Low program attribution ▪ Self-Directed programs with use it or lose it incentive structures	All
Three (3) percent of informed respondents (13/224 total) were found to have some confirmed participant spillover. For most programs, spillover projects were smaller than the program incented projects that led to the spillover. When combined, these findings result in spillover ratios that are less than the frequency of participant spillover.	Finding only; no action recommended	All

Finding	Recommendation	Applicable Utilities and Programs
The frequency of confirmed and potential participant spillover does not correlate strongly with the relative magnitude of spillover. Programs and program segments with the largest program measures (Union Large Volume and Custom Industrial for both utilities) had relatively high frequencies of confirmed and potential spillover, but the size of the evaluated projects in each, combined with the program attribution of these potential spillover projects, resulted in relative participant spillover savings rate (i.e. the participant spillover ratios) that are smaller than for programs and program segments with smaller program measures such as Enbridge Multi-Residential.	Program designs that increase the likelihood of participant spillover are the first consideration in selecting programs for a participant spillover study.	All
One of the most significant measures identified by participants was one where an incentive for the measure type was not available through the program in the region it was installed. The measure found was multi-family heat reflector panels which are incented by Enbridge, but not Union.	We generally recommend focusing on increasing attribution and savings through the program rather than specifically targeting participant spillover in program design; however, this is an exception to the general recommendation. The Union program is likely to have more participant spillover in future years as a result of discontinuing measures that were previously rebated due to concerns regarding free ridership on incentivized measures. Specifically, discontinued incentives included steam trap repairs and maintenance type measures. While Union discontinued incentivizing these measures for free ridership concerns, free ridership was not 100%. Continuing to recommend these types of measures to participants implementing other measures may result in more significant participant spillover savings from the current program than were found in the study.	Union

Finding	Recommendation	Applicable Utilities and Programs
Using an open-ended survey question to gather data on participant spillover may result in less customer recall than pairing the open-ended question with a limited number of probes. For this study, there was not a clear expectation for what types of spillover would be expected, so no probes were included.	The open nature of the initial spillover question casts a wide net with the intent of identifying a wide variety of spillover. This is appropriate when the program implementation and evaluation teams do not know the most likely technologies that might be occurring as spillover. Future studies should consider starting with an open question, but add probes for the most likely participant spillover technologies, which may be identified from interviews with utility reps, evaluator experience with the programs, process evaluations, or other sources.	All
The study primarily found unlike spillover, which is most appropriately evaluated as related to a customer rather than a specific program measure.	Future participant spillover studies should use a customer-level sample design rather than a project- or measure-level sample design.	All

2 Introduction

DNV GL prepared this document for the OEB, providing the program participant spillover results for a subset of programs in Enbridge and Union natural gas demand-side management (DSM) portfolios. The outcome of the exercise produced estimates of participant spillover ratios for the programs studied. The programs included in the participant spillover study are provided in Table 6.

Table 6. Programs Included in Participant Spillover Study

Program		Participant spillover (2013/14)
Union		
Custom	Large Volume	✓
	Commercial & Industrial*	✓
	Low Income Multi-Residential	
Enbridge		
Custom	Commercial*	✓
	Industrial	✓
	Low Income Multi-Family	
RunitRight		✓

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

The overall objectives of the study were to develop participant spillover ratios based on surveys with a sample of participants in the 2013 and 2014 program years for the Custom Commercial, Industrial, Large Volume and RunitRight programs. Once determined, the spillover results can be combined with free ridership to yield net-to-gross (NTG). The statistical error estimates (+/-, error ratios, relative precision and confidence intervals) provided in this report are appropriate and allow for application of the results to future program years of the same or similar programs.

This effort is the final stage in the DNV GL's scope of work delivered December 14, 2016.[7] It follows the submission of the CPSV/Free-ridership final report.[8]

[7] *Measurement of NTG Factors and Custom Savings Verification for Ontario's Natural Gas Custom Commercial and Industrial DSM Scope of Work*. Prepared for The Ontario Energy Board by DNV GL, December 14th, 2016.

[8] *2015 Natural Gas Demand Side Management Custom Savings Verification and Free-ridership Evaluation.* Prepared for The Ontario Energy Board by DNV GL, August 15, 2017

3 METHOD SUMMARY

The results presented in this report are based on data collected from five primary sources, supplemented with secondary source information.

1. Union and Enbridge program tracking databases (2013-2016 program years)
2. Union and Enbridge project contact information
3. Participant Spillover screener surveys completed as in-depth interviews during the 2015 CPSV evaluation, for customers with participation in 2013-2014.
4. Participant Spillover screener surveys completed as CATI interviews for a sample of customers who participated in 2013-2014 but were not included in the 2015 CPSV evaluation.
5. Follow-up in-depth interviews with participant spillover screener respondents who showed evidence of gas participant spillover

At a high level, the participant spillover study employed the following methodology:

- **Sample Design.** The sample design employed a stratified random sample that targeted 10% relative precision with 90% confidence at the program level.
- **Participant Spillover Screener.** The study started with a survey of a sample of 2013-2014 program participants to determine which participants had performed additional energy-saving actions as a result of their experience with the program(s). These projects are referred to as *potential gas participant spillover projects*.
- **Compare with Tracking Databases.** The tracking data was used to:
  - Verify that customer-reported non-incentivized projects did not receive an incentive
  - Check for program incentives for projects where the customer was unsure about whether an incentive was received.
  - Identify like versus unlike participant spillover.
- **In-depth Interviews.** An engineer called the participants back to gather the information required to estimate savings for confirmed participant spillover projects.
- **Calculate Project-Level Savings.** The engineer who performed the in-depth interviews estimated savings for each participant spillover project.
- **Impute values for respondents with partial information.** An analyst calculated and employed “average fill factors” (described in Appendix A) to estimate participant spillover savings for customers who answered “don’t know” to one or more of the key questions. This imputation technique, or “filling,” is not intended to represent the true response for the customer; rather, it is meant to limit the bias of the program-level estimate, and to make best use of the information we have.
- **Develop program-level participant spillover factors.** An analyst expanded the results to the population using ratio estimation to produce final participant spillover ratios.
- **Report the results.** The final step is this report.

Table 7 shows the targeted and completed data collection activities and the timeframe in which they were completed.

Table 7: Data collection activities

Target Group	Activity	Targeted Units of Analysis	Targeted Customers	Completed Units of Analysis	Complete and Informed Customers	Timeframe
Union						
Participating Customers	Spillover Screener	238	N/A	299	121	Feb-Oct, 2017
	In-Depth Interview	N/A	8	13	6	Nov, 2017, April 2018
Enbridge						
Participating Customers	Spillover Screener	246	N/A	214	105[9]	Feb-Oct, 2017
	In-Depth Interview	N/A	5	13	3	Nov, 2017, April 2018
Overall						
Participating Customers	Spillover Screener	484[10]	N/A	513	224[11]	Feb-Oct, 2017
	In-Depth Interview	N/A	13	26	9	Nov, 2017, April 2018

The following sections provide summaries of results by program. All precision and error statistics are reported with no finite population correction, i.e. the errors are those that are appropriate for consideration when applying results to future program years.

[9] Two customers had projects in both the RunitRight and Enbridge Custom C&I sample. They are each counted once in this number.
[10] Three customers had projects in the CATI sample frame for both Union and Enbridge.
[11] Two customers had projects in both the Union and Enbridge Custom C&I sample. They are each counted once in this number.

Union Custom Commercial and Industrial

This section presents the results of the participant spillover study for Union Custom Commercial (including Market Rate Multi-Family) and Industrial programs.

3.1 Sample

The respondents and projects included in each stage of the study process are shown in Figure 1 for Union Custom Industrial and Figure 2 for Union Custom Commercial and Market Rate Multi-Family. We did not call customers who were not randomly selected into the sample or backup sample of requested contact information. In Figure 1 and Figure 2, the sum of each row equals the number of “yes” responses (right-most boxes) on the row above. The boxes with a coloured border include the final status for customers who are included in the results.

- Boxes with green dashed borders are those respondents with clear evidence of participant spillover. Those that did not complete an engineering IDI had participant spillover savings estimated using a “gross SO fill” as described in APPENDIX A.
- Boxes with yellow dot-dashed borders are those respondents with a non-zero chance of participant spillover based on their survey responses. These had participant spillover savings estimated using a “net fill” as described in APPENDIX A.
- Boxes with red solid borders are those respondents that did not have any participant spillover based on their survey responses.

Figure 1 and Figure 2 also show the frequency of spillover observed. The formula used to calculate this frequency is shown in the bubble referencing the labels in the boxes to the left.

Seven of the boxes are labeled with letters in the corners. These include:

A. **Completed Screener** – This is the number of customers who provided at least some data for the study.

B. **Don’t know if project done after participation** -These customers were considered uninformed and dropped from the analysis.

C. **Don't Know (if project received incentive) / had many, but did not respond to follow up** – These customers knew that they did a project after participating in the program, but could not provide enough detail to determine if it saved gas or received an incentive. Some of these customers had done more projects (eight or more) than could be reasonably collected by CATI, but did not respond to a follow-up attempt to gather additional data. These customers had participant spillover savings estimated using a “net fill” described in APPENDIX A.

D. **Attributable –** These customers reported that the non-incented gas project they completed was not “very likely” to have been done without the prior interactions with the program.

E. **Attributable Don’t Know –** These customers reported that they completed a gas project without an incentive, but were unable to say whether or not the project was “very likely” to have happened without the program. These customers had their participant spillover savings estimated using a “gross SO fill” and “attribution fill” as described in APPENDIX A.

F. **Responded to follow up call -** These customers installed projects that were confirmed to be participant spillover and provided our engineers with sufficient information to quantify the savings of their project(s).

G. **Did not respond to follow up call -** These customers had installed projects that were confirmed to be participant spillover, but did not respond to follow-up attempts for information that would allow the savings to be estimated. These customers had their participant spillover savings estimated using a “gross SO fill” as described in APPENDIX A.

Figure 1. Summary of data collection for the Union Custom Industrial program

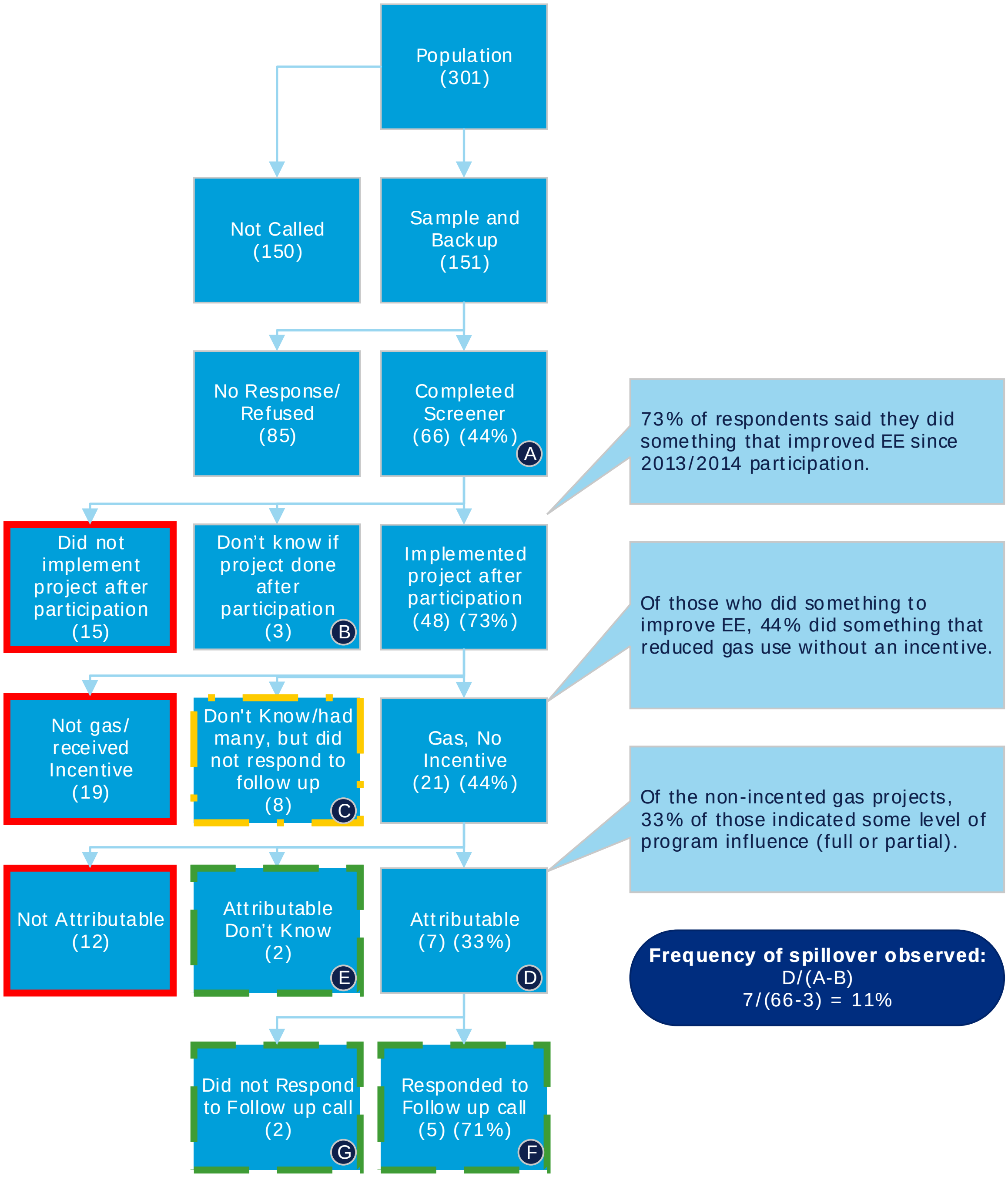
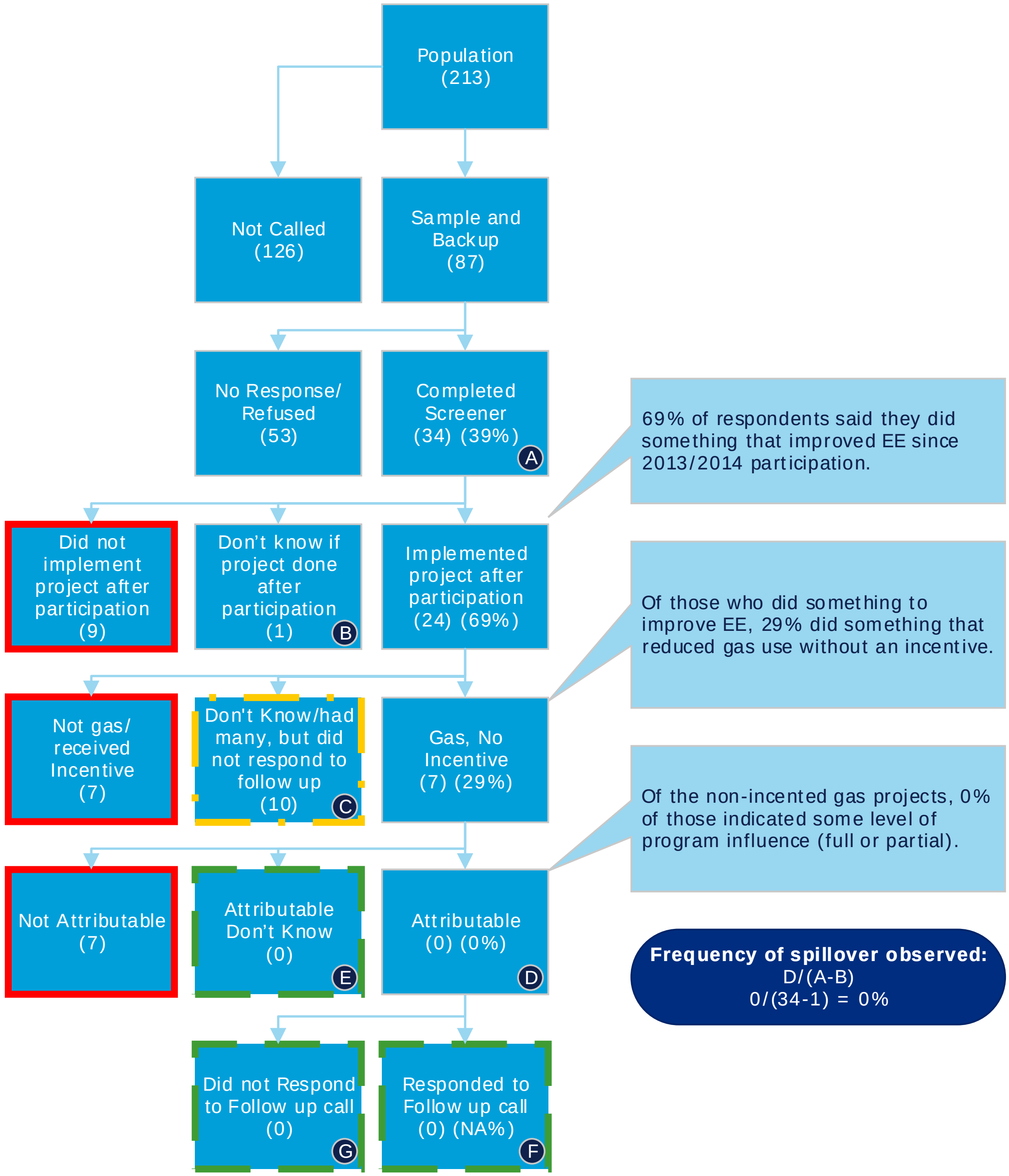


Figure 2. Summary of data collection for the Union Custom Commercial and Multi-family program



3.2 Results

Table 8 shows the participant spillover results for Union Custom Commercial and Industrial Programs. The "n customers" are the number of customers included in the analysis, equal to box A minus box B in the figures, because customers in box B above were treated as uninformed respondents and dropped from the analysis.

Table 8: 2013-2014 Participant spillover results for Union Custom Commercial and Industrial programs

Domain	n		SO Ratio	90% Confidence Interval (FPC off)				Error Ratio	% Program Savings
	Unit of Analysis	Customers		+ / -	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	127	63	0.89%	0.56%	0.33%	1.45%	63.36%	3.87	86.29%
Custom Comm & MF	69	33	0.00%	0.00%	0.00%	0.00%	0.00%	0.00	13.71%

The study found evidence of inside, outside (one project), and unlike participant spillover in the custom industrial segment. The strongest evidence was for inside unlike participant spillover. The evidence for like participant spillover was minimal, consisting only of customers who indicated they did something, but did not tell us what. We identified five industrial customers with quantifiable participant spillover projects: an energy curtain, pipe insulation, unit heaters, a process boiler, and a residential furnace. Three customers indicated that they did not go through the programs because the project was "too small" to bother with tracking the information required for the paperwork. One customer indicated that he was unaware of the incentive for the measure at the time. The fifth customer did not indicate why the project was not done through the program.

While we found a relatively high frequency of spillover for the custom industrial segment, the projects completed were small relative to the size of the projects the same participants completed through the program. This resulted in a low spillover rate, which is calculated as the spillover energy savings divided by the original tracking savings. This finding indicates that the program is doing a good job of capturing the major gas saving projects at participating sites through program participation.

We found no participant spillover for the commercial and multifamily programs. Seven of the 33 informed customers indicated that they did a non-incented gas project. All seven said they were "very likely" to complete the project had they not participated in Union programs previously.

Because the study produced only five quantified cases of spillover, we did not attempt to produce separate participant spillover rates in the like/unlike and inside/outside categories.

4 Union Large Volume

This section presents the results of the participant spillover study for Union Large Volume programs.

4.1 Sample

The respondents and projects included in each stage of the study process are shown in Figure 3. We did not call customers who were not randomly selected into the sample or backup sample of requested contact information. In Figure 3, the sum of each row equals the number of "yes" responses (right-most boxes) on the row above. The boxes with a coloured border include the final status for customers who are included in the results.

- Boxes with green dashed borders are those respondents with clear evidence of participant spillover. Those that did not complete an engineering IDI had participant spillover savings estimated using a "gross SO fill" as described in APPENDIX A.
- Boxes with yellow dot-dashed borders are those respondents with a non-zero chance of participant spillover based on their survey responses. These had participant spillover savings estimated using a "net fill" as described in APPENDIX A.
- Boxes with red solid borders are those respondents that did not have any participant spillover based on their survey responses.

Figure 3 also show the frequency of spillover observed. The formula used to calculate this frequency is shown in the bubble referencing the labels in the boxes to the left.

Seven of the boxes are labeled with letters in the corners. These include:

A. **Completed Screener** – This is the number of customers who provided at least some data for the study.

B. **Don't know if project done after participation** -These customers were considered uninformed and dropped from the analysis.

C. **Don't Know (if project received incentive) / had many, but did not respond to follow up** – These customers knew that they did a project after participating in the program, but could not provide enough detail to determine if it saved gas or received an incentive. Some of these customers had done more projects (eight or more) than could be reasonably collected by CATI, but did not respond to a follow-up attempt to gather additional data. These customers had participant spillover savings estimated using a "net fill" described in APPENDIX A.

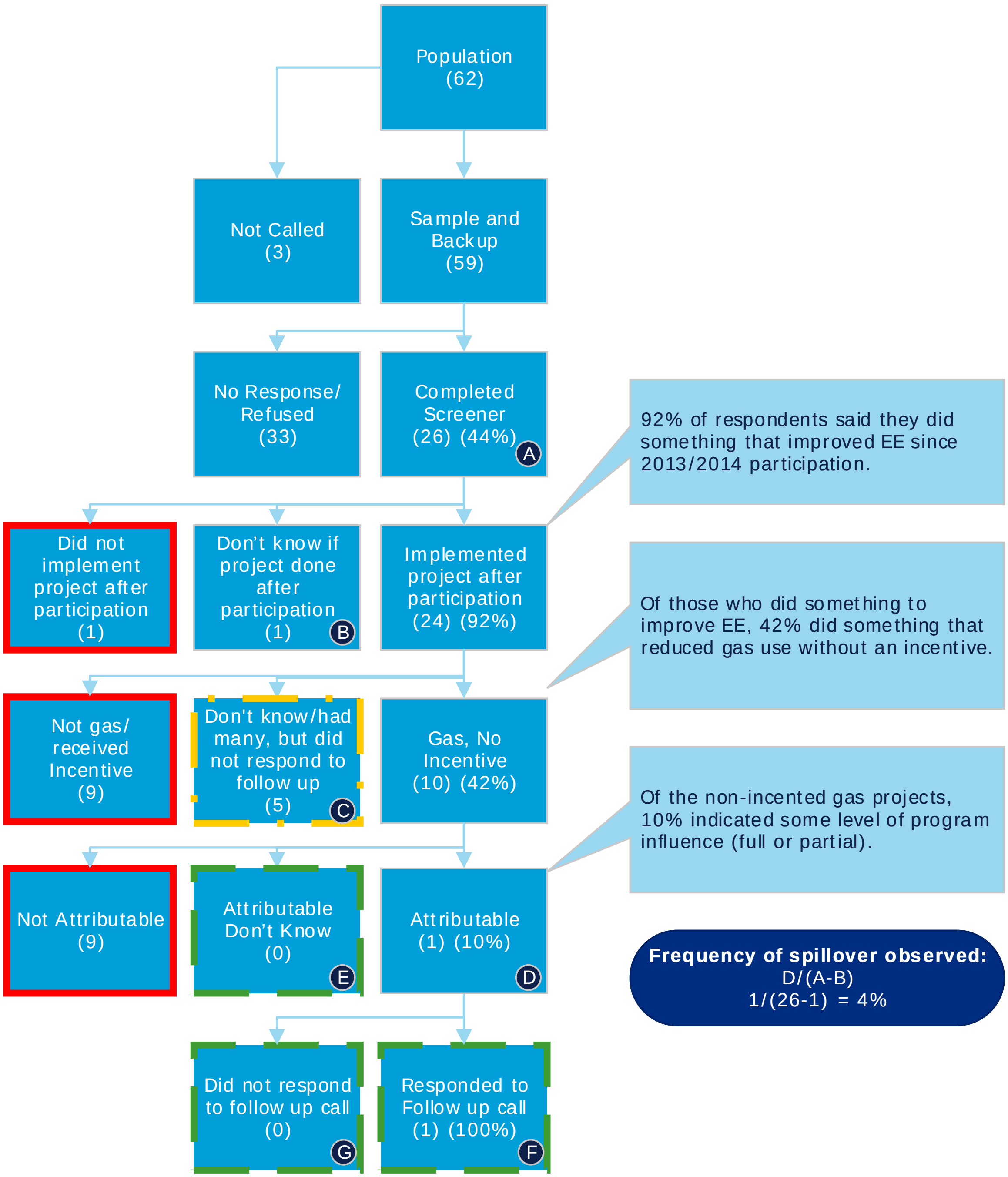
D. **Attributable –** These customers reported that the non-incented gas project they completed was not "very likely" to have been done without the prior interactions with the program.

E. **Attributable Don't Know –** These customers reported that they completed a gas project without an incentive, but were unable to say whether or not the project was "very likely" to have happened without the program. These customers had their participant spillover savings estimated using a "gross SO fill" and "attribution fill" as described in APPENDIX A.

F. **Responded to follow up call -** These customers installed projects that were confirmed to be participant spillover and provided our engineers with sufficient information to quantify the savings of their project(s).

G. **Did not respond to follow up call -** These customers had installed projects that were confirmed to be participant spillover, but did not respond to follow-up attempts for information that would allow the savings to be estimated. These customers had their participant spillover savings estimated using a “gross SO fill” as described in APPENDIX A.

Figure 3. Summary of data collection for Union Large Volume program



4.2 Results

Table 8 shows the participant spillover results for Union Large Volume programs. The ”n customers” are the number of customers included in the analysis, equal to box A minus box B in the figures, because customers in box B above were treated as uninformed respondents and dropped from the analysis.

Table 9: 2013-2014 participant spillover results for Union Large Volume programs

Domain	n		SO Ratio	90% Confidence Interval (FPC off)				Error Ratio	% Program Savings
	Unit of Analysis	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Large Volume	103	25	0.82%	1.12%	0.00%	1.94%	136.28%	6.69	100.00%

The study found evidence of inside and unlike participant spillover. The evidence for like participant spillover was minimal, consisting only of customers who indicated they did something, but did not tell us what. No respondent indicated any potential outside participant spillover. The directly quantifiable projects were relatively large optimization projects (like and inside participant spillover) installed at one facility. The customer indicated that they did not go through the program because the money available from the program was not worth the effort for these projects.

The frequency of spillover found for Large Volume was low at 4%. While a relatively high proportion of customers reported completing gas saving projects outside of the program, only one out of 10 indicated that the projects were anything other than “very likely” to be completed without the program.

Because we had only one quantifiable instance of participant spillover, we did not attempt to produce separate participant spillover rates in the like/unlike and inside/outside categories.

5 Enbridge Custom Commercial and Industrial

This section presents the results of the participant spillover study for Enbridge Custom Commercial, Multi-Residential, and Industrial programs.

5.1 Sample

The respondents and projects included in each stage of the study process are shown in Figure 4 for Enbridge Custom Industrial, Figure 5 for Enbridge Custom Commercial, and Figure 6 for Enbridge Custom Multi-Residential. We did not call customers who were not randomly selected into the sample or backup sample of requested contact information. In Figure 4 through Figure 6, the sum of each row equals the number of "yes" responses (right-most boxes) on the row above. The boxes with a coloured border include the final status for customers who are included in the results.

- Boxes with green dashed borders are those respondents with clear evidence of participant spillover. Those that did not complete an engineering IDI had participant spillover savings estimated using a "gross SO fill" as described in APPENDIX A.
- Boxes with yellow dot-dashed borders are those respondents with a non-zero chance of participant spillover based on their survey responses. These had participant spillover savings estimated using a "net fill" as described in APPENDIX A.
- Boxes with red solid borders are those respondents that did not have any participant spillover based on their survey responses.

Figure 4 through Figure 6 also show the frequency of spillover observed. The formula used to calculate this frequency is shown in the bubble referencing the labels in the boxes to the left.

Seven of the boxes are labeled with letters in the corners. These include:

A. **Completed Screener** – This is the number of customers who provided at least some data for the study.

B. **Don't know if project done after participation** -These customers were considered uninformed and dropped from the analysis.

C. **Don't Know (if project received incentive) / had many, but did not respond to follow up** – These customers knew that they did a project after participating in the program, but could not provide enough detail to determine if it saved gas or received an incentive. Some of these customers had done more projects (eight or more) than could be reasonably collected by CATI, but did not respond to a follow-up attempt to gather additional data. These customers had participant spillover savings estimated using a "net fill" described in APPENDIX A.

D. **Attributable –** These customers reported that the non-incented gas project they completed was not "very likely" to have been done without the prior interactions with the program.

E. **Attributable Don't Know –** These customers reported that they completed a gas project without an incentive, but were unable to say whether or not the project was "very likely" to have happened without the program. These customers had their participant spillover savings estimated using a "gross SO fill" and "attribution fill" as described in APPENDIX A.

F. **Responded to follow up call -** These customers installed projects that were confirmed to be participant spillover and provided our engineers with sufficient information to quantify the savings of their project(s).

G. **Did not respond to follow up call -** These customers had installed projects that were confirmed to be participant spillover, but did not respond to follow-up attempts for information that would allow the savings to be estimated. These customers had their participant spillover savings estimated using a “gross SO fill” as described in APPENDIX A.

Figure 4. Summary of data collection for Enbridge Custom Industrial program

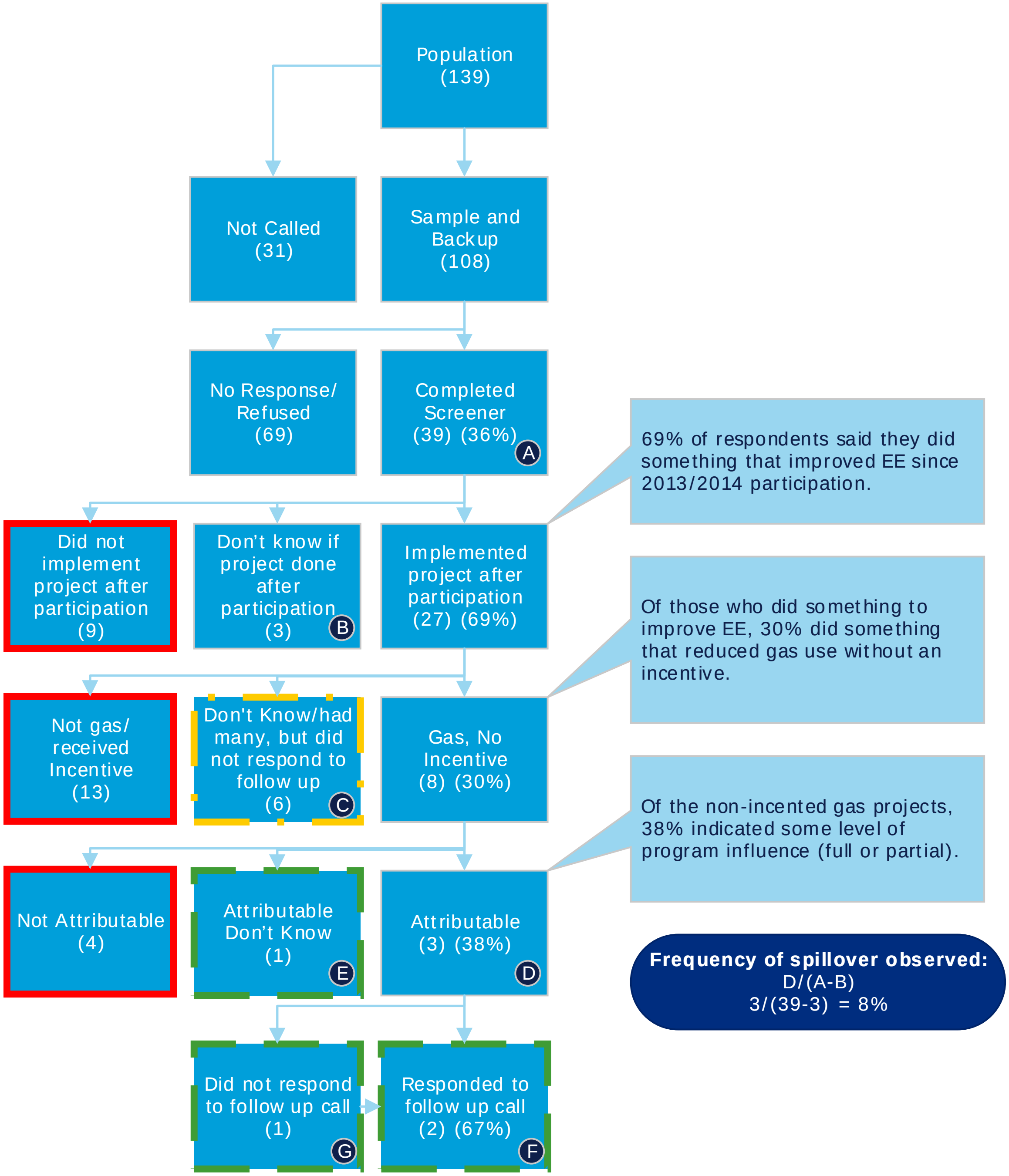


Figure 5. Summary of data collection for Enbridge Custom Commercial program

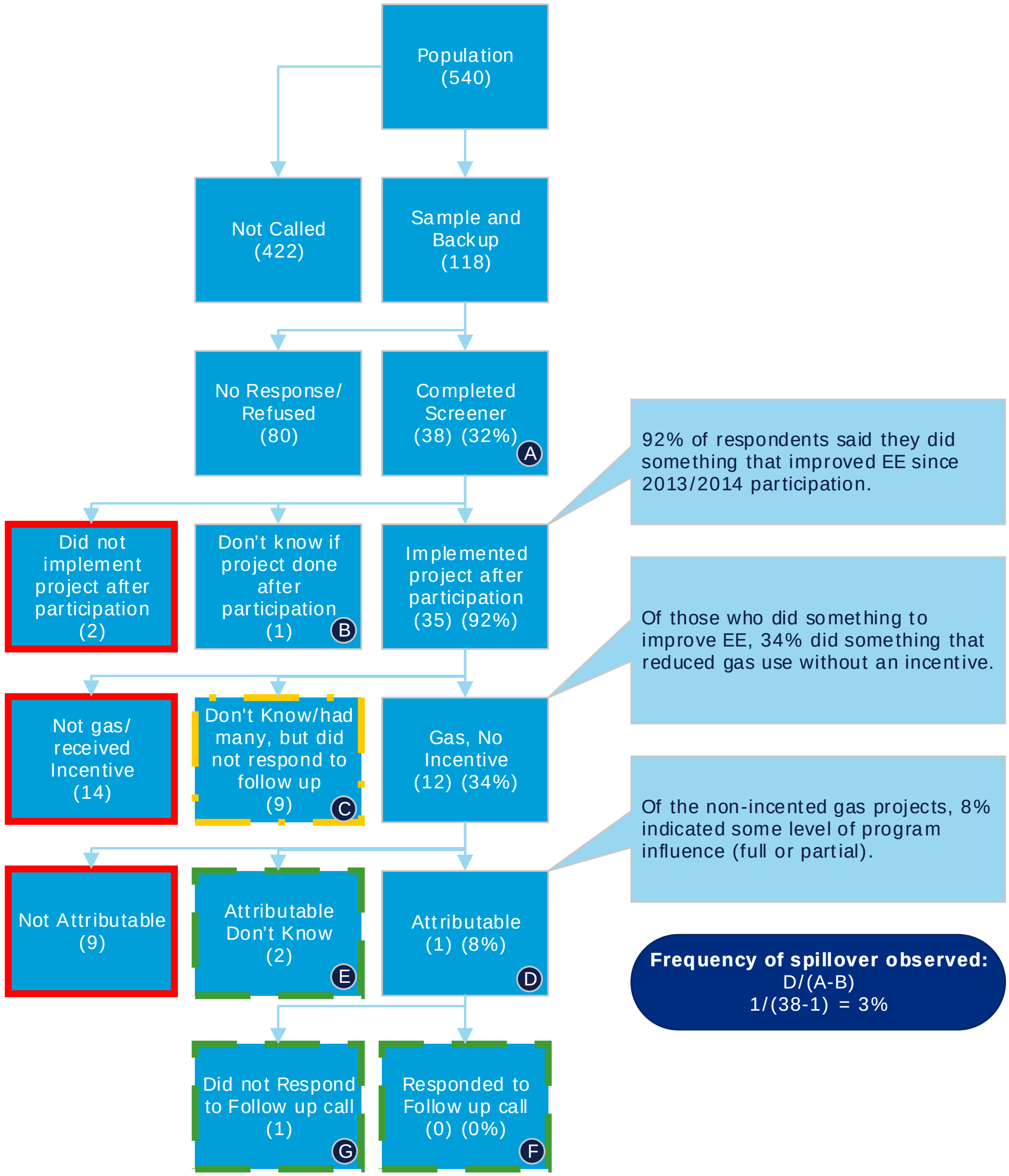
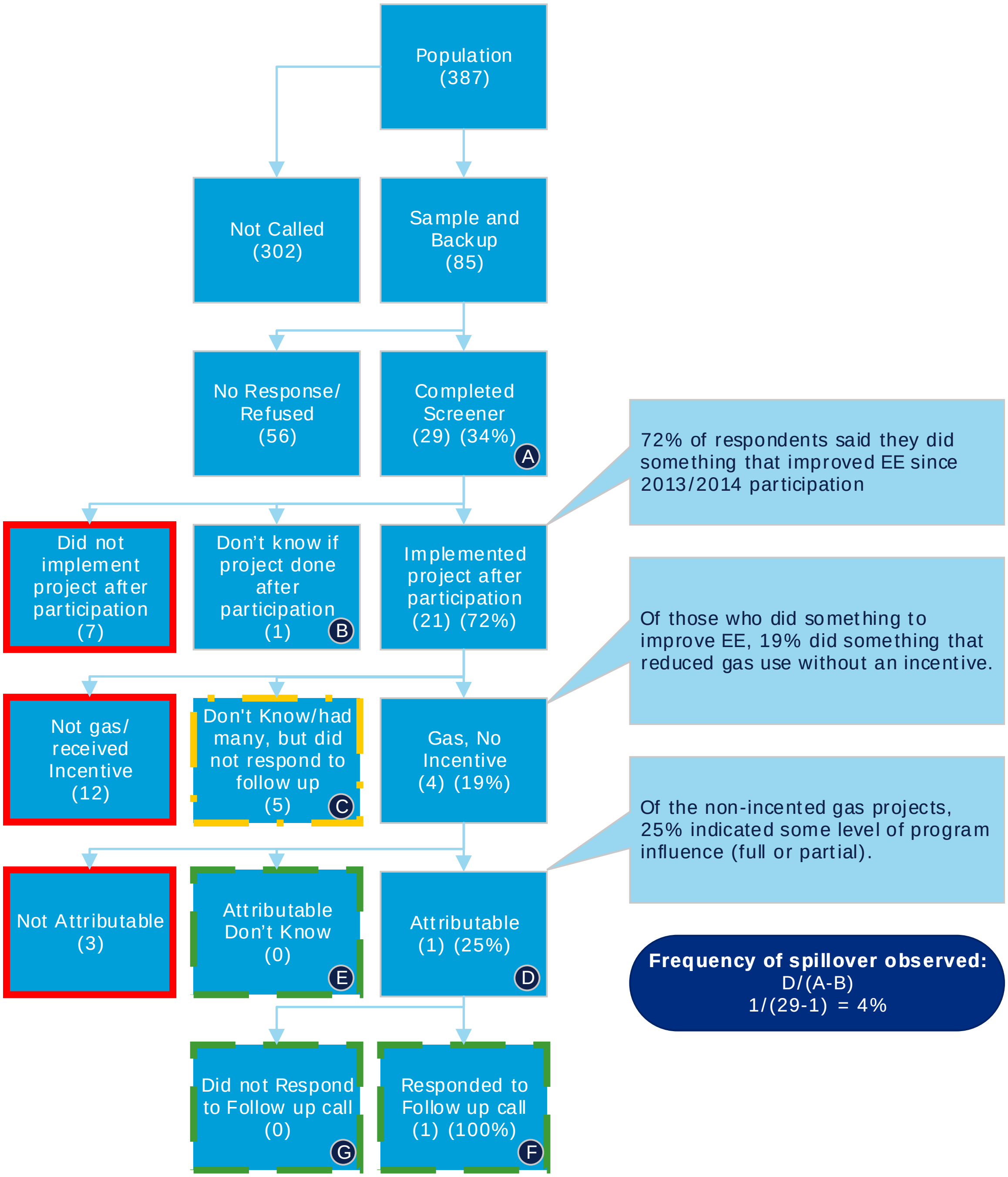


Figure 6. Summary of data collection for Enbridge Custom Multi-Residential program



5.2 Results

Table 10 shows the participant spillover results for Enbridge Custom Commercial and Industrial programs. The "n customers" are the number of customers included in the analysis, equal to box A minus box B in the figures, because customers in box B above were treated as uninformed respondents and dropped from the analysis.

Table 10: 2013-2014 participant spillover results for Enbridge Custom Commercial, Industrial, and Multi-Residential programs

Domain	n		SO Ratio	90% Confidence Interval (FPC off)				Error Ratio	% Program Savings
	Unit of Analysis	Customers		+/-	Lower Bound	Upper Bound	Relative Precision		
Custom Industrial	69	36	1.45%	1.10%	0.35%	2.55%	75.68%	3.45	43.39%
Custom Commercial	76	37	1.36%	1.52%	0.00%	2.88%	112.33%	5.25	31.28%
Custom Multi-Res	58	28	8.24%	6.35%	1.89%	14.59%	77.09%	2.89	25.33%

The study found confirmed projects with inside, outside, like, and unlike participant spillover. We quantified the participant spillover savings for two industrial projects and one multi-residential project.

The frequency of spillover for the industrial segment (8%) was higher than that found for the commercial (3%) or multi-residential (4%) segments.

The industrial projects we were able to quantify included the installation of a baghouse and steam trap replacement. In one case the customer indicated that they applied for an incentive, but their application was rejected. The other project did not provide the reason that they did not complete the project through the program. The two projects we were able to quantify for the industrial segment were small relative to the measures these customers completed through the program, which indicates that the program is doing a good job of capturing the larger projects completed by participants.

The multi-residential project was installation of heat reflector panels at several dozen apartment buildings in 2015/16 (unlike, outside). The customer was prompted to complete these participant spillover projects through experience with other projects in the Enbridge program. In 2015, the customer also completed multiple heat reflector projects through the Enbridge program. The customer did not go through the Enbridge program for the participant spillover projects because they were completed at sites with gas service from Union Gas. These sites are ineligible for the Enbridge program and the customer indicated that Union does not incent this measure.

Because the study produced only three quantified cases of spillover, we did not attempt to produce separate participant spillover rates in the like/unlike and inside/outside categories.

6 Enbridge RunitRight

This section presents the results of the participant spillover study for the Enbridge RunitRight program.

6.1 Sample

The respondents and projects included in each stage of the study process are shown in Figure 7. We did not call customers who were not randomly selected into the sample or backup sample of requested contact information. In Figure 7, the sum of each row equals the number of “yes” responses (right-most boxes) on the row above. The boxes with a coloured border include the final status for customers who are included in the results.

- Boxes with green dashed borders are those respondents with clear evidence of participant spillover. Those that did not complete an engineering IDI had participant spillover savings estimated using a “gross SO fill” as described in APPENDIX A.
- Boxes with yellow dot-dashed borders are those respondents with a non-zero chance of participant spillover based on their survey responses. These had participant spillover savings estimated using a “net fill” as described in APPENDIX A.
- Boxes with red solid borders are those respondents that did not have any participant spillover based on their survey responses.

Figure 7 also show the frequency of spillover observed. The formula used to calculate this frequency is shown in the bubble referencing the labels in the boxes to the left.

Seven of the boxes are labeled with letters in the corners. These include:

A. **Completed Screener** – This is the number of customers who provided at least some data for the study.

B. **Don’t know if project done after participation** -These customers were considered uninformed and dropped from the analysis.

C. **Don't Know (if project received incentive) / had many, but did not respond to follow up** – These customers knew that they did a project after participating in the program, but could not provide enough detail to determine if it saved gas or received an incentive. Some of these customers had done more projects (eight or more) than could be reasonably collected by CATI, but did not respond to a follow-up attempt to gather additional data. These customers had participant spillover savings estimated using a “net fill” described in APPENDIX A.

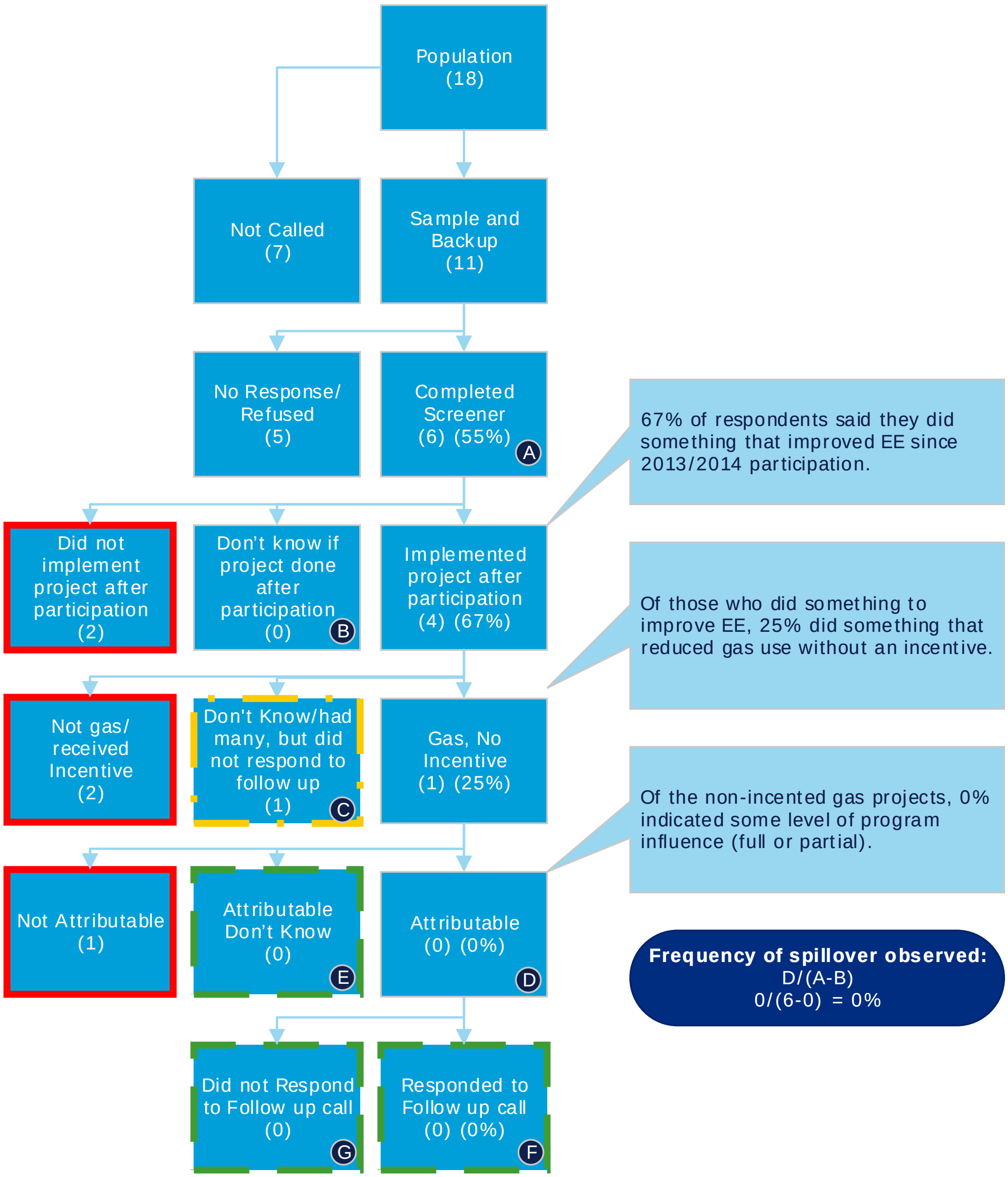
D. **Attributable –** These customers reported that the non-incented gas project they completed was not “very likely” to have been done without the prior interactions with the program.

E. **Attributable Don’t Know –** These customers reported that they completed a gas project without an incentive, but were unable to say whether or not the project was “very likely” to have happened without the program. These customers had their participant spillover savings estimated using a “gross SO fill” and “attribution fill” as described in APPENDIX A.

F. **Responded to follow up call -** These customers installed projects that were confirmed to be participant spillover and provided our engineers with sufficient information to quantify the savings of their project(s).

G. **Did not respond to follow up call -** These customers had installed projects that were confirmed to be participant spillover, but did not respond to follow-up attempts for information that would allow the savings to be estimated. These customers had their participant spillover savings estimated using a "gross SO fill" as described in APPENDIX A.

Figure 7. Summary of data collection for the Enbridge RunitRight program



6.2 Results

Table 11 shows the participant spillover results for Enbridge RunitRight program. The ”n customers” are the number of customers included in the analysis, equal to box A minus box B in the figures, because customers in box B above were treated as uninformed respondents and dropped from the analysis.

Table 11: 2013-2014 participant spillover results for the Enbridge RunitRight program

Domain	n		SO Ratio	90% Confidence Interval (FPC off)				Error Ratio	% Program Savings
	Unit of Analysis	Customers		+ / -	Lower Bound	Upper Bound	Relative Precision		
Run-it-Right	11	6	0.00%	0.00%	0.00%	0.00%	0.00%	0.00	100.00%

The study did not find any participant spillover from the RunitRight program. Only six customers responded to the survey. One customer did more projects (8 or more) than could reasonably be collected with a CATI, but did not respond to follow-up attempts to collect detailed project information and determine program attribution. Another customer indicated they did a non-incented gas project., but it was not attributable, as the respondent said they were “very likely” to do the same project had they not participated in RunitRight previously.

APPENDIX A. PARTICIPANT SPILLOVER METHODOLOGY

The participant spillover analysis provides estimates of participant spillover for each program segment. The study was designed to support separate estimates for inside-like, inside-unlike, outside-like, and outside-unlike participant spillover; however, the data collected was not sufficient to accurately estimate each of these participant spillover types separately.

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."[12] As in many jurisdictions, Ontario's Demand-Side Management Guidelines recognize the importance of spillover in determining program benefits, and also require "comprehensive and convincing empirical evidence" to support any program spillover claim.

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

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

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

- We confirm that the actions tentatively identified as spillover were not already counted by another program by cross-checking tracking databases. 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 participant spillover measure. Employee turnover can also complicate this.
- *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 participant 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 participant spillover attribution.
- *Estimating the energy savings for the participant spillover measures* - Because participant spillover measures occurred outside the program, evaluators do not have access to the same information

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

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.

Understanding energy-related standard practices

The first objective of the survey was 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. Before doing that, we collected some information about the company or organization's energy-related decision-making process. We asked 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.

By getting the respondent to think about the project decision-making process, these questions should improve customer recall about energy efficiency projects they have completed. It should also 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 collected this information about participant energy practices, we asked the participants whether their company/organization had installed any energy-efficient projects after the installation of the tracked project. If the participants reported no subsequent actions, we terminated the survey since there is no participant spillover to be measured. If they did identify subsequent projects, we then collected some basic information about the project, including:

- The approximate year of the project
- The geographic location of the project (e.g. city or complete address)
- The types of energy-efficient measures installed or energy-efficient O&M practices implemented
- Whether the tracked project and the subsequent project were in the same facility or not (needed for the calculation of inside vs. outside participant spillover)
- If they received incentives (if so, from whom)

Because this information was collected by CATI program surveyors who do not have an energy background, or at the end of the CPSV/NTG interview, we did not try to collect detailed information about the energy-efficient project. The goal was to have information just detailed enough to allow the evaluators to make a reasonable match with any projects in the program tracking data.

Calculating program attribution for candidate participant spillover actions

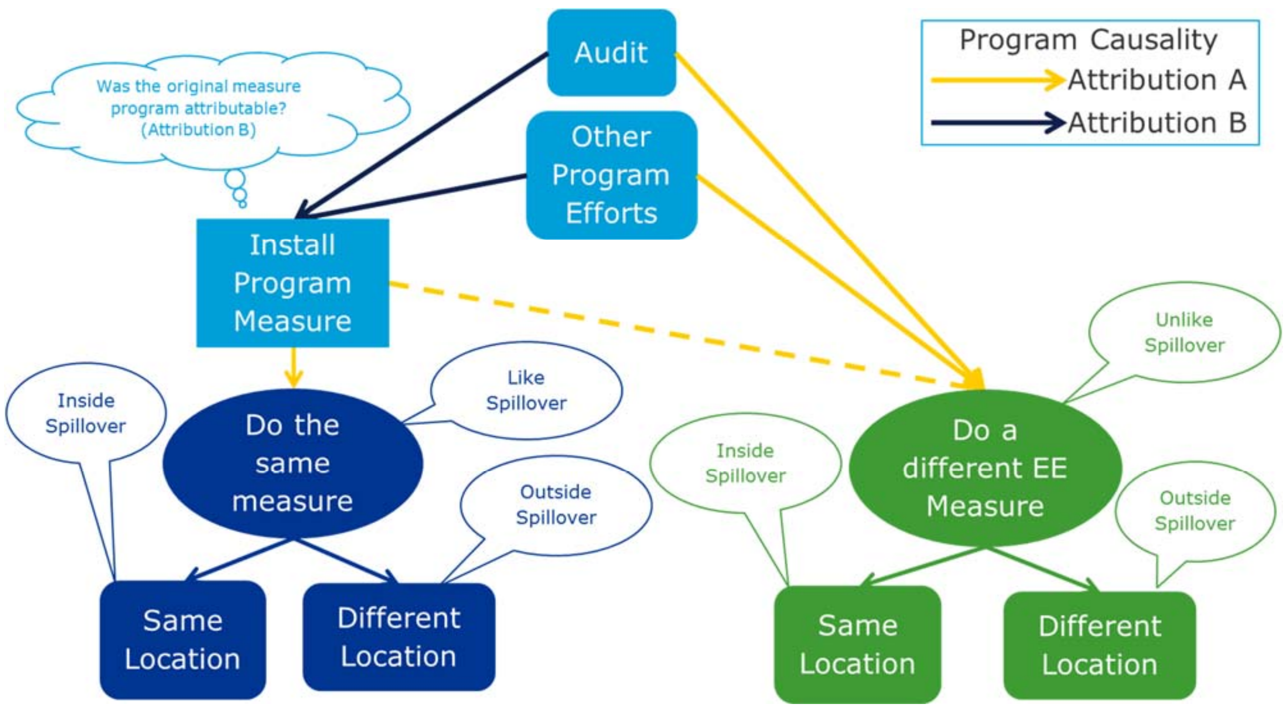
The next stage of the survey focused on program attribution. Our method awards participant spillover energy savings if two criteria are met:

1. The potential participant spillover project is at least partially attributable to the participant's experience with the program in implementing the earlier tracked project (Attribution Factor A).
2. For like participant spillover, the original tracked project is at least partially attributable to the program (Attribution Factor B). For unlike participant spillover, Attribution B would theoretically apply if the

respondent indicates that the original program measure (separate from other program efforts) was a factor in their decision.[13] However capturing and parsing this information was not feasible, so we did not apply attribution B to any unlike spillover cases.

Figure 8 shows how program causality ties to different types of participant spillover. Attribution B applies to like participant spillover in all cases, while for unlike participant spillover Attribution B only applies to the participant spillover if the original program measure was part of the program influence that led to the participant spillover measure being implemented.

Figure 8. Program influence on Participant spillover by Type



If a measure met these two criteria, we assigned it participant spillover savings according to the following formula:

(Participant spillover savings) = (the measure's savings) X (Attribution Factor A) X (Attribution Factor B).

We apply both Attribution Factor A and Attribution Factor B because, if the program had no influence on the original tracked project, the program should not get credit for any additional measure installations resulting from that tracked project. To reduce respondent fatigue, Attribution Factor A was asked in the CATI survey, while Attribution B was only planned to be asked in the engineering follow up IDI. If Attribution A was zero, we did not follow up with an IDI. Attribution B was asked of one customer with like spillover and resulted in an attribution factor B of 100%.[14]

To determine Attribution Factor B, we used the FR question battery described in the SOW Appendix C.

For Attribution factor A, we used a scoring method that was triggered from the question:

[13] In this study Attribution B did not affect the results.

[14] *Measurement of NTG Factors and Custom Savings Verification For Ontario's Natural Gas Custom Commercial and Industrial DSM Scope of Work*. Prepared for The Ontario Energy Board by DNV GL, December 14th, 2016.

On a 1 to 4 scale, where '1' is "Not likely at all" and '4' is "Very Likely", how likely would you say your organization would have been to perform that project without having previously worked with or had contact with the <Utility program>?

The scoring method is shown in Table 12.

If the participant said they were very likely to have made the additional energy efficiency improvement without the program, then we moved to the next potential participant spillover measure (if multiple) or ended the survey since there was no participant spillover to be measured. If the potential unlike participant spillover measure is fully or partially attributable, then a follow up question was administered as part of the engineering interview to assess whether Attribution B was applicable. In this study, there were no cases of unlike participant spillover where Attribution B was found to be applicable.

Table 12: Program Attribution for Subsequent Measures (Attribution A)

S3b. On a 1 to 4 scale, where '1' is "Not likely at all" and '4' is "Very Likely", how likely would you say your organization would have been to perform that project without having previously worked with or had contact with the <Utility program>?		Assigned Attribution Factor A
1	Not likely at all	1.00
2	Not very likely	0.90
3	Somewhat likely	0.55
4	Very likely	0.00
-98	Don't Know/Refused	Weighted average of scored respondents

The reason we use a different method for Attribution Factor A than for Attribution Factor B is that the character of influence is different. For the program's influence on the tracked project (Attribution Factor B), financial incentives are a source of program influence by reducing payback periods; therefore, we want to measure things like acceleration effects. However, with participant spillover, the influence is less tangible and more likely to be a general positive experience with a new energy-efficient technology and the energy savings it produces. We believe that using a Likert scale question (such as in Table 12) better captures the less tangible character of this type of influence.

The question above, which was used in this study, refers to broad program effects rather than the specific earlier measure, making the causal tie between Attribution A and B tenuous. The original question for Attribution A was "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?". This phrasing keeps the causal link between the two attribution factors, but does not provide for utility attribution on the spillover measure through avenues separate from the original measure. In future work, we would not apply Attribution B if the Attribution A question uses the same wording; however, since Attribution B was only applied once and that one value was 100%, it did not affect this study's results.

Avoiding double counting of energy savings

Once a participant identified a subsequent project that is attributable – e.g. one where Attribution Factor A (and Attribution Factor B where applicable) are both greater than zero -- we then conducted some additional checks to ensure that the subsequent project is not also a tracked project. Some of these checks occurred in the survey itself. For example, we asked the participants if they recalled receiving financial incentives from an energy efficiency program for the subsequent projects. For measures where the customer said they did not receive an incentive or did not know, we also examined the program tracking data to make sure that the subsequent project was not in the tracking program data for future years. For example, when we interviewed a 2013 participant and they identified a subsequent project in 2014, we looked at the 2014-2016 program tracking data to see if we could find that project. We looked at all three program years in case their memory of the project timing was faulty. If we found the subsequent project in program tracking data, we removed that project as a candidate for participant spillover energy savings since the savings for that project had already been claimed by the program. When the customer indicated that an incentive was provided for a project we did not attempt to verify this in the program databases because we do not have non-gas utility program data and the gas utility data provided did not contain the information necessary for the search. There is also a high probability of false negatives (ie there is a high likelihood that we would not find an incentive that is in the database due to challenges using search parameters such as customer names and addresses). This false negative risk also affects our search for incentives when the customer indicated they did not receive one, but in those cases there are at least two independent sources of information that are not in conflict.

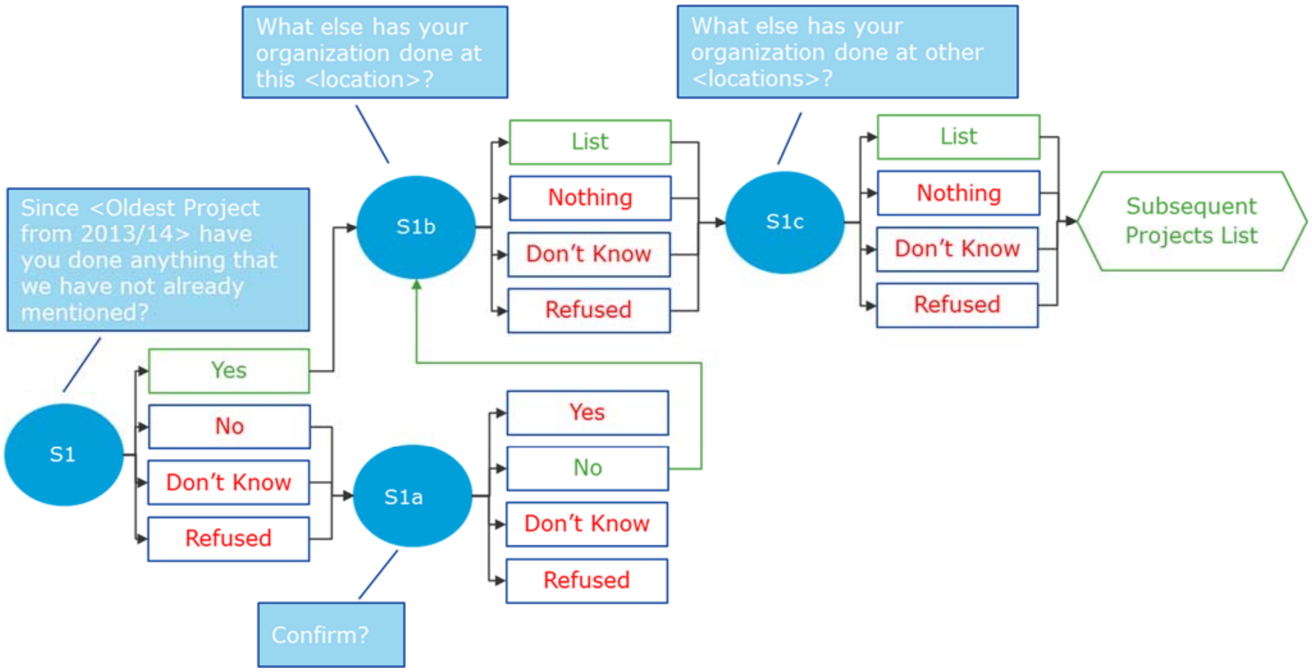
Estimating energy savings for participant spillover measures

Once a project was identified as having participant spillover energy savings, meaning it was program attributable and we could not locate it in the program tracking data, the final step was to estimate its energy savings. To estimate the energy savings for participant spillover measures, we had engineers conduct follow-up interviews with the persons identified in the CATI surveys as being most familiar with the participant spillover projects. The engineers had some basic project information collected from the CATI survey as well as some information about deemed savings algorithms for that measure, which allowed them to prepare the types of questions they needed to ask before the interview (e.g., about baseline measures, hours-of-use, etc.). Once they conducted the interview and collected the necessary information, they calculated the first-year savings and EUL (estimated useful life) for the measure. If a deemed savings algorithm existed for the measure, they used it as a default. If none existed, they used their best professional judgment to estimate the energy savings.

Participant spillover decision trees

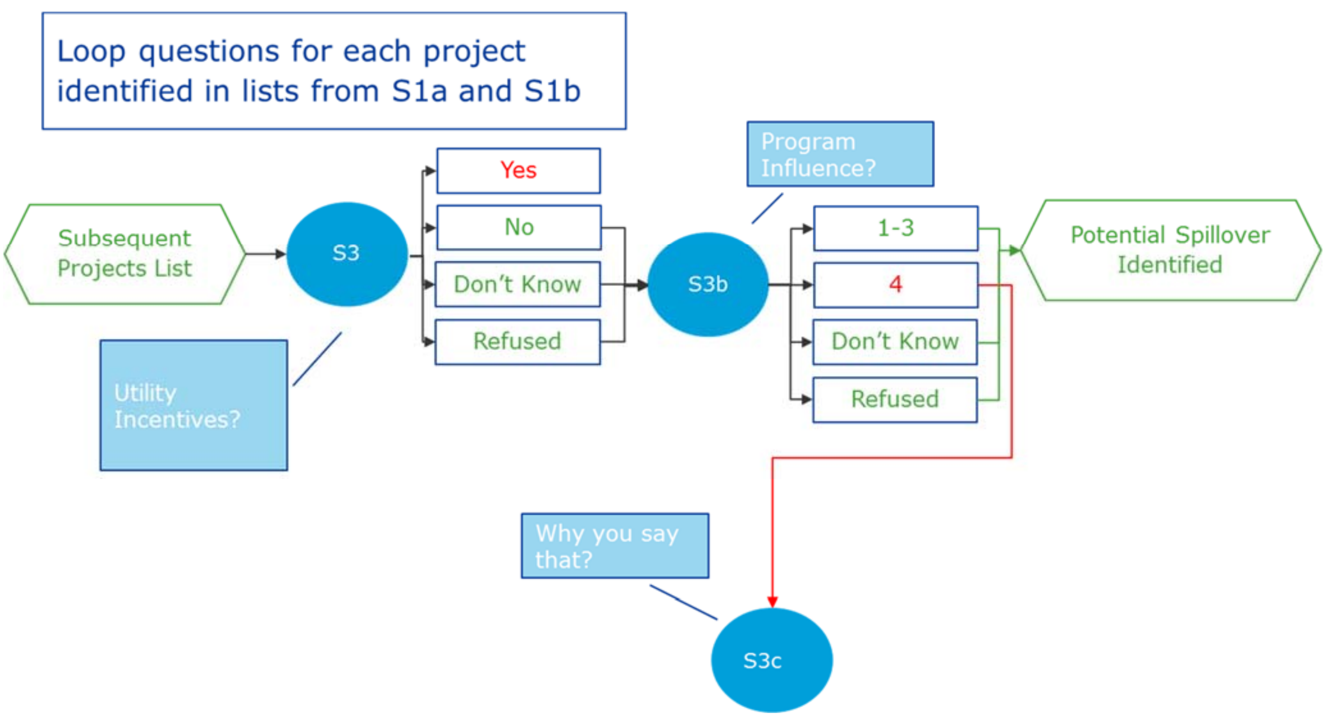
The initial participant IDI and participant CATI each included a participant spillover module that produced a list of potential participant spillover projects for each participant. The first part of the module (Figure 9) generated a list of changes to energy using equipment at the same location as the original measure and another list of changes to equipment at other locations.

Figure 9. Participant spillover Module Part 1: Identify Subsequent Projects



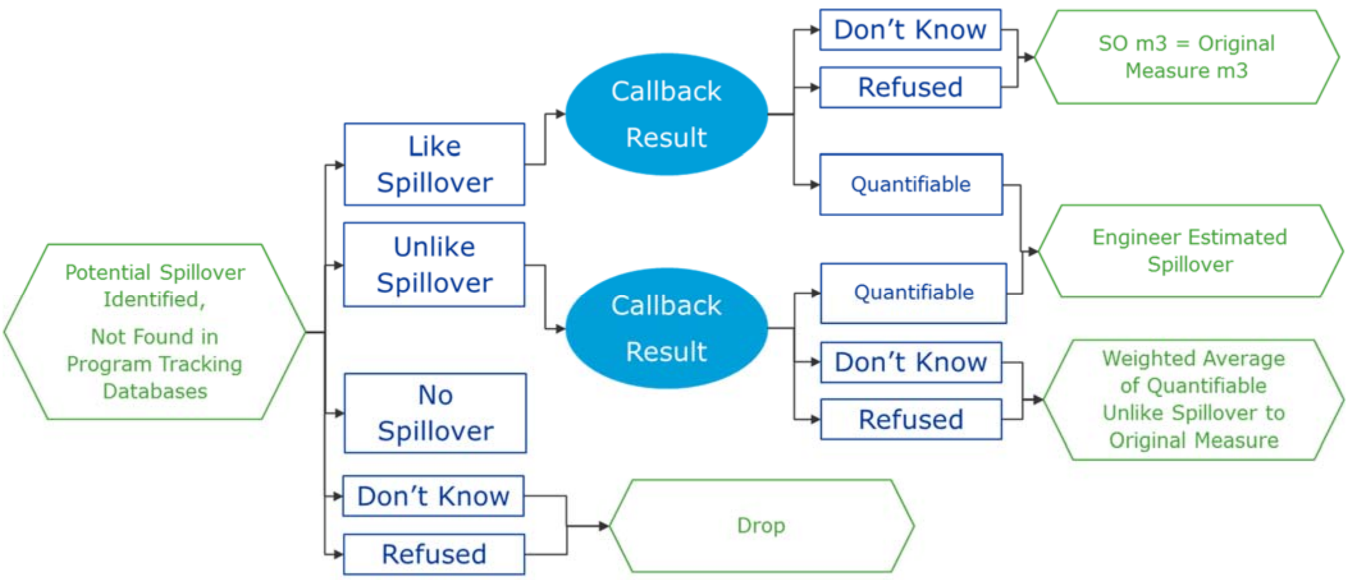
The second part of the module (Figure 10) looped through the list of subsequent projects to eliminate projects that received utility incentives or were non-gas and to establish program influence. The projects identified as program influenced are referred to as potential participant spillover and received a follow-up engineering interview to quantify savings. Question S3b is the question described in Table 12.

Figure 10. Participant spillover Module Part 2: Subsequent Project loop



Potential participant spillover projects that were not found in program tracking databases received a call from a DNV GL engineer (Figure 11). If the customer refused the interview or the engineer was not able to find a contact who could answer technical questions, the participant spillover was quantified in one of two ways. Where the project was like participant spillover, we used the savings of the original program measure as the basis for the savings estimate. This was done for one measure. Where the project was unlike participant spillover, we used the average of other customers with unlike participant spillover for the estimate.

Figure 11. Participant spillover callback high-level process



Details of the average fill process

The final participant spillover results are based on 224 customer contacts that found evidence of spillover for 62 customers (27%).[15] The study found definitive evidence of attributable participant spillover for 13 customers (6%)[16] and quantifiable participant spillover for nine customers.[17] One of the features of the analysis was the process by which we imputed responses and estimated participant spillover savings for customers where we had some evidence of potential participant spillover, but did not have enough information to calculate participant spillover directly. The process of imputing the responses to substitute for the "Don't Know" response is called filling.

In this section, we discuss the process of utilizing averages to fill responses where customers answered "don't know" to a key question. We begin with an overview of the fill process, including how many customers received fills and how many responses were used to calculate the fill averages. We conducted fills at the customer level to avoid double counting: the final dataset had a many-to-many relationship[18] of program measures to potential participant spillover projects, making project level fills impractical.

Three fill factors were calculated and used in this study:

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[15] Green and yellow boxes in figure below.

[16] Bottom two green boxes (also 4th box down in column 3) in figure below

[17] Bottom box in column 3 in figure below.

[18] A single customer with more than one program measure and more than one potential spillover measure.

- **Gross SO fill** – the relationship between the participant spillover savings estimated and the program tracking savings
- **Attribution fill** – the average of program influence on potential participant spillover measures
- **Net SO fill** – the relationship between the average net participant spillover savings estimated and the program tracking savings

For customers requiring fills, or customers that showed evidence of participant spillover but did not provide a key piece of information, we filled with averages appropriate to what was known about the customer, as described below. Figure 12 shows a visual explanation of how survey responses were categorized.[19]

In Figure 12, the sum of each row equals the number of "yes" responses (right most boxes) on the row above. The boxes with a coloured border include the final status for customers who are included in the results.

- Boxes with green dashed borders are those respondents with clear evidence of participant spillover. Those that did not complete an engineering IDI had participant spillover savings estimated using a "gross SO fill" as described below.
- Boxes with yellow dot-dashed borders are those respondents with a non-zero chance of participant spillover based on their survey responses. These had participant spillover savings estimated using a "net fill" as described below.
- Boxes with red solid borders are those respondents that did not have any participant spillover based on their survey responses.

The figure also shows the *frequency of spillover observed*, or the observed percentage of customers who completed a gas project for which they did not receive an incentive and was attributable to the program. The formula used to calculate this frequency is shown in the bubble referencing the labels in the boxes to the left.

Seven of the boxes are labeled with letters in the corners. These include:

A. **Completed Screener** – This is the number of customers who provided at least some data for the study.
B. **Don't know if project done after participation** -These customers were considered uninformed and dropped from the analysis.
C. **Don't Know (if project received incentive) / had many, but did not respond to follow up** – These customers knew that they did a project after participating in the program, but could not provide enough detail to determine if it saved gas or received an incentive. Some of these customers had done more projects (eight or more) than could be reasonably collected by CATI, but did not respond to a follow-up attempt to gather additional data. These customers had participant spillover savings estimated using a "net fill" as described below.
D. **Attributable –** These customers reported that the non-incented gas project they completed was not "very likely" to have been done without the prior interactions with the program.

[19] The totals reported below only count customers who were sampled in two programs once. There two customers who were sampled for projects in both Union and Enbridge programs and another two who had projects in both Enbridge Custom C&I and RunitRight.

E. **Attributable Don't Know –** These customers reported that they completed a gas project without an incentive, but were unable to say whether or not the project was "very likely" to have happened without the program. These customers had their participant spillover savings estimated using a "gross SO fill" and "attribution fill" as described below.

F. **Responded to follow up call -** These customers installed projects that were confirmed to be participant spillover and provided our engineers with sufficient information to quantify the savings of their project(s).

G. **Did not respond to follow up call -** These customers had installed projects that were confirmed to be participant spillover, but did not respond to follow-up attempts for information that would allow the savings to be estimated. These customers had their participant spillover savings estimated using a "gross SO fill" as described below.

In Figure 12 we can see that the study completed surveys with 234 customers (box A), 13 of which confirmed that they completed gas saving projects, did not receive an incentive and credited the program with influencing their decision to implement these projects (box D). We can also see that 44 customers (box C) did something to save energy, but could not confirm that it saved gas and did not receive an incentive. Five customers (box E) completed a gas saving project without an incentive, but could not say whether the program had any influence. The frequency of confirmed spillover was six (6) percent.

Figure 12. Survey Response Category Tree for Overall Participant Spillover Study[20]

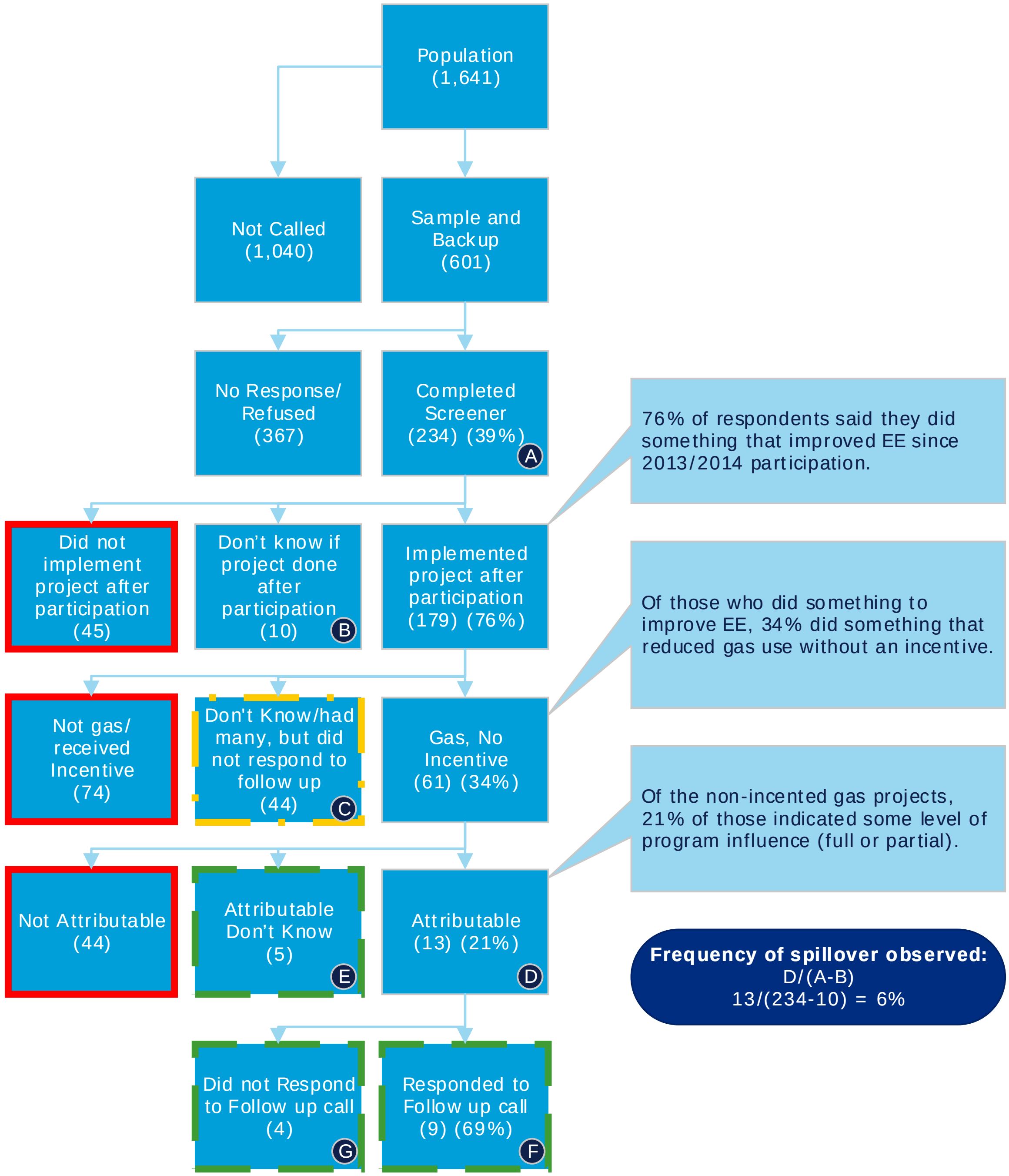

Table 13 shows the same information, and adds the breakdown of which response categories were included in the weighted average that was used to calculate each fill and which response categories received fills. The number of customers shown is the number for the study as a whole, including all four utility programs.

[20] The totals reported in this figure are lower than the sum of the figures reported in the body of the report. This is due to overlap of customers across utilities, programs and segments in the samples, sample frames and population. In this figure, the sum of the boxes in the second row from the bottom is 62, not the 61 that the "Gas, no incentive" box implies. One customer that was in both the Union and Enbridge samples had different outcomes from each program and is included twice in the figure in this row.

References to the corresponding boxes in Figure 12 are included in the first column. Box A is the sum of the "total cust." column below, while box D is the sum of boxes F and G.

Table 13. Customer Responses and Fill Approach[21]

	Did Something?	Did non-incented gas savings project?	Attribution of Potential Participant spillover	Gross Participant spillover	Final Participant spillover	Included in Fill for: Gross SO	Included in Fill for: Attribution	Included in Fill for: Net Part. Spillover	Total Cust.
	No				Zero				45
	Yes	No			Zero			Yes	74
	Yes	Yes	Zero		Zero		Yes	Yes	44
F	Yes	Yes	Non-Zero	Quantified	Known from Customer		Yes	Yes	9
G	Yes	Yes	Non-Zero	Don't Know	Fill with Gross SO	Yes	Yes	Yes	4
E	Yes	Yes	Don't Know		Fill with Gross SO and Attribution			Yes	5
C	Yes	Don't Know			Fill with Net Spillover				44
B	Don't Know				Dropped				10

DNV GL tested the sensitivity of the results to following the described fill process by using an alternate analysis. Customers requiring a fill of any type were dropped from the alternate analysis. Including the fill process increased the estimates of participant spillover for Union Industrial from 0.57% to 0.89%, increased Enbridge Industrial from 0.58% to 1.45%, increased Enbridge Commercial from 0% to 1.36%, and increased Enbridge Multi-Residential from 8.07% to 8.24%.

More detail on each fill is included below.

Gross SO Fill

Nine customers indicated that Union or Enbridge's program had an influence on a participant spillover project,[22] but we were unable to collect enough information to quantify the magnitude of savings that resulted from the project. In each of these cases, we estimated the gross participant spillover for the project using a "gross SO fill" multiplier. We calculated the multiplier as the ratio of gross participant spillover CCM to tracking CCM from the customers who completed the engineering interview. In the example in Table 14, the "gross SO multiplier" is calculated as 5,000 CCM / 18,000 CCM = 0.2778. We used responses from five Union Custom C&I customers to calculate a savings-weighted average fill for two Union Custom C&I customers requiring a fill. We used three Enbridge Custom C&I customers to calculate a savings-weighted average fill for two Enbridge Custom C&I customers requiring a fill.

[21] The sum of the table is 225, not the 224 found in box A in Figure 12. One customer that was in both the Union and Enbridge samples had different outcomes from each program and is included twice in the table.

[22] Sum of rows 5 and 6 in Table 13 and box E and G in Figure 12

Table 14: Example calculation of a gross SO multiplier

Program Measures	Example Tracking Savings (CCM)	Gross SO Fill multiplier	Unlike Participant spillover Measure	Unlike Participant spillover Measure Savings (CCM)
Program Meas 1	7,000		SO Measure A	3,000
Program Meas 2	10,000		SO Measure B	2,000
Program Meas 3	1,000		NONE	0
Customer total	18,000	**0.2778**		5,000

The Gross SO fill process provided a scaled magnitude of savings relative to the program project savings that the customer with unknown participant spillover savings completed through the program. In the example provided in Table 15, gross participant spillover is estimated for the customer using the gross SO fill multiplier as 24,000 CCM X 0.2778 = 6,667 CCM.

Table 15: Example application of a gross SO multiplier

Program Measures	Example Tracking Savings (CCM)	SO Fill multiplier (from above)	Measure	Unlike Participant spillover Measure Savings (CCM)
Program Meas 4	6,000		SO Measure C	?
Program Meas 5	18,000		SO Measure D	?
Customer total	24,000	0.2778		**6,667**

Each of the customers with only a gross SO fill value has known attribution that is then multiplied by the Gross SO value to calculate a net SO value.

Table 16 shows the number of customers requiring only a gross SO fill[23] for each segment (n Customers Requiring Fill). The table also shows the number of customers with known gross SO that were included in calculating each gross SO fill multiplier (n Customers in Fill Average) as well as the level of calculation (Fill Program/ Segment) and multipliers that resulted (Gross SO fill multiplier).

[23] Additional customers required a gross fill and an attribution fill as shown later in Table 18.

Table 16: Customers requiring only Gross SO fill

Utility	Reporting Program	n Customers Requiring Fill	Fill Program / Segment	n Customers in Fill Average	Gross SO fill multiplier
Union	Custom Industrial	2	Union All Custom	5	0.0745
	Custom Commercial	0			
	Multi-Family	0			
	Large Volume	0	Union Large Volume	1	0.2254
Enbridge	Custom Industrial	1	Enbridge All Custom	3	0.2589
	Custom Commercial	1			
	Multi-Residential	0			
	RunitRight	0	RunitRight	N/A	N/A

Our plan included an alternative approach for estimating the unlike participant spillover savings that were filled by the gross SO fill process. The alternative was to base the savings on known projects in the program of the same or similar project type. We investigated this option, but did not pursue it because similar projects in the program data were not found or had a very wide range of savings magnitudes. The projects in all cases were of unknown size or number and included:

- Pipe insulation
- Water recovery
- Air handling unit
- Sealing roof vents

We tested alternate values for the gross SO fill to determine the sensitivity of the results to this fill. None of the tests were a real alternative, so we are not reporting the specific results of these tests. The gross SO fill had no effect on Enbridge Multi-residential, Enbridge RunitRight, Union Comm & MF or Union Large Volume results. The gross SO fill multiplier has a significant effect on Enbridge Commercial, Enbridge Industrial, and Union Industrial results.

We had one like participant spillover project completed in addition to two unlike projects for a customer who did not respond to the engineering interview (the Enbridge Industrial customer). In this case the customer received the gross SO fill for program measures that were not “like” the like participant spillover measures. For the like participant spillover measure, gross SO was set equal to the program measure savings (as planned in the study methodology).

Attribution Fill

Five customers who had a potential SO project did not know how likely they were to install the participant spillover project without the prior program participation. These customers received the same “gross SO fill multiplier” fill as the four above and also received the program “attribution fill” (for the potential participant spillover, not the program measure, Attribution A) using a weighted average program attribution from the 58 (see below) customers who provided this information.

We used a savings weighted average of program attribution for potential participant spillover, including all customers who answered the attribution question and had attribution between zero and 100% inclusive.

This is consistent with the approach DNV GL used in filling missing values for determining free ridership. In the FR study this average was calculated across measures, while for the spillover study we had to modify the approach to accommodate unlike spillover, which is related to customer experiences with the program and not a specific measure. The approach we used is described below.

Calculating an appropriately weighted average of attribution scores for participant spillover proved problematic: attribution was asked for each non-incented gas project that a customer reported, but we do not have information on the size of projects that were not reported as attributable because we did not follow up with an engineering IDI. Unlike participant spillover also does not have a clear causal relationship with a specific program project. To address this problem, we:

1. aggregated measure level Attribution A scores to the customer level for customers with more than one score
2. calculated the program savings weighted average of known customer Attribution A scores (rows 3-5 inTable 17).

The customer aggregation step was done using a simple average of the maximum attribution for a customer. We selected the maximum because, without knowing the size of the measures, an average risked inadvertently disadvantaging the programs. The maximum avoided this risk and the decision ultimately had little effect on the overall results (discussed below). An example of the customer level aggregation is provided in Table 17.

Table 17: Aggregation of Attribution A to Customer Level

Measure	Unlike Participant Spillover Measure Savings	Likelihood of implementing without prior program participation	Assigned Attribution A
SO Measure F	?	Very Likely	0%
SO Measure G	?	Not Likely at all	100%
SO Measure H	?	Somewhat Likely	55%
Customer Aggregated Attribution			100%

We investigated the effect of this decision by looking at the final participant spillover results using an average and comparing the two results. For Union Industrial, the result using an average was 0.32%, while using the max was 0.89%. For Enbridge Commercial, the result using an average was 0.65%, while using the max was 1.36%. None of the other results were affected. Customers with zero reported attribution for one potential participant spillover measure and “don’t know” for another received the attribution fill. Three of those filled had one measure with no attribution and another measure with “don’t know.”

Table 18 shows the number of customers requiring both a gross SO and attribution fill for each segment (n Customers Requiring Fill). The table also shows the number of customers with known attribution that were included in calculating each average attribution score (n Customers in Fill Average) as well as the level of calculation (Fill Program/ Segment) and fill values that resulted (Attribution A fill value). The gross fill multipliers are provided from above (Gross SO fill multiplier) as they were also used to estimate participant spillover for these customers.

Table 18: Customers Requiring Attribution Fill and Gross SO fill

Utility	Reporting Program	n Customers Requiring Fill	Attribution of potential Participant spillover			Applicable Gross SO fill multiplier
			Fill Program / Segment	n Customers in Fill Average	Attribution A fill value	
Union	Custom Industrial	2	Custom Industrial	19	23.58%	0.0745
	Custom Commercial	0	Custom Commercial	5	0.00%	
	Multi-Family	0	Multi-Family	2	0.00%	
	Large Volume	0	Large Volume	10	7.29%	0.2254
Enbridge	Custom Industrial	1	Custom Industrial	7	23.05%	0.2589
	Custom Commercial	2	Custom Commercial	10	20.86%	
	Multi-Residential	0	Multi-Residential	4	75.99%	
	RunitRight	0	RunitRight	1	0.00%	N/A

Net Participant Spillover Fill

Forty-four customers required a fill of net participant spillover. These customers indicated that they had done additional energy saving projects following their participation in 2013/14 programs, but did not know what or whether they received an incentive. Twenty of these customers had too many additional energy saving projects for the CATI screener to reasonably collect (eight or more) and follow-up attempts to contact the customer were unsuccessful. An additional 24 customers indicated that they had done something but that they did not know how many projects had been performed, which ended the interview. These customers received an average fill based on 136 customers, which included all the customers that were filled in the gross SO and attribution fill tables above, all the customers that were used to develop the fills above, and all the customers who did something, but received an incentive or did a non-gas project (lines 2-6 in Table 13). Again, aggregation to the customer level was required before taking the average. In this case the information requiring aggregation was “did the customer complete at least one gas project without an incentive.”

Table 19: Customers Requiring Net Participant Spillover Fill

Utility	Reporting Program	n Customers Requiring Fill	Net Participant Spillover		
			Fill Program / Segment	n Customers in Fill Average (max per customer)	Fill Factor
Union	Custom Industrial	8	Custom Commercial	40	1.01%
	Custom Commercial	8	Custom Industrial	12	0.00%
	Multi-Family	2	Multi-Family	2	0.00%
	Large Volume	5	Large Volume	19	0.83%
Enbridge	Custom Industrial	6	Custom Industrial	21	1.81%
	Custom Commercial	9	Custom Commercial	26	1.43%
	Multi-Residential	5	Multi-Residential	16	9.27%
	RunitRight	1	RunitRight	3	0.00%

Averages and association of participant spillover savings to program participation

The study encountered multiple situations of many-to-many relationships between participant spillover or potential participant spillover measures and program measures for the same customer. That is, a customer had multiple measures in 2013/2014 and also identified multiple potential participant spillover measures which did not tie back to individual 2013/2014 measures (unlike participant spillover). For unlike participant spillover, tying the potential participant spillover back to a single measure does not make sense: the experience with the program drives the participant spillover. For this reason, we proportionally associated unlike participant spillover savings with all program measures completed by a customer. We had one Enbridge customer with like participant spillover confirmed by attribution A who did not respond to the engineering interview. This customer had other unlike participant spillover measures. For this customer, we assumed the like spillover measure was the same magnitude for the program measure (like multiplier of 1) that was "like" the participant spillover measure. All other measures were filled using the program "gross SO fill" multiplier.

Table 20: Example Treatment of Like Participant Spillover for Customer with Like and Unlike Participant Spillover.

Program Measure	Like / Unlike	Gross SO Fill Multiplier	Like multiplier	Example Tracking Savings	Example Gross SO Savings
Measure A	Like	0.00	1.00	5,000	5,000
Measure B	Unlike	0.39	0.00	10,000	3,900
Measure C	Unlike	0.39	0.00	3,000	1,170

APPENDIX B. FINAL SAMPLE ACHIEVEMENT

The tables below (Table 21 to Table 24) show the achieved sample for each stratum in the sample designs. The tables are specific to a program group and show the categorical stratification (grouping) and size strata (larger numbers are bigger projects). Sampling was done at the unit of analysis level which was a slight aggregation of the measures in the database. The target column shows the number of units we attempted to complete. “Normal completes” were randomly selected and received a full sample weight, while “extra completes” were non-random measures that we collected data on while collecting data for a selected unit. “Extra completes” were unit weighted (given a weight of 1) so that they only represent themselves in the sample expansion. Percent of frame cumulative savings is the percent of total savings in the sample frame (population studied) in each category.

Table 21: Participant Spillover Sample Achievement for Union Custom C&I Programs

Grouping		Size	Units of Analysis					Percent of Frame CCM Savings			
			Target	Complete			Frame Total	Strata %	% Completed		
				Total	Normal	Extra			Total	Normal	Extra
Commercial	Action	1	6	16	10	6	50	<1%	<1%	<1%	<1%
		2	6	8	8	0	12	<1%	<1%	0%	<1%
		3	6	0	0	0	6	<1%	0%	0%	0%
		4	6	2	2	0	6	3%	<1%	0%	<1%
	Equipment	1	9	19	9	10	135	1%	<1%	<1%	<1%
		2	9	3	3	0	26	1%	<1%	0%	<1%
		3	8	2	2	0	14	2%	<1%	0%	<1%
		4	8	8	8	0	9	2%	1%	0%	1%
		5	6	2	2	0	6	2%	<1%	0%	<1%
	Multi-family	1	7	9	9	0	37	<1%	<1%	0%	<1%
		2	1	0	0	0	1	<1%	0%	0%	0%
Industrial	Action	1	8	23	7	16	108	5%	1%	<1%	<1%
		2	8	4	3	1	28	5%	<1%	<1%	<1%
		3	8	3	3	0	16	5%	<1%	0%	<1%
		4	7	2	2	0	8	5%	1%	0%	1%
		5	7	2	2	0	7	13%	2%	0%	2%
	Equipment	1	10	54	10	44	269	7%	2%	<1%	<1%
		2	10	19	7	12	66	6%	2%	1%	<1%
		3	10	9	7	2	35	7%	2%	<1%	2%
		4	9	8	8	0	21	8%	3%	0%	3%
		5	9	1	1	0	12	11%	<1%	0%	<1%
		6	9	2	2	0	9	15%	4%	0%	4%

Table 22: Participant Spillover Sample Achievement for Union Large Volume

Grouping	Size	Units of Analysis					Percent of Frame CCM Savings			
		Target	Complete			Frame Total	Strata %	% Completed		
			Total	Normal	Extra			Total	Normal	Extra
Action	1	8	41	12	29	80	11%	6%	3%	3%
	2	8	8	7	1	20	13%	5%	<1%	5%
	3	7	4	4	0	13	10%	3%	0%	3%
	4	7	6	6	0	9	15%	9%	0%	9%
	5	8	6	6	0	8	21%	15%	0%	15%
Equipment	1	6	18	9	9	58	3%	<1%	<1%	<1%
	2	6	5	5	0	12	2%	1%	0%	1%
	3	5	6	6	0	8	4%	3%	0%	3%
	4	5	2	2	0	5	4%	1%	0%	1%
	5	11	7	7	0	11	18%	12%	0%	12%

Table 23: Participant Spillover Sample Achievement for Enbridge Custom C&I Programs

Grouping		Size	Units of Analysis					Percent of Frame CCM Savings			
			Target	Complete			Frame Total	Strata %	% Completed		
				Total	Normal	Extra			Total	Normal	Extra
Commercial	Action	1	7	3	3	0	47	<1%	<1%	0%	<1%
		2	6	5	5	0	17	<1%	<1%	0%	<1%
		3	6	2	2	0	9	<1%	<1%	0%	<1%
		4	6	3	3	0	6	2%	1%	0%	1%
	Equipment	1	12	16	9	7	358	3%	<1%	<1%	<1%
		2	11	12	10	2	115	4%	<1%	<1%	<1%
		3	11	19	13	6	66	4%	2%	<1%	1%
		4	11	8	8	0	40	5%	2%	0%	2%
		5	11	6	5	1	20	6%	1%	<1%	1%
		6	4	2	2	0	4	4%	2%	0%	2%
Multi-Residential		1	13	14	9	5	289	3%	<1%	<1%	<1%
		2	13	14	10	4	109	4%	<1%	<1%	<1%
		3	13	13	9	4	73	4%	<1%	<1%	<1%
		4	13	13	11	2	51	4%	1%	<1%	<1%
		5	12	4	4	0	30	5%	<1%	0%	<1%
		6	1	0	0	0	1	<1%	0%	0%	0%
Industrial	Action	1	8	8	8	0	26	<1%	<1%	0%	<1%
		2	8	4	4	0	10	1%	<1%	0%	<1%
		3	4	3	3	0	4	3%	2%	0%	2%
	Equipment	1	8	20	6	14	98	3%	<1%	<1%	<1%
		2	8	7	6	1	34	4%	<1%	<1%	<1%
		3	8	11	10	1	23	5%	2%	<1%	2%
		4	8	10	10	0	16	6%	4%	0%	4%
		5	8	2	2	0	10	6%	1%	0%	1%
		6	10	4	4	0	10	18%	5%	0%	5%

Table 24: Participant Spillover Sample Achievement for Enbridge RunitRight

Grouping	Size	Units of Analysis					Percent of Frame CCM Savings			
		Target	Complete			Frame Total	Strata %	% Completed		
			Total	Normal	Extra			Total	Normal	Extra
Action	1	7	5	5	0	26	-34%	-4%	0%	-4%
	2	5	2	2	0	5	17%	8%	0%	8%
	3	5	2	2	0	5	24%	10%	0%	10%
	4	9	2	2	0	9	93%	21%	0%	21%

APPENDIX C. DATA COLLECTION INSTRUMENT

The embedded documents below are the interview guides used for CATI and In-Depth Interviews for the participant spillover study. Participant spillover questions were also included in the interview guide used for 2015 CPSV/NTG (provided as an appendix to that report)

Spillover Survey CATI Final.docx

Spillover Follow up IDI Guide Final.docx

APPENDIX D. SITE SPECIFIC PARTICIPANT SPILLOVER SUMMARY

This appendix contains the summary results from the participant spillover surveys and calculations. It contains only the results from those participants who completed participant spillover projects with energy savings which were attributable to the programs.

Table 25: Summary of Project-Specific Participant Spillover Results

Utility	Program / Segment	Cust ID	Participant Spillover Project		
			Description	Calculation Method	Lifetime Savings (CCM)
Enbridge	Custom Industrial	A	Baghouse Installation	Customer provided the weight of production increase at the same level of energy consumption and the dollar value following the baghouse installation. Literature review provided the energy per weight required for efficiently producing this particular metal oxide; this is the savings because the customer stated that additional production occurred with the same amount of total energy (a reduction in per unit energy use). Energy savings value is consistent with the cost savings (20% of the dollar value).	1,160,050
Enbridge	Custom Industrial	B	Steam Trap Replacement	Customer estimated that 3-4 low pressure steam traps were repaired, plus leaks at one other place. We estimated the savings based on default values in the Illinois TRM, which allows for reasonable savings estimates with a minimum of input information.	60,285
Enbridge	Multi-Residential	C	Heat Reflector Panels at many sites[24]	Contractor provided m3 savings estimates for most buildings which was based on 10% of space heat consumption (consistent with EGD's approach in 2015). They also provided the number of apartments for each building. For buildings without an estimate, we used the average m3/apartment of those with estimates to calculate the annual savings.	5,832,960
Union	Custom Industrial	D	Greenhouse Energy Curtains	Onsite contact provided the size of greenhouse and material for the curtain. We used Virtual Grower to calculate the baseline and installed case to derive the savings.	8,007,630

[24] Precise number of sites not reported to preserve respondent confidentiality.

Utility	Program / Segment	Cust ID	Participant Spillover Project		
			Description	Calculation Method	Lifetime Savings (CCM)
		E	Pipe Insulation	Customer provided the steam pressure, length of pipe and pipe diameter. We used the 3E Plus calculator to estimate savings.	289,726
		F	Unit heater replacements. Convective space heaters units in non-insulated spaces were replaced with higher efficiency units near the end of their EUL.	Onsite contact could not find records or details. Estimated heating load based on building area and compared usage for baseline vs. efficient heater efficiencies.	175,302
		G	Process Boiler	Customer stated the boiler size, load and operating hours for the boiler. Assumed improvement from 80 to 85% efficiency.	830,954
		H	Furnace	Customer noted that a residential furnace was added. Estimated load using heating degree days and design temperatures for the customer's location. Furnace size assumed for a 2,000 sq ft house. Assumed base case heating system based on code (90%), efficient case at 95%. EUL of 18 years from EPA for residential furnaces.	4,466
	Large Volume	I	Boiler Optimization	Customer provided internal calculation results.	36,158,661
			Process Optimization		1,070,430
			Process Optimization		4,268,042
			Process Optimization		3,501,983
			Process Optimization		967,833
			Process Optimization		1,087,530
			Process Optimization		16,200,092
			Heat Exchanger Upgrade		820,777

2017 C&I PRESCRIPTIVE VERIFICATION

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Ontario Energy Board

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TERMINOLOGY

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

A *free rider* is "a program participant who would have installed a measure on his or her own initiative even without the program." [1]

Free-ridership rate: Ratio of savings claimed from participants that were not influenced by the utility program.

Gross Realization Rate (Gross RR): Adjustment factor used to multiply tracked savings to arrive at verified gross savings estimate, or "ex-post" savings estimate; disaggregated by measure type and utility. Each gross RR is developed through data collected during the gross impact portion of the C&I Prescriptive program verification efforts, which will verify program-achieved gross savings for measures at a sample of sites. It is the ratio of the verified gross savings to the tracking estimate of gross savings for installed measures, and includes corrections to the numbers of units installed, eligibility criterion (as listed in the measure Sub Docs), etc. (as detailed in section 2.2.2 of the workplan in Appendix A). The Gross RR is derived through the participant survey data collection (either via phone or an on-site), which confirms that the reported equipment / measure was installed and is currently operational at the facility.

Gross savings are "the changes in energy consumption and/or demand that result directly from program-related actions taken by participants in an efficiency program, regardless of why they participated." [2]

In-Depth Interviews (IDIs) are structured interviews administered by evaluation engineers (for gross impact verification and SO follow-up data collection) and market researchers/ project analysts (for FR and SO data collection) either in person or, more frequently, over the phone.

Net-to-Gross Ratio (NTGR): Ratio that accounts for effects such as attribution, free riders, and the spillover effects (if any); disaggregated by measure type and utility.

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

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

Priority Measure Groups: Per the final workplan, the evaluation addressed the top four Priority Measure Groups for each utility. See Appendix A (workplan) for complete details.

Spillover(SO) "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."[3] We considered both inside and outside, and both like and unlike spillover through this project.

- Inside spillover refers to non-incented measures that were installed within the same facility.[4]
- Outside spillover refers to measures for which the customer did not receive an incentive adopted in an outside location for a participating customer.[5]
- Like spillover refers to non-incented measures of the same type as incented measures.[6]
- Unlike spillover refers to non-incented measures of a different type as incented measures.[7]

Telephone Supported Engineering Reviews (TSERs) are desk reviews, entailing a phone interview with program participants (typically the person(s) most knowledgeable about the measure in question), conducted for those projects outside the on-site sample points, to verify measure installation and operation.

Tracked Savings: Gross natural gas savings claimed by each utility (in CCM) for each measure, or "ex-ante" savings estimate.

Verified Savings: Gross natural gas savings by each utility (in CCM) for each measure, verified by the evaluation team, or "ex-post" savings estimate.

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

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

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

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

7 Ibid

Vendors are program trade allies, business partners, service providers, contractors and suppliers who work with program participants to implement energy saving measures.

+/- or Absolute Precision: If the evaluation were repeated several times selecting samples from the same population, 90% of the time the ratio would be within this range of the ratio.

Confidence interval: The upper bound is defined by the ratio plus the absolute precision. the lower bound is defined by the ratio minus the absolute precision.

Relative Precision is calculated as the absolute precision divided by the ratio itself. By convention, relative precisions are the statistic that are targeted in sampling (i.e., 90/10 is a relative precision metric).

Coefficient of Variation (CV): is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation represents the ratio of the standard deviation to the mean.

Finite population correction (FPC) is a factor that reduces the measured error of samples drawn from small populations (less than 300). FPC applies when the ratio is applied to the same population from which the sample was drawn.[8]

[8] Results from this study with FPC will be applied to the lost revenue calculations for the 2017 program. Those without FPC will be applied to future study year shareholder incentive and lost revenue calculations.

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1 EXECUTIVE SUMMARY

This report has been prepared for the Ontario Energy Board (OEB) and provides the results of the gross savings verification and net-to-gross ratios (NTGRs), by Priority Measure Group, for the commercial and industrial prescriptive programs in Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) portfolio delivered in 2017. The combined study produced gross impact verification, free ridership (FR) and participant spillover (SO) ratios.[9]

1.1 EVALUATION OBJECTIVES

The overall goals of the combined evaluation were to develop:

- Verified gross and net ratios for a selected set of Priority Measure Group projects (designed to meet 90/10 statistical confidence and relative precision levels) from the 2017 prescriptive commercial and industrial programs
- Participant spillover factors applicable to commercial and industrial prescriptive projects, for a selected set of Priority Measure Groups, based on projects installed in 2017

1.2 EVALUATION APPROACH

At a high level, the gross savings verification and NTG study employed the following methodology:

- Receive program data and documentation.
- Design and select the sample.
- Collect data.
- Analyze the results.
- Report the results.

The methodology selected for the gross impact portion of the study consisted of telephone supported engineering reviews (TSERs) and on-site verification visits to aid in calculation of the ex-post gross savings. The methodology selected for the NTG evaluation relied on end-user self-report surveys and interviews.

[9] Free-ridership rate: Ratio of savings claimed from participants that were not influenced by the utility program.

The end user self-reports were supplemented by interviews with vendors to capture their and the program's influence on end-user decision making. The NTG analysis also considered spillover savings due to the programs.

1.3 RESULTS

The following section presents the results from gross impact verification and NTG research study for Enbridge and Union. Table 1-1 and Table 1-2 show the Enbridge gross verification and NTG results, respectively. Itron did not find any participant spillover results for Enbridge or Union.

The Enbridge results show that the program's gross savings estimates are accurate and confirm with the specifications in the technical reference manual (TRM) and subdocuments (subdocs) describing savings calculations.

TABLE 1-1: ENBRIDGE GROSS IMPACT RESULTS SUMMARY

Priority Measure Group	Gross Verification Realization Rate	90% Confidence Interval			
		(+/-)	Lower Bound	Upper Bound	Relative Precision
Boilers	100%	0%	100%	100%	0%
Kitchen Ventilation	103%	3%	100%	106%	3%
Infrared Heating	103%	6%	97%	109%	6%
DCV	104%	2%	102%	106%	2%

The NTG results show that the program is influencing installations that represent less than 62% of the energy savings reported by the program, with a very minimal influence on the DCV Priority Measure Group.

TABLE 1-2: ENBRIDGE NET-TO-GROSS RESULTS

Priority Measure Group	Free Ridership Rate	Spillover	NTGR	90% Confidence Interval			Absolute Precision (w/ FPC) (+/-)	Absolute Precision (w/o FPC) (+/-)
			= [(1-FR) + SO]	+/-	Lower Bound	Upper Bound		
Boilers	70%	0%	**30%**	20%	10%	50%	17%	21%
Kitchen Ventilation	38%	0%	**62%**	24%	38%	86%	24%	26%
Infrared Heating	89%	0%	**11%**	9%	2%	20%	9%	10%
DCV	92%	0%	**8%**	17%	0%	25%	13%	21%

Table 1-3 and Table 1-4 show the Union gross verification and NTG results, respectively.

The Union results show that the program's gross savings estimates are accurate and confirm with the specifications in the TRM and subdocs describing savings calculations.

TABLE 1-3: UNION GROSS IMPACT RESULTS SUMMARY

Priority Measure Group	Gross Verification Realization Rate	90% Confidence Interval			
		(+/-)	Lower Bound	Upper Bound	Relative Precision
Boilers	102%	1%	100%	103%	1%
ERV	100%	1%	99%	100%	1%
Infrared Heating	103%	3%	99%	106%	3%
Air Curtains	100%	0%	100%	100%	0%

The NTG results show that the program is influencing installations that represent less than 50% of the energy savings reported by the program, with a very minimal influence on the Infrared Heating Priority Measure Group.

TABLE 1-4: UNION NET-TO-GROSS RESULTS

Priority Measure Group	Free Ridership Rate	Spillover	NTGR = [(1-FR) + SO]	90% Confidence Interval +/-	90% Confidence Interval Lower Bound	90% Confidence Interval Upper Bound	Absolute Precision (w/ FPC) (+/-)	Absolute Precision (w/o FPC) (+/-)
Boilers	76%	0%	**24%**	9%	15%	32%	9%	9%
ERV	70%	0%	**30%**	13%	17%	43%	8%	13%
Infrared Heating	93%	0%	**7%**	6%	1%	13%	6%	6%
Air Curtains	50%	0%	**50%**	22%	29%	72%	19%	24%

1.4 FINDINGS & RECOMMENDATIONS SUMMARY

Key findings and recommendations from the study are presented in Table 1-5 below.

TABLE 1-5: 2017 C&I PRESCRIPTIVE PROGRAM VERIFICATION: FINDINGS & RECOMMENDATIONS

Finding	Recommendation	Applicable Entity
Free-ridership levels for Enbridge ranged from 38% to 92% and from 50% to 93% for Union.	The utilities should consider evaluating free-ridership for the programs annually and consider coupling the free-ridership evaluation with process evaluation to better understand how the utilities are influencing the vendors and their outreach to the end-users.	Enbridge & Union
Both utilities had high ex-post gross realization rates, implying that the utilities are accurately estimating the ex-ante savings based on the measure sub-docs and/or the TRM.	GRRs were close to 100% for all evaluated Priority Measure Groups; ***no action recommended.***	Enbridge & Union
There was no participant spillover for either utility.	▪ The utilities should work with the vendors to find out their protocol on recommending the installation of program measures at customers' facilities. This would enable the utilities to better understand the influence the programs have on the customers' behavior, especially in the context of spillover.	Enbridge & Union

Finding	Recommendation	Applicable Entity
	■ The utilities should also consider conducting a market study to quantify any nonparticipant spillover, contingent on EAC and EC consideration.	
Union could benefit from investing in a modern program tracking database with document storage capabilities as most of the participant and vendor contact information had to be extracted by the verification team.	■ Digitize and file project documentation for all projects as they are completed and paid during project closeout. ■ Track contacts associated with projects in the program tracking database. ■ Strongly consider investing in relational program tracking databases.	Union; however, it must be noted that Union has indicated the presence of an online tracking database for their 2018 programs
Vendor surveys had very low response rates	■ Incentives to complete survey ■ Recommendation for utilities to communicate with vendors regarding the importance of this evaluation step during future NTG studies	Enbridge & Union and Verification Team
Participants were generally receptive in responding to surveys. The response rate for participants was around 50% for the first few months. After the first wave of customers were contacted, the more difficult corporate customers and unresponsive customers were attempted to be reached. By the end, after many attempts and exhausting the sample, the overall response rate was about 30% overall for participants.	■ Incentives to complete survey ■ Recommendation for Utility to communicate with customers about the importance of this evaluation steps during future NTG studies	Enbridge & Union and Verification Team

2 INTRODUCTION

This report has been prepared for the Ontario Energy Board (OEB) and provides the results of the gross savings verification and net-to-gross ratios (NTGRs), by Priority Measure Group, for the commercial and industrial prescriptive programs in Enbridge Gas Distribution Inc.'s (Enbridge) and Union Gas Limited's (Union) natural gas demand-side management (DSM) portfolio delivered in 2017. The combined study produced gross impact verification, free ridership (FR) and participant spillover (SO) ratios.

2.1 EVALUATION OBJECTIVES

The overall goals of the combined evaluation were to develop:

- Verified gross and net ratios for a selected set of Priority Measure Group projects (designed to meet 90/10 statistical confidence and relative precision levels) from the 2017 prescriptive commercial and industrial programs
- Participant spillover factors applicable to commercial and industrial prescriptive projects, for a selected set of Priority Measure Groups, based on projects installed in 2017

The programs and projects included in each portion of the study are shown in Table 2-1.

TABLE 2-1: 2017 C&I PRESCRIPTIVE VERIFICATION – GROSS IMPACT, NTG AND SO ACTIVITIES BY PROGRAM

Utility	Scorecard	Program Offering	Gross Impact	NTG	SO
Enbridge	Resource Acquisition	Commercial and Industrial Prescriptive Offer (including both pure and quasi- prescriptive projects)	✓	✓	✓
Union	Resource Acquisition	Commercial /Industrial Prescriptive Offering (including both pure and quasi- prescriptive projects)	✓	✓	✓

2.2 BACKGROUND

Customers receive an incentive through Enbridge and Union C&I prescriptive programs for installing eligible high efficiency pure prescriptive or quasi-prescriptive gas-saving equipment. Prescriptive programs offer fixed incentives that offset the cost of installing energy efficient equipment for a set of technologies. Due to the general nature of prescriptive programs, it is not uncommon for prescriptive programs to remain cost-effective while having higher free-ridership rates. Vendors and distributors also receive an incentive through Enbridge and Union C&I prescriptive programs to offset the increased cost of participating in the program. Vendors receive $100 per application while distributors received $50; these values are nominal compared to the customer incentives, which range from $100 to $8,500 per unit, depending on the measure. Customer eligibility is dependent on TRM/subdocs requirements as well as measure-level technical requirements. Both Enbridge and Union also provide vendors with marketing and technical tools to educate them on the high efficiency equipment.

2.3 EVALUATION APPROACH

At a high level, the gross savings verification and NTG study employed the following methodology:

- **Receive program data and documentation.** The evaluation started with a review of the program tracking data, which formed the basis of the sample, and an initial review of the program documentation. Once the sample was selected, additional documentation was provided by the program to describe the energy efficiency measures and support the tracking savings estimates, also called the ex-ante estimates.
- **Design and select the sample.** The tracking data was used to design and select a sample for the Priority Measure Groups (the top four measure groups contributing to the two programs' CCM in

2017). Full documentation and contact information was requested for all sites within the sample. The gross impact sample was designed as a subset of the NTG sample.

- **Collect data.** Data was collected (via onsites and telephone) to verify the ex-ante energy savings and estimate NTG ratios at the Priority Measure Group level.
- **Analyze the results.** The collected data was used to verify the gross savings and estimate NTG ratios at the Priority Measure Group level.
- **Report the results.** The final step was to report the results, presented in Section 4below.

The methodology selected for the gross impact portion of the study consisted of telephone supported engineering reviews (TSERs) and on-site verification visits to aid in calculation of the ex-post gross savings. Full details of the gross impact methodology can be found in the embedded workplan in Appendix A (Task 2; pages 2-9 to 2-23). Gross Realization Rate (Gross RR) is the adjustment factor used to multiply tracked savings to arrive at verified gross savings estimate, or "ex-post" savings estimate; disaggregated by Priority Measure Group and utility. Gross RR is the ratio of the verified gross savings to the tracking estimate of gross savings for installed measures, and includes corrections to the numbers of units installed, eligibility criterion (as listed in the measure Sub Docs), etc. (as detailed in section 2.2.2 of the embedded workplan in Appendix A). This ratio can be applied to the tracking savings to produce verified gross savings within the Priority Measure Group.

FOR A PRESCRIPTIVE PROJECT:

$$Verified\ project\ savings =$$

$$Claimed\ project\ savings \times \frac{\#\ Verified\ \boldsymbol{eligible}\ units}{\#\ Claimed\ units} \times \frac{Verified\ prescr\ savings\ value\ from\ subdoc}{Claimed\ prescr\ savings\ value}$$

FOR A QUASI-PRESCRIPTIVE PROJECT:

$$Verified\ project\ savings =$$

$$\text{Claimed project savings} \times \frac{\#\ Verified\ \boldsymbol{eligible}\ units}{\#\ Claimed\ units} \times \frac{Verified\ prescr\ savings\ rate\ from\ subdoc}{Claimed\ prescr\ savings\ rate} \times \frac{Verified\ quasi\ input}{Claimed\ quasi\ input}$$

Gross savings realization rates are then calculated for each measure sampled as follows:

$$Gross\ RR = \frac{Verified\ project\ savings}{Claimed\ project\ savings}$$

The methodology selected for the NTG evaluation relied on end-user self-report surveys and interviews. These surveys produce a score based on the participants' responses to questions pertaining to the program's influence on their decision to install energy efficient equipment. This type of influence, of the utility directly on the participant, is called direct influence. These end-user self-reports were supplemented by interviews with vendors to capture the utility's influence on vendor actions when selling the equipment. This indirect utility influence cannot be seen by the customer and therefore cannot be captured in customer surveys. Again, the surveys produce a score based on the vendors' responses to the questions. The NTG analysis also considered participant spillover savings due to the programs. The final free-ridership for each project is the minimum of vendor and customer free-ridership scores. The NTG analysis also considered participant spillover savings due to the programs, which is added to the complement of free ridership to produce the overall net-to-gross ratio. Full details of the NTG methodology can be found in the embedded workplan in Appendix A (Task 3; pages 2-23 to 2-36). This ratio can be applied to the verified gross savings to produce net savings within a priority measure group.

$$NTGR = \left(1 - \min(FR_{participant}, FR_{vendor})\right) + SO$$

3 SAMPLE DISPOSITION

Table 3-1 and Table 3-2 summarize the data collection efforts of both participant and vendor surveys. The targeted number of projects, the completed number of projects, the number of unique customers, the associated savings, and the vendor surveys are displayed below for each Priority Measure Group.

TABLE 3-1: SUMMARY OF ENBRIDGE NTG DATA COLLECTION

Priority Measure Group	Target	Completed			
	Number of Projects	Number of Projects	Number of Unique Customers	Lifecycle Verified CCM of Survey Completes	Vendor Survey Completes
Boilers	31	19	13	4,836,281	0
Kitchen Ventilation	32	16	11	2,716,072	6
Infrared Heating	32	12	12	1,123,778	3
DCV	26	23	4	2,862,741	1
Total	121	70	40	11,538,872	10

TABLE 3-2: SUMMARY OF UNION NTG DATA COLLECTION

Priority Measure Group	Target	Completed			
	Number of Projects	Number of Projects	Number of Unique Customers	Lifecycle Verified CCM of Survey Completes	Vendor Survey Completes
Boilers	44	41	32	12,624,586	5
ERV	40	45	30	13,754,494	11
Infrared Heating	43	28	28	4,024,533	5
Air Curtains	19	13	10	6,614,880	4
Total	146	127	100	37,018,493	25

4 RESULTS

The outcome of the 2017 C&I Prescriptive Verification project produced verified gross and net ratios for the 2017 programs. Section 4.1 below presents the results of this study for Enbridge while Section 4.2 presents the results for Union.

4.1 2017 C&I PRESCRIPTIVE VERIFICATION RESULTS – ENBRIDGE

4.1.1 Enbridge Gross Impact Results

A summary of the measure specific gross realization rates for Enbridge's 2017 C&I Prescriptive program is provided below.

TABLE 4-1: ENBRIDGE GROSS IMPACT RESULTS SUMMARY

Priority Measure Group	Gross Verification Realization Rate	90% Confidence Interval			
		(+/-)	Lower Bound	Upper Bound	Relative Precision
Boilers	100%	0%	100%	100%	0%
Kitchen Ventilation	103%	3%	100%	106%	3%
Infrared Heating	103%	6%	97%	109%	6%
DCV	104%	2%	102%	106%	2%

The gross verification realization rates for Enbridge's 2017 C&I Prescriptive programs indicate that the program's ex-ante gross savings estimates are accurate and conform with TRM/ subdoc stipulations. The measure specific gross impact reports, which present detailed findings for each of the evaluated Priority Measure Groups, are presented in Appendix C. The small relative precisions indicate that the verified savings for most projects were close to the reported savings. While there were a few adjustments, they were not large.

4.1.2 Enbridge NTG Results

Enbridge NTG Ratios

Table 4-2 summarizes Enbridge NTG ratios along with confidence interval and absolute precision statistics. The free-ridership ratio is 70% for the Boilers measure group, 38% for the Kitchen Ventilation measure group, 89% for the Infrared Heating measure group, and 92% for the DCV measure group. Based on the participant IDIs, Itron found no evidence of participant spillover. Therefore, the NTG ratios are 30%, 62%, 11%, and 8% respectively for Boilers, Kitchen Ventilation, Infrared Heating, and DCV.

Absolute precisions are calculated with and without finite population correction (FPC).[10] The absolute precisions with FPC are 17%, 24%, 9%, and 13% respectively for Boilers, Kitchen Ventilation, Infrared Heating, and DCV. The absolute precisions without FPC are 21%, 26%, 10%, and 21% respectively for Boilers, Kitchen Ventilation, Infrared Heating, and DCV. The absolute precisions of the study were in line with the study objectives, but the low NTG ratios resulted in lower than planned relative precisions. While the absolute precisions are not always in compliance with the standards set forth for applying ratios to produce verified savings in other programs such as the Custom Program Savings Verification (CPSV), the results presented here are indicative of program performance based on data collected during the NTG interviews.

The free-ridership rates in the NTG results are the ratio of savings claimed from participants that were not influenced by the utility program. NTG ratios are an estimation statistic of the true population net to gross value. Unlike the variations seen with the gross realization rates, the variations seen with the NTGRs are higher due to the larger ranges of customer responses regarding program influence. For example, the variation seen with Infrared Heating Priority Measure Group interview responses is lower than the variation of interview responses for other Priority Measure Groups. This indicates that customers generally had similar interview responses, where the NTGR for each project remained +/- nine percent within the average NTGR value of eleven percent.

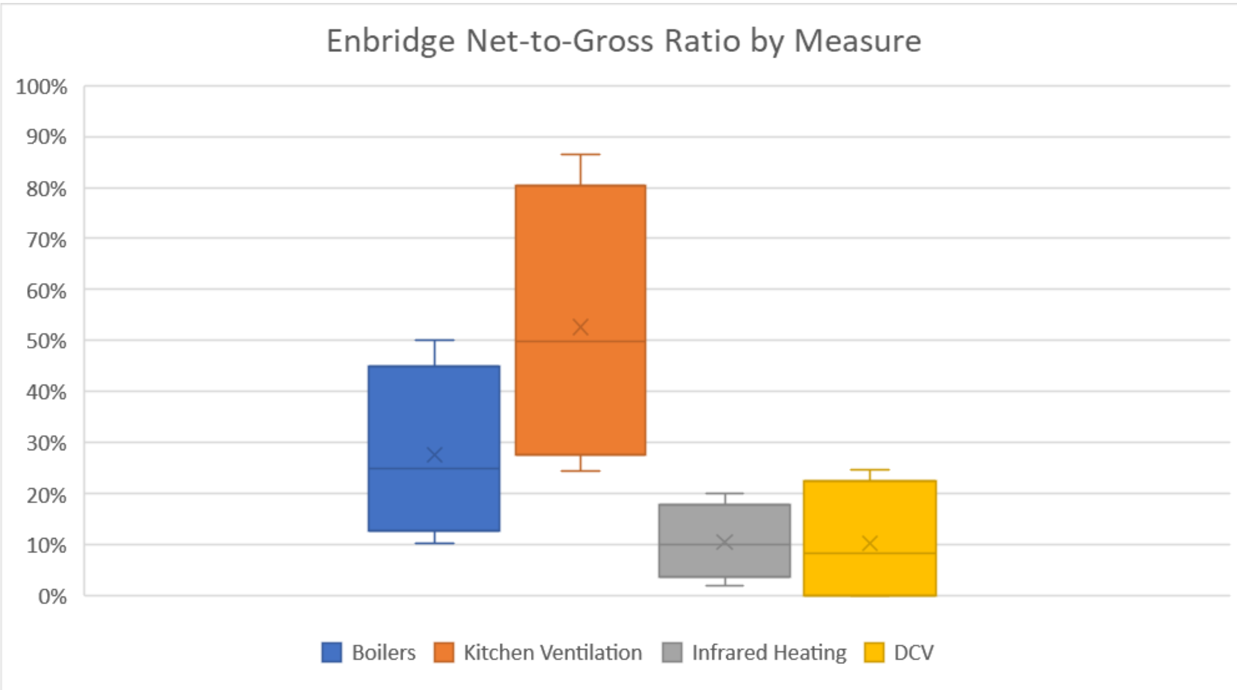
[10] Results from this study with FPC will be applied to the lost revenue calculations for the 2017 program. Those without FPC will be applied to future study years shareholder incentive and lost revenue calculations.

TABLE 4-2: ENBRIDGE NET-TO-GROSS RESULTS

Priority Measure Group	Free Ridership Rate	Spillover	NTGR	90% Confidence Interval			Absolute Precision (w/ FPC) (+/-)	Absolute Precision (w/o FPC) (+/-)
			= [(1-FR) + SO]	+/-	Lower Bound	Upper Bound		
Boilers	70%	0%	**30%**	20%	10%	50%	17%	21%
Kitchen Ventilation	38%	0%	**62%**	24%	38%	86%	24%	26%
Infrared Heating	89%	0%	**11%**	9%	2%	20%	9%	10%
DCV	92%	0%	**8%**	17%	0%	25%	13%	21%

Figure 4-1 displays the results at 90% confidence, meaning that the probability that the true NTGR is within the confidence interval range is 90%.

FIGURE 4-1: ENBRIDGE NET-TO-GROSS RESULTS



These NTG results are indicative of the program influence on the participants' decision-making. For example, the free-ridership ratio of 70% for the Boilers Priority Measure Group indicates that the program is influencing 30% of the energy savings they report.

Enbridge Vendor Surveys

The decision to pursue a vendor interview is dependent on participant questions VT1 and VT2, listed below.

> Now, I am going to ask you some questions about factors that influenced your decision-making process. If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:
>
> - VT1. <Vendor> recommendation regarding equipment selection?
>   - VT1a. What specific recommendations did <Vendor> provide that influenced your decision to purchase the equipment?

- VT2. Price of the equipment
  - VT2x. I would like to get a sense of your price sensitivity for the equipment. Let's say the project would have cost <20% vendor rebate in dollars> more, would you have still done it? What about <40% vendor rebate in dollars>? What about <60% vendor rebate in dollars>? <80% vendor rebate in dollars>? <100% vendor rebate in dollars>?

When the sum points of VT1 and VT2 are greater than 50%, given that VT1>0 and/or VT2x is valid (participant indicates that the amount more they would spend on the equipment is equal to or less than the vendor rebate), then that vendor is given priority to be contacted for an interview. These vendors are prioritized by being the first group of vendors to dial, with more allotted calling attempts (6 attempts). Participants that allocate VT1+VT2 with less points are also contacted after the high priority vendors are contacted. Participant VT1+VT2 scores ranked less than 30% are generally not contacted, unless this vendor happens to overlap with a vendor of a different customer with a high score. Please note that any participant interviews that were conducted in the last few days of data collection did not warrant enough time to schedule vendor interviews. Vendor interviews are scheduled the week after the data collection for the participant interview is completed. Also, if the participant NTG ratio was already 1.0, then the vendor was not contacted for an interview. The 5 vendors that were not contacted belonged to two boiler projects, two kitchen ventilation projects, and an infrared heating project.

A total of 30 vendor IDIs were attempted and 10 completed, as shown in Table 4-3 below. One vendor interview can apply to more than one project. There were five participants that did not purchase the program qualifying equipment through a vendor.

TABLE 4-3: ENBRIDGE VENDOR SURVEY DATA COLLECTION – COMPLETES

	# Vendors	# Projects
Completed	10	14

There were five vendors where Itron did not attempt an interview due to varying reasons such as participant score being 1.0, or if the VT1+VT2 scores were <30%, or due to the timing of the interview. Table 4-4 provides the summary of the data collection disposition of vendor surveys that we could not complete.

TABLE 4-4: ENBRIDGE VENDOR SURVEY DATA COLLECTION – NOT COMPLETED

	No Vendor	Attempted, Not Completed # Vendors in Participant Sample	Not Attempted # Vendors in Participant Sample
Not Completed	5	20	5

Table 4-5 shows the percentage of program savings broken up by the VT1 score, which asks the customer to allocate a certain amount of points to the vendor recommendation. Customers representing 2% of savings gave the vendor recommendation 100 influence points. Customers representing another 2% of savings gave the vendor recommendation between 76-99 influence points. Customers representing another 4% of savings gave the vendor between 51-75 influence points. Customers representing another 64% of savings gave the vendor between 1-50 influence points. Customers representing another 28% of savings gave the vendor 0 influence points.

TABLE 4-5: PERCENTAGE OF SAVINGS OF ENBRIDGE PROJECTS WITH VENDOR TO PARTICIPANT INFLUENCE

Level of Influence	% Energy Savings Influenced by Vendor
Fully Influenced (VT1 100%)	2%
High Influence (VT1 76-99%)	2%
Moderate Influence (VT1 51-75%)	4%
Low Influence (VT1 1-50%)	64%
No Influence (VT1 0%)	28%

Enbridge Spillover

Based on the participant IDIs, we found no evidence of spillover in the analysis for Enbridge. To determine spillover, Itron asked participants to identify projects they installed as a result of their participation in the Enbridge prescriptive program. Five customers responded with something that they considered as inside spillover, while four customers responded to what they considered was outside spillover. To confirm that these were spillover projects, Itron followed up with questions about the installed equipment, such as if a rebate was received, what fuel type did the equipment use, and if the equipment was purchased under a different program, etc. Using the results of that activity, Itron confirmed that these projects were not spillover because the potential spillover action was either incentivized, performed under another Enbridge/Union program, was performed under an electric utility program, or was not influential on the customer. Therefore, we found no evidence of spillover in the analysis for Enbridge. Greater detail on the participant responses and subsequent analysis of the spillover battery of question is provided in Appendix D.4 of this report.

4.2 2017 C&I PRESCRIPTIVE VERIFICATION RESULTS – UNION

4.2.1 Union Gross Impact Results

A summary of the measure specific realization rates for Union's 2017 C&I Prescriptive program is provided below.

TABLE 4-6: UNION GROSS IMPACT RESULTS SUMMARY

Priority Measure Group	Gross Verification Realization Rate	90% Confidence Interval			
		(+/-)	Lower Bound	Upper Bound	Relative Precision
Boilers	102%	1%	100%	103%	1%
ERV	100%	1%	99%	100%	1%
Infrared Heating	103%	3%	99%	106%	3%
Air Curtains	100%	0%	100%	100%	0%

The gross verification realization rates for Union's 2017 C&I Prescriptive programs indicate that the program's ex-ante gross savings estimates are accurate and conform with TRM/ subdoc stipulations. The measure specific gross impact reports, which present detailed findings for each of the evaluated Priority Measure Groups, are presented in Appendix D. The small relative precisions indicate that the verified savings for most projects were close to the reported savings. While there were a few adjustments, they were not large.

4.2.2 Union NTG Results

Union NTG Ratios

Table 4-7 summarizes Union NTG ratios along with confidence interval and absolute precision statistics. The free-ridership ratio is 76% for Boilers measure group, 70% for the ERV measure group, 93% for the Infrared Heating measure group, and 50% for the Air Curtains measure group. Based on the participant IDIs, Itron found no evidence of spillover. Therefore, the NTG ratios are 24%, 30%, 7%, and 50% respectively for Boilers, ERV, Infrared Heating, and Air Curtains.

Absolute precisions are calculated with and without FPC.[11] The absolute precisions with the FPC are 9%, 8%, 6%, and 19% respectively for Boilers, ERV, Infrared Heating, and Air Curtains. The absolute precisions without the FPC are 9%, 13%, 6%, and 24% respectively for Boilers, ERV, Infrared Heating, and Air Curtains. The absolute precisions of the study were in line with the study objectives, but the low NTG ratios resulted in lower than planned relative precisions. While the absolute precisions are not always in compliance with the standards set forth for applying ratios to produce verified savings in other programs such as the Custom Program Savings Verification (CPSV), the results presented here are indicative of program performance based on data collected during the NTG interviews.

The free-ridership rates in the NTG results are the ratio of savings claimed from participants that were not influenced by the utility program. NTG ratios are an estimation statistic of the true population net to gross value. Unlike the variations seen with the gross realization rates, the variations seen with the NTGR are higher due to the larger range of customer responses regarding program influence. For example, the variation seen with Infrared Heating Priority Measure Group interview responses is lower than the variation of interview responses for other Priority Measure Groups. This indicates that customers generally had similar interview responses, where the NTGR for each project remained +/- six percent within the average NTGR value of seven percent.

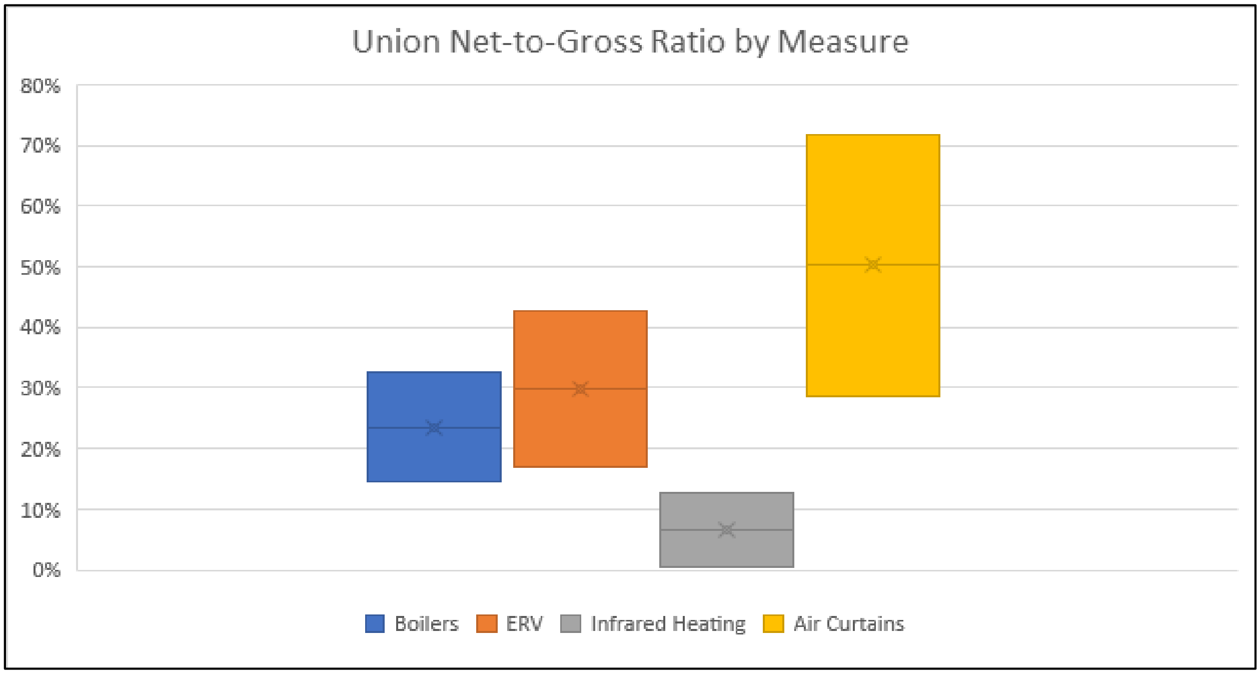
TABLE 4-7: UNION NET-TO-GROSS RESULTS

Priority Measure Group	Free Ridership Rate	Spillover	NTGR	90% Confidence Interval			Absolute Precision (w/ FPC) (+/-)	Absolute Precision (w/o FPC) (+/-)
			= [(1 – FR) + SO]	+/-	Lower Bound	Upper Bound		
Boilers	76%	0%	**24%**	9%	15%	32%	9%	9%
ERV	70%	0%	**30%**	13%	17%	43%	8%	13%
Infrared Heating	93%	0%	**7%**	6%	1%	13%	6%	6%
Air Curtains	50%	0%	**50%**	22%	29%	72%	19%	24%

Figure 4-2 displays the results at 90% confidence, meaning that the probability that the true NTGR is within the confidence interval range is 90%.

[11] Results from this study with FPC will be applied to the lost revenue calculations for the 2017 program. Those without FPC will be applied to future study year shareholder incentive and lost revenue calculations.

FIGURE 4-2: UNION NET-TO-GROSS RESULTS



These NTG results are indicative of the program influence on the participants' decision-making. For example, the free-ridership ratio of 76% for the Boilers Priority Measure Group indicates that the program is influencing 24% of the energy savings they report.

Union Vendor Surveys

The decision to pursue a vendor interview is dependent on participant questions VT1 and VT2, listed below.

> Now, I am going to ask you some questions about factors that influenced your decision-making process. If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:
>
> - VT1. <Vendor> recommendation regarding equipment selection?
>   - VT1a. What specific recommendations did <Vendor> provide that influenced your decision to purchase the equipment?
> - VT2. Price of the equipment
>   - VT2x. I would like to get a sense of your price sensitivity for the equipment. Let's say the project would have cost <20% vendor rebate in dollars> more, would you have still

done it? What about <40% vendor rebate in dollars>? What about <60% vendor rebate in dollars>? <80% vendor rebate in dollars>? <100% vendor rebate in dollars>?

When the sum points of VT1 and VT2 are greater than 50%, given that VT1>0 and/or VT2x is valid (participant indicates that the amount more they would spend on the equipment is equal to or less than the vendor rebate), then that vendor is given priority to be contacted for an interview. These vendors are prioritized by being the first group of vendors to dial, with more allotted calling attempts (6 attempts). Participants that allocate VT1+VT2 with less points are also contacted after the high priority vendors are contacted. Participant VT1+VT2 scores ranked less than 30% are generally not contacted, unless this vendor happens to overlap with a vendor of a different customer with a high score. Please note that any participant interviews that were conducted in the last few days of data collection did not warrant enough time to schedule vendor interviews. Vendor interviews are scheduled the week after the data collection for the participant interview is completed. Also, if the participant NTG ratio was already 1.0, then the vendor was not contacted for an interview. The 15 vendors that were not contacted belonged to five ERV projects, six boiler projects, and four infrared heating projects.

A total of 79 vendor IDIs were attempted and 25 completed as shown in Table 4-8 below. One vendor interview can apply to more than one project. There were five participants that did not purchase the program qualifying equipment through a vendor.

TABLE 4-8: UNION VENDOR SURVEY DATA COLLECTION – COMPLETED

	# Vendors	# Projects
Completed	25	32

There were 15 vendors where Itron did not attempt an interview due to varying reasons such as participant score being 1.0, or if the VT1+VT2 scores were <30%, or due the timing of the interview. Table 4-9 provides the summary of the data collection disposition of vendor surveys that we could not complete.

TABLE 4-9: UNION VENDOR SURVEY DATA COLLECTION – NOT COMPLETED

	No Vendor	Attempted, Not Completed # Vendors in Participant Sample	Not Attempted # Vendors in Participant Sample
Not Completed	5	54	15

Table 4-10 shows the percentage of program savings broken up by the VT1 score, which asks the customer to allocate a certain amount of points to the vendor recommendation. Customers representing 8% of savings gave the vendor recommendation 100 influence points. Customers representing another 5% of savings gave the vendor recommendation between 76-99 influence points. Customers representing another 14% of savings gave the vendor between 51-75 influence points. Customers representing another 60% of savings gave the vendor between 1-50 influence points. Customers representing another 14% of savings gave the vendor 0 influence points.

TABLE 4-10: PERCENTAGE OF SAVINGS OF UNION PROJECTS WITH VENDOR TO PARTICIPANT INFLUENCE

Level of Influence	% Energy Savings Influenced by Vendor
Fully Influenced (VT1 100%)	2%
High Influence (VT1 76-99%)	2%
Moderate Influence (VT1 51-75%)	4%
Low Influence (VT1 1-50%)	64%
No Influence (VT1 0%)	28%

Union Spillover

Based on the participant IDIs, we found no evidence of spillover in the analysis for Union. To determine spillover, Itron asked participants to identify projects they participated in outside if the Enbridge and Union prescriptive programs. Seven customers responded with something that they considered as inside spillover, while one of the customers responded to what they considered was outside spillover. To confirm that they were spillover, Itron followed up with questions about the equipment, such as if a rebate was received, and the equipment was purchased under a different program. Using the results of that activity, Itron confirmed that these projects were not spillover because the potential spillover action was either incentivized, performed under another Enbridge/Union program, was performed under an electric utility program, or was not influential on the customer. Therefore, we found no evidence of spillover in the analysis for Union. Greater detail on the participant responses and subsequent analysis of the spillover battery of question is provided in Appendix F.4 of this report.

5 FINDINGS & RECOMMENDATIONS

Key findings and recommendations from the study are presented in Table 4-11 below.

TABLE 5-1: 2017 C&I PRESCRIPTIVE PROGRAM VERIFICATION: FINDINGS & RECOMMENDATIONS

Finding	Recommendation	Applicable Entity
Free-ridership levels for Enbridge ranged from 38% to 92% and from 50% to 93% for Union.	The utilities should consider evaluating free-ridership for the programs annually and consider coupling the free-ridership evaluation with process evaluation to better understand how the utilities are influencing the vendors and their outreach to the end-users.	Enbridge & Union
Both utilities had high ex-post gross realization rates, implying that the utilities are accurately estimating the ex-ante savings based on the measure sub-docs and/or the TRM.	GRRs were close to 100% for all evaluated Priority Measure Groups; ***no action recommended.***	Enbridge & Union
There was no participant spillover for either utility.	■ The utilities should work with the vendors to find out their protocol on recommending the installation of program measures at customers' facilities. This would enable the utilities to better understand the influence the programs have on the customers' behavior, especially in the context of spillover. ■ The utilities should also consider conducting a market study to quantify any nonparticipant spillover, contingent on EAC and EC consideration.	Enbridge & Union
Union could benefit from investing in a modern program tracking database with document storage capabilities as most of the participant and vendor contact information had to be extracted by the verification team.	■ Digitize and file project documentation for all projects as they are completed and paid during project closeout. ■ Track contacts associated with projects in the program tracking database. ■ Strongly consider investing in relational program tracking databases.	Union; however, it must be noted that Union has indicated the presence of an online tracking database for their 2018 programs

Finding	Recommendation	Applicable Entity
Vendor surveys had very low response rates	▪ Incentives to complete survey ▪ Recommendation for Utility to communicate with vendors regarding the importance of this evaluation step during future NTG studies	Enbridge & Union and Verification Team
Participants were generally receptive in responding to surveys. The response rate for participants was around 50% for the first few months. After the first wave of customers were contacted, the more difficult corporate customers and unresponsive customers were attempted to be reached. By the end, after many attempts and exhausting the sample, the overall response rate was about 30% overall for participants.	▪ Incentives to complete survey ▪ Recommendation for utilities to communicate with customers about the importance of this evaluation steps during future NTG studies	Enbridge & Union and Verification Team
Scoring methodology for participant's responses to efficiency questions "between standard and high" was sometimes not clear.	▪ This item should be re-visited during subsequent NTG studies contingent on EAC and EC discussion. One alternative is that if a respondent indicates that they would have used an efficiency between standard and high without the program, but cannot answer the follow up question of the efficiency level they would use, instead of taking the average "between standard and high" responses for the measure, use the scoring for "standard efficiency" instead. The logic behind this is that if the customer does not know the efficiency level, it is likely that they may not have equipment at this efficiency.	Verification Team

6 APPENDICES

This section presents the appendices for this report.

APPENDIX A – WORKPLAN

This appendix provides the final workplan for the combined C&I Prescriptive Gross and NTG Ratios measurement project. It provides complete details on the program background, the evaluation objectives, sampling details and gross and NTG methodologies.

OEB_2017_CIPMSV
Workplan_Sent_To_

APPENDIX B – NTG METHODOLOGY SUMMARY

In addition to providing full details on the NTG methodology in Appendix A (Workplan; Task 3; pages 2-23 to 2-36), we present an overview of the NTG methodology employed for this study in this section. The evaluation team used an end-user self report approach (SRA) to estimate net-to-gross ratios, which is the most commonly used approach for this type of program, and relies on participating customer survey results.

The free-ridership (FR) and participant spillover (SO) scores for each Priority Measure Group are developed using data collected from participant and vendor interviews. FR data is collected via in-depth telephone surveys. For the FR determination, a specific project completed by a customer for each Priority Measure Group (identified by unique *contract account numbers* for Enbridge and by *Customer IDs* and *measure name* for Union) as listed within the program tracking databases is defined as one sampling unit.

A minimum CV of 0.8 was used to determine the net-to-gross sample size, which yielded 121 participants for Enbridge and 146 participants for Union. Full details on NTG sampling can be found in in Appendix A (Workplan; pages 2-24 and 2-25). Greater detail on the number of attempted and achieved completes is provided in Appendix D for Enbridge and in Appendix F for Union.

The free-ridership portion of the customer-decision maker survey was divided into three sections: timing, efficiency, and quantity. Timing questions determine the free-ridership during the acceleration period,[12] where applicable, and efficiency and quantity determine the free-ridership during the post-acceleration period.

B.1 NOTATION

AE = Efficiency Attribution

AQ = Quantity (size) Attribution

fE = Efficiency free ridership

[12] Program causes the participant to install a piece of equipment (not necessarily high efficiency) sooner than they would have otherwise

fQ = Quantity (size) free ridership

NS_A = Net Acceleration Period Savings

NS_L = Net Lifetime Savings

NS_P = Net Post-Acceleration Period Savings

SPA = Simple Program Attribution (function of efficiency and quantity free ridership, not timing)

VGS_E = Verified Gross Savings based on pre-existing equipment baseline (annual)

VGS_S = Verified Gross Savings based on ISP or code efficiency equipment baseline (annual)

VGS_L = Verified Gross Lifetime Savings

Y_A = Years Accelerated

B.2 INTRODUCTION

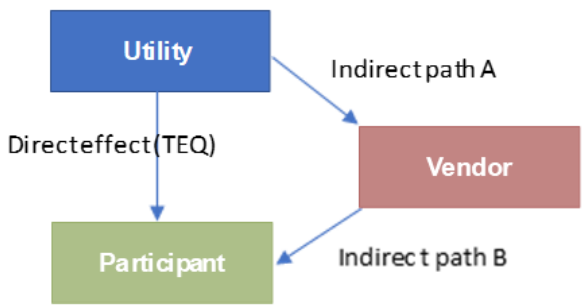
B.2.1 What is Net-to-Gross?

Net-to-gross is a ratio that measures the portion of program gross savings that were installed because of utility influence. These are energy savings that would not have happened if there wasn't a utility energy efficiency program. This included analyzing reasons for participation and investigating various program related factors that influenced the customers' decision to participate in the Enbridge and Union energy efficiency C&I prescriptive programs. NTG measures the utilities' influence on the customer's decision to install high efficiency priority measures.

There are two main channels of influence that were studied. Direct influence occurs when the utility directly influences the customers' decision to install energy efficient equipment. Indirect influence is when the utility influences the actions of the vendor, and the new vendor actions influence the customer's decision to install energy efficient equipment.

The relationship between utility, participant, and vendor is shown in the flow chart below.[13] The influence the utility has on the customer is a direct effect because the influence is "seen" by the customer and can be measured using the customer self-report survey. There is also an indirect influence that we must account for: the influence of the utility on the participant through the vendor. The customer does not see how the utility influenced the vendor in ways that influenced the customer. In the customer self-report survey, any such indirect influence would be attributed to the vendor. Therefore, vendor surveys are necessary to complete the picture and fully recognize the utility's impact.

FIGURE B-1: INDIRECT INFLUENCE PATHWAY



To capture indirect influence, two pathways are examined. Utility to vendor influence is assessed through vendor interviews (Indirect path A), while vendor to participant influence is assessed through participant interviews (Indirect path B).

Both upselling and price were factors analyzed in determining indirect influence. Upselling occurs when the utility gives the vendor marketing materials, education on energy efficiency benefits, selling tools, etc., which the vendor then uses to influence the customers' purchasing decision. Indirect influence due to price occurs when the incentive from the utility to the vendor is passed on to the customer.

B.2.2 NTG – Spillover & Free-Ridership

The Net-to-Gross calculation is the sum of spillover and (1-freeridership).

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

[13] Infographic developed by DNV GL and used with permission

B.2.3 Free-Ridership – Relation between Participant and Vendor Result

The overall customer level free-ridership ratio is the minimum free-ridership ratio of the vendor and participant. Ratios are calculated at the customer/measure level, where each customer/measure has one free-ridership value. Then, results are aggregated to a utility/measure level final ratio.

$$FR = \min(FR_{participant}, FR_{vendor})$$

B.2.4 Data Collection & Self-Reported Surveys

Data used to calculate the NTGR was obtained through two sources: the participant survey, and the vendor survey. The participant survey provided responses to direct influence (TEQ), vendor trigger (Indirect path B), and spillover. The vendor survey provided responses to the utility to vendor influence (Indirect path A).

B.2.5 Final Net-to-Gross Calculation

$$NTGR = \left(1 - \min(FR_{participant}, FR_{vendor})\right) + SO$$

B.3 FREE-RIDERSHIP

B.3.1 Participant Free-Ridership (TEQ)

The terms direct attribution and participant free-ridership are used interchangeably as compliments of one another. Direct attribution is determined by responses to the timing, efficiency, and quantity (TEQ) questions. The period of time the program accelerated the measure is called the acceleration period, and is calculated from the timing questions. The post-acceleration period is the effect of efficiency and quantity. The participant survey is also used to assess vendor trigger, if a customer reports that the vendor recommendation(upselling) or price had influenced their decision.

Timing

The acceleration period is dependent on question DAT1 in the survey, which asks:

1. DAT1a: “Without <the program>, would you have <installed, performed> <measure> at the same time, earlier, later, or never?”
    - DAT1a_O: “Why do you say that?”
2. DAT1b: “Approximately how many months later?” (DAT1b is only asked if DAT1a is “Later.”)

Savings within the acceleration period are calculated as the difference in energy use of the replaced equipment and the rebated equipment.

$$NS_A = VGS_E \times Y_A$$

If the respondent answers DAT1 saying that they would “Never” have installed the measure without the program, or if the acceleration period is greater than four years, then the program attribution is 100% and free-ridership is 0%.

Four years is the time horizon beyond which we assume the respondent cannot answer with certainty. Anything answer to Dat1b of beyond four years (Y_A>=4) is treated as a “never would have installed” response (100% attributable), rather than an accelerated measure.

If the respondent answers DAT1 with the response of “Don’t know” or “Refused”, and the efficiency and quantity parameters are valid, then the weighted average of DAT1 responses that are not “Don’t know” or “Refused” for that measure is used. If the respondent indicates, however, that without the program they would have installed the measure at a later time, but consequentially don’t know or refuse how much time later, then the average free-ridership for the accelerated measures within the same Priority Measure Group is applied.

Efficiency

The efficiency attribution (AE) is determined by question DAT2:

1. DAT2a: “Without <the program>, would you have installed the same efficiency as what you installed, lower efficiency, or higher efficiency?”
2. DAT2b: “Without <the program>, would you have installed <measure> that was “< baseline> efficiency,” or “between <baseline> efficiency and the efficiency that you installed?” (DAT2b is only asked if DAT2a is “Lesser.”)

If the respondent indicates that they would have installed equipment of lesser efficiency without the program, then if the equipment installed would have been standard efficiency, the efficiency attribution is 100%. If the equipment installed would have been between standard efficiency and the efficiency of the equipment that was installed, the efficiency attribution is 50%.

If the respondent answers DAT2 with the response of “Don’t know” or “Refused”, and the timing and quantity parameters are valid, then the weighted average of DAT2 responses that are not “Don’t know” or “Refused” for that measure is used. If the respondent indicates, however, that they would have installed a lesser efficiency without the program, and don’t know if it would be at baseline efficiency or between baseline and standard efficiency, then the average score for the measures with response of DAT2a of lesser efficiency is applied.

Quantity

The quantity attribution (AQ) is determined by question DAT3:

1. DAT3a: “Without <the program>, how different would the <number/size> of the <equipment type> have been? Would you say you would have installed the same amount, less, more, or not have installed anything?”
2. DAT3b: “By what percentage did you change the amount of <equipment type> installed because of <the program>?” (DAT3b is only asked if DAT3a is “Less” or “More.”)

If the respondent would have installed less of the equipment without the program, the quantity attribution would be the percent decrease/(1+percent decrease). If more equipment would have been installed without the program, the quantity attribution is the percent increase. *(Note that the workplan mistakenly states the opposite effect, corrected here and within the analysis based on EC team’s review).*

If the respondent answers DAT3 with the response of “Don’t know” or “Refused”, and the timing and efficiency parameters are valid, then the weighted average of DAT3 responses that are not “Don’t know” or “Refused” for that measure is used. If DAT3 is answered with “None”, then the quantity attribution is 100%. If the respondent indicates, however, that they would have installed a different quantity (less/more) without the program, and don’t know the quantity they would have installed, then the average score for the measures with response of DAT3a of “less” quantity is applied to DAT3a “less” responses, and DAT3a of “more” is applied to DAT3a “more” responses.

Direct Attribution Score

Simple Program Attribution (SPA) measures the portion of the post-acceleration period gross savings due to the influence of the program and is based on efficiency and quantity. SPA is equal to 100% when the DAT1 response is "Never". The following equations show how SPA is calculated.

$$fE = 1 - AE$$
$$fQ = 1 - AQ$$

$$SPA = 1 - fQ\, fE$$

For measures without baseline efficiency, also termed "add-on measures", the SPA score is solely a function of quantity.

$$fQ = 1 - AQ$$

$$SPA = 1 - fQ$$

The final estimate of lifetime net savings (NS_L) is:

$$NS_L = VGS_E \; x \; Y_A + VGS_S \; x \; SPA \; x \; (Y_{V.EUL} - Y_A)$$

The net and gross savings for each sample point within a Priority Measure Group are summed, and the participant attribution is:

$$Direct\ Attribution = \frac{NS_L}{VGS_L}$$

How Participant Surveys Trigger Vendor Surveys

The decision to pursue a vendor interview is dependent on participant questions VT1 and VT2. VT1, VT2, and VT3 are the participant's scores for upselling, price, and other influence respectively. Combined, all three scores total to 100%. VT1, VT2, and VT3 ask the following:

Now, I am going to ask you some questions about factors that influenced your decision-making process. If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:

- VT1. <Vendor> recommendation regarding equipment selection?
  - VT1a. What specific recommendations did <Vendor> provide that influenced your decision to purchase the equipment?
- VT2. Price of the equipment
  - VT2x. I would like to get a sense of your price sensitivity for the equipment. Let's say the project would have cost <20% vendor rebate in dollars> more, would you have still done it? What about <40% vendor rebate in dollars>? What about <60% vendor rebate in dollars>? <80% vendor rebate in dollars>? <100% vendor rebate in dollars>?
- VT3. All other influences
  - VT3a. What other factors influenced your decision to purchase the equipment?

When the sum points of VT1 and VT2 are greater than 50%, given that VT1>0 and/or VT2x is valid (participant indicates that the amount more they would spend on the equipment is equal to or less than the vendor rebate), then that vendor is given priority to be contacted for an interview. These vendors are prioritized by being the first group of vendors to dial, with more allotted calling attempts (6 attempts). Participants that allocate VT1+VT2 with less points are also contacted after the high priority vendors are contacted. Participant VT1+VT2 scores ranked less than 30% are generally not contacted, unless this vendor happens to overlap with a vendor of a different customer with a high score. Please note that any participant interviews that were conducted in the last few days of data collection did not warrant enough time to schedule vendor interviews. Vendor interviews are scheduled the week after the data collection for the participant interview is completed. Also, if the participant NTG ratio was already 1.0, then the vendor was not contacted for an interview. Total indirect influence scores are the product of indirect path A and indirect path B and represents the influence of the utility on the participant through the vendor.

Note that although participant surveys are asked at a project level, vendor surveys are not specific to the customer or project but based on general questions on the vendor's behavior for each measure as a result of the program. The actual scoring, however, is at the customer level, where the vendor attribution from vendor responses is applied by customer.

B.3.2 Vendor Free-Ridership

The terms indirect attribution and vendor free-ridership are used interchangeably as compliments of one another. Indirect attribution is determined by upselling and price. A vendor interview is triggered if a customer reports that the vendor recommendation(upselling) or price had influenced their decision (Indirect path B). Then, the vendor is also asked questions regarding upselling and price (Indirect path A). Indirect attribution from both path A and path B are used in the final indirect attribution score.

Upselling

Upselling refers to the influence of the vendor on the customer due to the vendor's recommendation to consider program qualifying equipment over other options, like less efficiency equipment or doing nothing at all, in the case of add-on measures. If the customer allocates any points to upselling, the customer is asked to explain the recommendations the vendor provided to assist their decision. If the vendor interview is triggered, the following questions are asked of the vendor:

1. U2: "In situations where you are selling <project_n>, about what percent of the time are you recommending the high-efficiency equipment?"

2. U4: “For <project_n> measure, what percent of the time would you recommend the high-efficiency equipment option without the program?”

Therefore, the total vendor upselling score is a combination of a few components.

- Part 1- Customer Allocation Upselling % (VT1)
- Part 2- Vendor Response = (U2-U4)/U2
- Total Vendor Upselling= Part1*Part2

Price

The purpose of this question is to see if any vendor rebate passed onto the customer has an influence on the customer’s decision to participate in the program. If the customer allocates any points to pricing, follow up questions are asked, where the customer must identify if their involvement in the project would change due to increase in cost by incremental amounts of the vendor incentive – either by 20%, 40%, 60%, 80% or 100% of the vendor incentive.

If the vendor interview is triggered, then the vendor is asked the following question:

1. P5: “On average, what percent of the rebate is passed on to the buyer for <project_n>, either directly or indirectly?”

A dollar amount is calculated by multiplying the total vendor incentive amount by the response of P5. If this dollar amount of passed on rebate is greater than the customer’s dollar threshold level, a pricing score of 1 is given.

Therefore, the total pricing score is a combination of a few components.

- Part 1- Customer Allocation Pricing % (VT2)
- Part 2- Binary (0/1) Response dependent on Customer Threshold and Amount Vendor Rebate Passed On
- Total Price= Part1*Part2

Other Influence

If there are other significant influences that are not accounted for by upselling and price, then this other influence will be asked of the customer. There is an open-end follow up that is used to identify the other factors. The other influence score is the percent allocation the customer gives to this influence. This other influence is not used in the indirect influence score. It is used to give opportunity to other areas of influence that may not be directly asked from other questions. The reason behind "other influence" is to allow the customer to rank all of their influences fairly, and if the main source of influence was not due to upselling or price, then this question allows for an unbiased point distribution. After careful review of ‘other influence’ responses, none of these responses warrant another form of indirect influence that was not already captured by upselling, price, or TEQ.

All ‘other influence’ open-ended responses have been post-coded are presented in the word cloud below. The larger words indicate more common responses from the customers.

FIGURE B-2: OPEN-END RESPONSE WORD CLOUD FOR “OTHER INFLUENCE”

B.3.3 Overall Free-Ridership

Determining Overall Free-Ridership

The total indirect influence score is the sum of Total Vendor Upselling and Total Price. The total vendor free-ridership is (1-indirect influence score). The minimum vendor free-ridership and participant/TEQ free-ridership score is used as the final free-ridership for that customer/measure level.

$$FR_{participant} = 1 - \frac{NS_L}{VGS_L}$$

$$Total\ Vendor\ Upselling = \mathrm{VT1} * (\mathrm{U2} - \mathrm{U4})/\mathrm{U2}$$

$$Total\ Price\ (if\ vendor\ passed\ incentive) = \mathrm{VT2}$$

$$FR_{vendor} = Total\ Vendor\ Upselling + Total\ Price$$

$$\boldsymbol{FR_{overall}(\ at\ customer/measure\ level) = (\min(FR_{participant}, FR_{vendor}))}$$

B.4 SPILLOVER

B.4.1 Initial Data Collection

The participant spillover estimate will be developed through data collected from participant and vendor surveys, and a follow-up participant interview. Spillover is present when any of the following conditions are met:

- A non-program measure is installed outside the program after initial program participation by the participant
- A program measure is installed that does not receive a program incentive
- The original measure was attributable to the program and the spillover measure is at least partially attributable to the participant's experience with the program

B.4.2 Confirmation of Spillover

Potential participant spillover savings are identified through a separate battery of spillover questions in the participating customer survey. The survey collects initial general information on what was installed and the degree to which the installed measure was influenced by their previous participation in the program. The findings are then analyzed to confirm attribution and to validate that the measure is indeed spillover and did not receive an incentive through the program. Once a causal link is established between the program and the project, a separate follow-up interview is conducted by the engineer responsible for the energy savings calculation and the collected data are used to develop an estimate of spillover savings for each pertinent project. This produces a more accurate savings estimate than if the customer were asked to provide an estimate themselves.

B.4.3 Follow-up Data & Spillover Estimation

Attribution of claimed spillover is based on the following 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 Attribution Factor is assigned in the following way:

1. Not likely at all- Attribution Factor=1.00
2. Not very likely- Attribution Factor=0.90
3. Somewhat likely- Attribution Factor=0.55
4. Very likely- Attribution Factor=0.00

Spillover Savings = Estimate Spillover Measure Savings X Attribution Factor

The NTG calculator produces measure-level ratios of spillover cumulative m^3 to tracked or verified cumulative m^3, which are the source data for the Workplan's Task 4 (expansion process).

APPENDIX C – ENBRIDGE GROSS IMPACT REPORTS

C.1 BOILERS

Enbridge_Boilers_Final.pdf

C.2 DEMAND CONTROLLED KITCHEN VENTILATION

Enbridge_Kitchen Ventilation_Final.pd

C.3 INFRARED HEATING

Enbridge_Infrared Heating_Final.pdf

C.4 DEMAND CONTROLLED VENTILATION

Enbridge_DCV_Final.pdf

APPENDIX D – ENBRIDGE NTG STUDY DETAILS

D.1 ENBRIDGE NET-TO-GROSS DATA COLLECTION

The Net-to-Gross analysis for Enbridge was conducted for the following four Priority Measure Groups:

- Boilers
- Kitchen Ventilation
- Infrared Heating
- DCV

The number of targeted completes for Enbridge NTG data collection (121) was determined using a 90/10 relative precision with a CoV of 0.8, as detailed on pages 2-24 and 2-25 of the embedded workplan in Appendix A. Due to lower than expected response rates, a total of 70 of the targeted 121 projects completed NTG interviews.

Some customers represented multiple projects. The 70 completed NTG interviews entailed 40 customers. Of the data collection not completed, 83 projects attempted an NTG interview without success, while dialing was attempted on the entire population.

The verified lifecycle savings of projects with completed NTG data collection represents at total of 11,538,872 CCM, which is approximately 30% of total population savings in 2017, on a lifecycle CCM basis.

Across all four Enbridge Priority Measure Groups, vendors for 10 projects completed a vendor NTG survey. Table D-1 summarizes Enbridge NTG data collection.

TABLE D-1: ENBRIDGE NET-TO-GROSS DATA COLLECTION ACTIVITIES

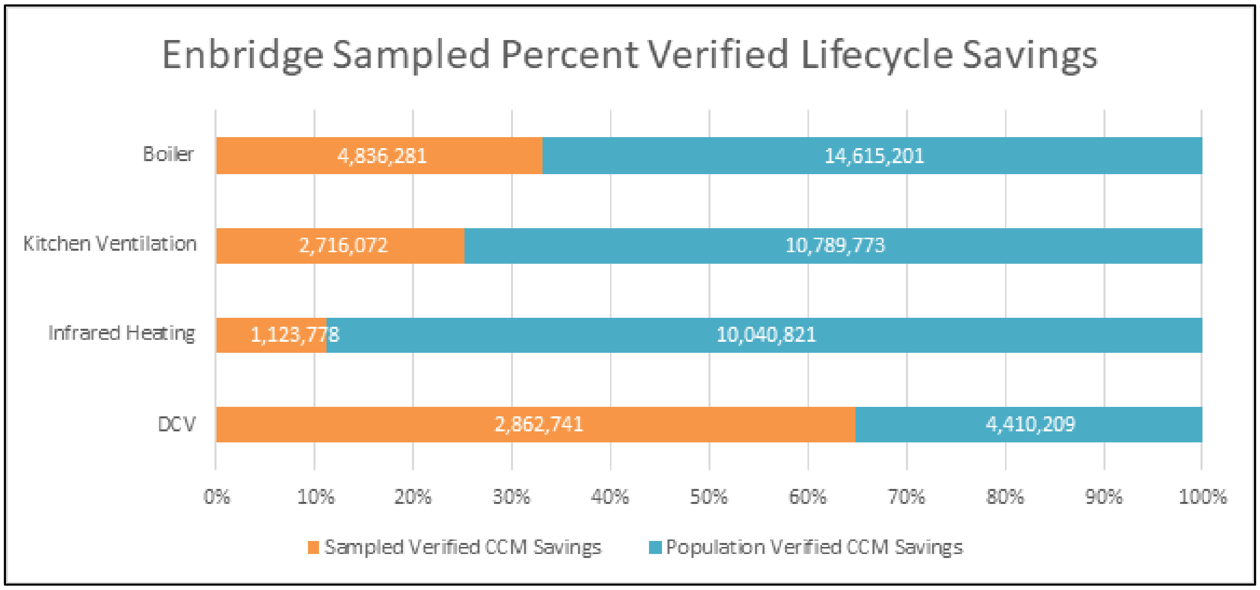
	Total Pop			Target	Completed				Not Completed	
Priority Measure Group	Number of Projects	Number of Unique Customers	Lifecycle Verified CCM of Population	Number of Projects	Number of Projects	Number of Unique Customers *	Lifecycle Verified CCM of Survey Completes	Vendor Survey Completes (# Projects) **	Attempted, Not Completed # Projects	Not Attempted # Projects
Boilers	59	34	14,615,201	31	19	13	4,836,281	0	40	0
Kitchen Ventilation	72	61	10,789,773	32	16	11	2,716,072	6	56	0
Infrared Heating	85	81	10,040,821	32	12	12	1,123,778	3	73	0
DCV	29	6	4,410,209	26	23	4	2,862,741	1	6	0
Total	245	182	39,856,003	121	70	40	11,538,872	10	175	0

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

** A vendor can appear multiple times if their responses varied by measures, resulting in a total greater than the number of vendors interviewed.

Figure D-1 displays the proportion of sampled verified lifecycle CCM savings in relation to the population verified lifecycle CCM savings for Enbridge. NTG survey data encompasses ~35% of Boiler population savings, ~25% of Kitchen Ventilation population, ~11% of Infrared Heating population, and ~65% of DCV population savings.

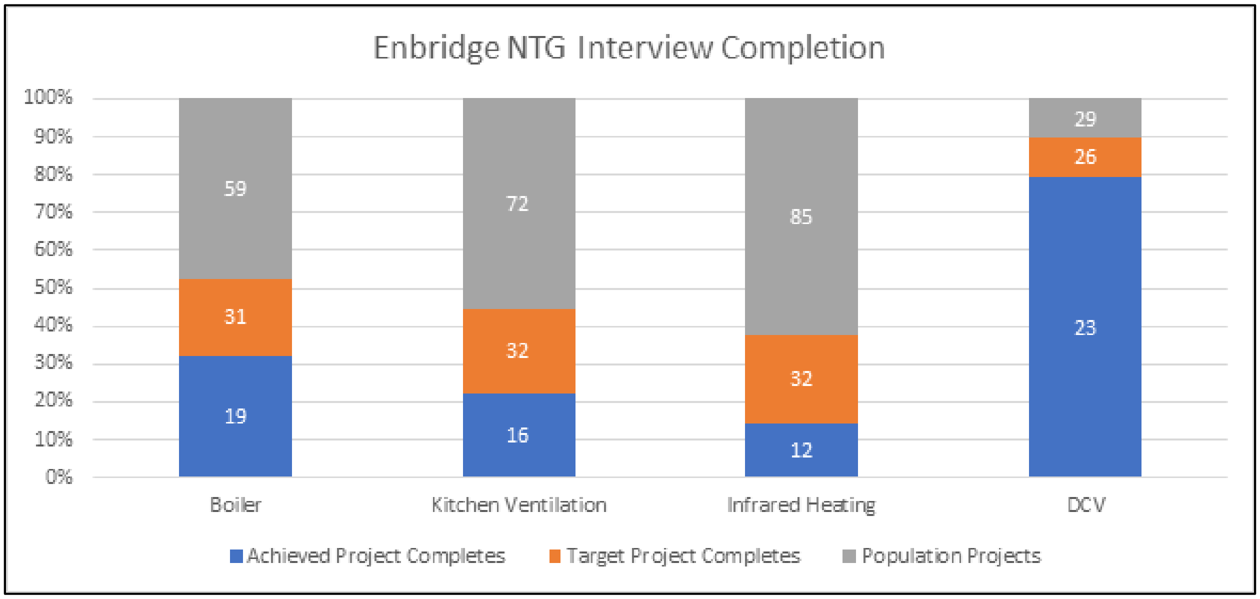
FIGURE D-1: ENBRIDGE NET-TO-GROSS SAMPLED PERCENT VERIFIED LIFECYCLE SAVINGS



In Figure D-2 the achieved NTG survey completes are compared to targets in relation to the overall population.

- The target number of completed Boilers Priority Measure Group NTG IDIs was 31, while 19 were achieved. Approximately 32% of the population of Boiler projects was sampled.
- The target number of completed Kitchen Ventilation NTG IDIs was 32, while 16 were achieved. Approximately 22% of the population of Kitchen Ventilation projects was sampled.
- The target number of completes for Infrared Heating NTG IDIs was 32, while 12 were achieved. Approximately 14% of the population of Infrared Heating projects was sampled.
- The target number of completes for DCV was 26, while 23 were achieved. Approximately 80% of the population of DCV projects was sampled.

FIGURE D-2: ENBRIDGE NET-TO-GROSS INTERVIEW COMPLETION



* Note that the project counts in the figure above are cumulative, where the top value includes the counts of the bottom value.

D.2 ENBRIDGE NET-TO-GROSS RATIOS

Table D-2 summarizes Enbridge NTG ratios along with confidence interval and absolute precision statistics. The free-ridership ratio is 70% for the Boilers measure group, 38% for the Kitchen Ventilation measure group, and 89% for the Infrared Heating measure group, and 92% for the DCV measure group. Based on the participant IDIs, Itron found no evidence of spillover. Therefore, the NTG ratios are 30%, 62%, 11%, and 8% respectively for Boilers, Kitchen Ventilation, Infrared Heating, and DCV.

Absolute precisions are calculated with finite population correction (FPC), and without FPC[14]. The absolute precisions with FPC are 17%, 24%, 9%, and 13% respectively for Boilers, Kitchen Ventilation, Infrared Heating, and DCV. The absolute precisions without FPC are 21%, 26%, 10%, and 21% respectively for Boilers, Kitchen Ventilation, Infrared Heating, and DCV.

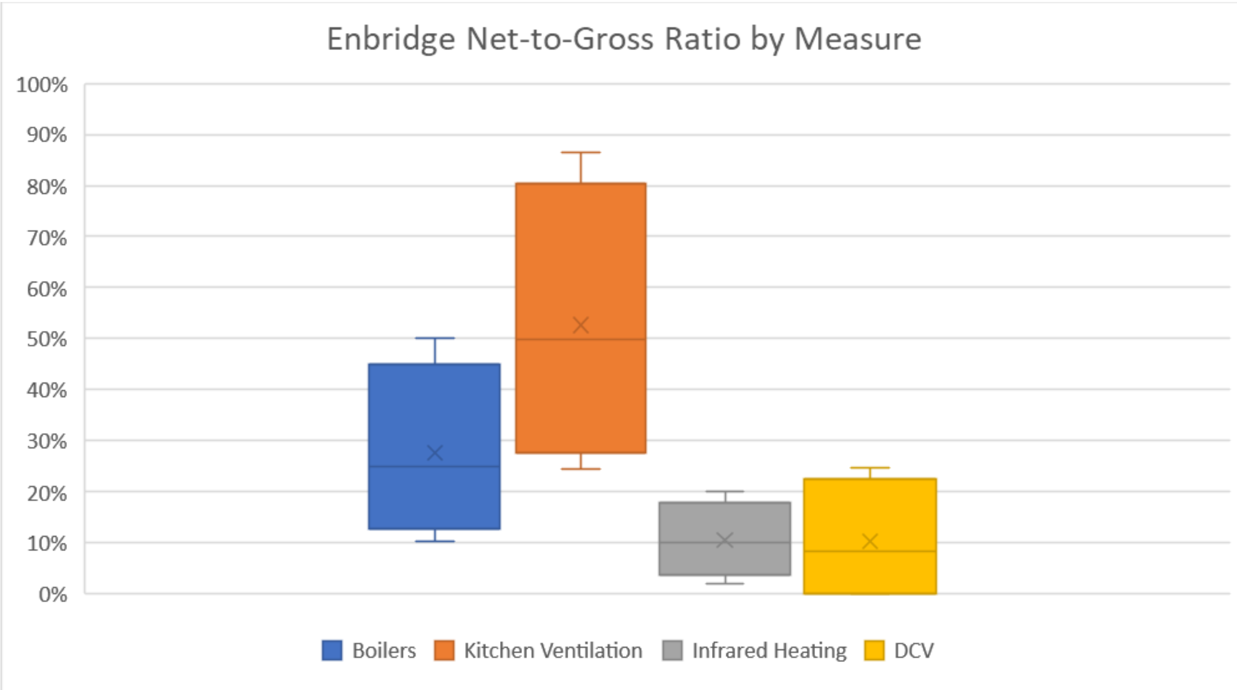
[14] Results from this study with FPC will be applied to the lost revenue calculations for the 2017 program. Those without FPC will be applied to future study year shareholder incentive and lost revenue calculations.

TABLE D-2: ENBRIDGE NET-TO-GROSS RESULTS

Priority Measure Group	Free Ridership Rate	Spillover	NTGR	90% Confidence Interval			Absolute Precision (w/ FPC) (+/-)	Absolute Precision (w/o FPC) (+/-)
			= [(1-FR) + SO]	+/-	Lower Bound	Upper Bound		
Boilers	70%	0%	**30%**	20%	10%	50%	17%	21%
Kitchen Ventilation	38%	0%	**62%**	24%	38%	86%	24%	26%
Infrared Heating	89%	0%	**11%**	9%	2%	20%	9%	10%
DCV	92%	0%	**8%**	17%	0%	25%	13%	21%

The NTG ratios along with their confidence intervals are presented in Figure D-3, which displays the results at 90% confidence, meaning that the probability that the true NTGR is within the confidence interval range is 90%. Unlike the variation seen with the gross realization rates, the variation seen with the NTGR are higher due to the larger range of customer responses regarding program influence. For example, the variation seen with infrared heating interview responses is lower than the variation of interview responses for other measures. This indicates that customers generally had similar interview responses, where the NTGR for each project remained +/- 9% within the average NTGR value of 8%.

FIGURE D-3: ENBRIDGE NET-TO-GROSS RESULTS



The breakdown of the components of the NTG score is summarized below in Table D-3. Not all measures have the efficiency component Only customers with Boiler projects were asked the efficiency questions.

Of the sampled group of projects, 47% responded that timing, efficiency, and quantity had no influence on their decision to purchase the equipment under the Enbridge Prescriptive Program. Of the remaining 53%, 89% indicated that they were influenced by timing, and 24% indicated that they were influenced by quantity. Of the Boilers Priority Measure Group respondents that were asked the efficiency question, 16% indicate that efficiency was a factor of influence.

Itron

TABLE D-3: ENBRIDGE TEQ OVERVIEW

Timing	Efficiency*	Quantity	Customers**	Projects
YES	YES	YES	0	0
YES	YES	NO	2	2
YES	NO	YES	0	0
YES	NO	NO	2	4
NO	YES	YES	0	0
NO	YES	NO	1	1
NO	NO	YES	1	3
NO	NO	NO	7	9
YES	NA	YES	2	6
YES	NA	NO	10	21
NO	NA	YES	0	0
NO	NA	NO	15	24
	Total		**40**	**70**

* Efficiency levels not asked for all measures.

** A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

An overview of the Enbridge timing, efficiency, and quantity data collection responses are listed below in Table D-4, Table D-5, and Table D-6 respectively. Detailed results by Priority Measure Group are presented in the subsequent tables (Table D-7 through Table D-15).

Based on table values, Enbridge had the most impact on helping customers accelerate their purchases, increasing the scope of the project, or right-sizing the equipment, while Enbridge had much less impact on the efficiency of the equipment.

Of the technologies Enbridge influenced, Kitchen Ventilation had a substantial number of sampled projects that were influenced by timing, and quantity, where ~38% of sampled projects would not have taken place at all without the influence of the program (full attribution). Regarding the timing question, ~42% of infrared heaters, and ~52% of DCV sampled projects would have installed the equipment at a later time without the program. The Boilers Priority Measure Group did not show as much influence as the other measure groups in regard to the timing question, where only ~26% of sampled projects were accelerated.

TABLE D-4: ENBRIDGE TIMING OVERVIEW

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	24	37	None
Later	Months (Cap at 48 mo.)	11	23	0-4 (mo. Converted to years)
	Don't Know/ Refused	2	3	Timing Attribution of avg. of DAT1b
Never	NA	2	6	Full
Don't Know/Refused	NA	1	1	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-5: ENBRIDGE EFFICIENCY OVERVIEW

Dat2a. Without the utility, would you have installed the same, higher, or lower efficiency?

Dat2b. Without the utility, what efficiency would you have installed?

Dat2a	Dat2b	Customers*	Projects	Efficiency Attribution
Same	NA	10	16	None
Lower	Standard Efficiency	3	3	Full
	Between Standard and High	0	0	Half
	Don't know / Refused	0	0	Average of Dat2b
Don't Know/Refused	NA	0	0	Average of Dat2a
Not Applicable	NA	27	51	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-6: ENBRIDGE QUANTITY OVERVIEW

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	30	52	None

Less	% Less	2	4	(% Less)/(1 + % Less)
	Don't know / Refused	2	3	Average of DAT3a
More	% More	1	2	% More
	Don't know / Refused	2	2	Average of DAT3a
None	NA	2	6	Full
Don't Know/Refused	NA	1	1	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

D.2.1 Enbridge Boilers: Timing, Efficiency, Quantity Response Summary

TABLE D-7: TIMING ENBRIDGE BOILERS

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	9	13	None
Later	Months (Cap at 48 mo.)	3	5	0-4 (mo. Converted to years)
	Don't Know/ Refused	0	0	Timing Attribution of avg. of DAT1b
Never	NA	0	0	Full
Don't Know/Refused	NA	1	1	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-8: EFFICIENCY ENBRIDGE BOILERS

Dat2a. Without the utility, would you have installed the same, higher, or lower efficiency?

Dat2b. Without the utility, what efficiency would you have installed?

Dat2a	Dat2b	Customers*	Projects	Efficiency Attribution
Same	NA	10	16	None
Lower	Standard Efficiency	3	3	Full
	Between Standard and High	0	0	Half
	Don't know / Refused	0	0	Average of Dat2b
Don't Know/Refused	NA	0	0	Average of Dat2a

Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-9: QUANTITY ENBRIDGE BOILERS

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	11	15	None
Less	% Less	1	3	(% Less)/(1 + % Less)
	Don't know / Refused	0	0	Average of DAT3a
More	% More	0	0	% More
	Don't know / Refused	1	1	Average of DAT3a
None	NA	0	0	Full
Don't Know/Refused	NA	0	0	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

D.2.2 Enbridge Kitchen Ventilation: Timing, Quantity Response Summary

TABLE D-10: TIMING ENBRIDGE KITCHEN VENTILATION

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	6	6	None
Later	Months (Cap at 48 mo.)	1	1	0-4 (mo. Converted to years)
	Don't Know/ Refused	2	3	Timing Attribution of avg. of DAT1b
Never	NA	2	6	Full
Don't Know/Refused	NA	0	0	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-11: QUANTITY ENBRIDGE KITCHEN VENTILATION

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	7	7	None
Less	% Less	0	0	(% Less)/(1 + % Less)
	Don't know / Refused	1	2	Average of DAT3a
More	% More	0	0	% More
	Don't know / Refused	1	1	Average of DAT3a
None	NA	2	6	Full
Don't Know/Refused	NA	0	0	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

D.2.3 Enbridge Infrared Heating: Timing, Quantity Response Summary

TABLE D-12: TIMING ENBRIDGE INFRARED HEATING

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	7	7	None
Later	Months (Cap at 48 mo.)	5	5	0-4 (mo. Converted to years)
	Don't Know/ Refused	0	0	Timing Attribution of avg. of DAT1b
Never	NA	0	0	Full
Don't Know/Refused	NA	0	0	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-13: QUANTITY ENBRIDGE INFRARED HEATING

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	9	9	None
Less	% Less	1	1	(% Less)/(1 + % Less)
	Don't know / Refused	1	1	Average of DAT3a
More	% More	0	0	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	0	0	Full
Don't Know/Refused	NA	1	1	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

D.2.4 Enbridge DCV: Timing, Quantity Response Summary

TABLE D-14: TIMING ENBRIDGE DCV

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	2	11	None
Later	Months (Cap at 48 mo.)	2	12	0-4 (mo. Converted to years)
	Don't Know/ Refused	0	0	Timing Attribution of avg. of DAT1b
Never	NA	0	0	Full
Don't Know/Refused	NA	0	0	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE D-15: QUANTITY ENBRIDGE DCV

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	3	21	None
Less	% Less	0	0	(% Less)/(1 + % Less)
	Don't know / Refused	0	0	Average of DAT3a
More	% More	1	2	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	0	0	Full
Don't Know/Refused	NA	0	0	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

D.3 ENBRIDGE INDIRECT INFLUENCE

D.3.1 Vendor to Participant Influence

The decision to pursue a vendor interview is dependent on participant questions VT1 and VT2. VT1, VT2, and VT3 are the participant's scores for upselling, price, and other influence respectively. Combined, all three scores total to 100%. VT1, VT2, and VT3 ask the following:

> Now, I am going to ask you some questions about factors that influenced your decision-making process. If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:

- VT1. <Vendor> recommendation regarding equipment selection?
  - VT1a. What specific recommendations did <Vendor> provide that influenced your decision to purchase the equipment?
- VT2. Price of the equipment
  - VT2x. I would like to get a sense of your price sensitivity for the equipment. Let's say the project would have cost <20% vendor rebate in dollars> more, would you have still done it? What about <40% vendor rebate in dollars>? What about <60% vendor rebate in dollars>? <80% vendor rebate in dollars>? <100% vendor rebate in dollars>?
- VT3. All other influences
  - VT3a. What other factors influenced your decision to purchase the equipment?

How Participants Trigger Vendor Interviews

When the sum points of VT1 and VT2 are greater than 50%, given that VT1>0 and/or VT2x is valid (participant indicates that the additional amount they would spend on the equipment is equal to or less than the vendor rebate), then that vendor is given priority to be contacted for an interview.

These vendors are prioritized by being the first group of vendors to dial, with more allotted calling attempts (6 attempts). Participants that allocate VT1+VT2 with less points are also contacted after the high priority vendors are contacted.

Vendors with participant VT1+VT2 scores ranked less than 30% were generally not contacted, unless those vendors happened to overlap with a vendor of a different customer with a high score. Vendor interviews were scheduled after the NTG IDI is completed. Also, if the participant NTG ratio was already 1.0, then the vendor was not contacted for an interview.

Distribution of Participant Responses on Upselling and Price (VT1 & VT2)

The distribution of VT1 and VT2 responses are displayed in Table D-16 and Table D-17. Of VT1 upselling responses, 92% of sampled projects allocate 50% or less points to upselling.

TABLE D-16: ENBRIDGE CUSTOMER DISTRIBUTION OF VT1, VT2, & VT3 POINT ALLOCATION

	VT1	VT2	VT3
0-10%	7	5	15
11-20%	4	3	8
21-30%	6	10	5
31-40%	5	11	3
41-50%	9	9	8
51-60%	6	0	1
61-70%	0	1	0
71-80%	1	1	0
81-90%	0	0	0
91-100%	2	0	0
Total Customers	**40**	**40**	**40**

TABLE D-17: PERCENT OF SAVINGS OF ENBRIDGE PROJECTS WITH VENDOR TO PARTICIPANT INFLUENCE (VT1)

	% Energy Savings Influenced by Vendor
Fully Influenced (VT1 100%)	2%
High Influence (VT1 76-99%)	2%
Moderate Influence (VT1 51-75%)	4%
Low Influence (VT1 1-50%)	64%
No Influence (VT1 0%)	28%

In order to receive price attribution, the additional amount that the customer would spend on the energy efficient equipment must be less than the amount of vendor rebate that the vendor passes to the customer. Once these criteria are met, the price attribution is VT2, the amount of points the participant allocates to price.

The following eight customers represented in Table D-18 indicated that the additional amount they would spend was equal to or less than the vendor rebate. The vendors for these customers were given high priority contact for an interview. However, if there was no vendor, or the participant already received full attribution from the TEQ score, then the vendor was not contacted.

TABLE D-18: ENBRIDGE VT2 PRICE RESPONSES

Questions to customers:				
If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:				
VT1. <Vendor> recommendation regarding equipment selection?				
VT2. Price of the equipment				
VT3. Other				
VT2	Customers*	Average Vendor Rebate ($)	Avg Additional Amount Customer Would Spend ($)	Average VT1 Score
0-20%	1	200	160	0.8
21-40%	6	415	220	0.44

41-60%	1	100	20	0.5
61-80%	0	-	-	-
81-100%	0	-	-	-

D.3.2 Utility to Vendor Influence

Vendor Surveys Data Collection

Ten Enbridge vendors completed interviews representing 14 projects. There were five participants that did not purchase program qualifying equipment through a vendor. Twenty vendors were contacted without success. Five vendors were not contacted.

TABLE D-19: ENBRIDGE VENDOR SURVEY DATA COLLECTION – COMPLETES

	# Vendors	# Projects
Completed	10	14

There were five vendors where Itron did not attempt an interview due to varying reasons such as participant score being 1.0, or if the VT1+VT2 scores were <30%, or due to the timing of the interview. Table D-20 provides the summary of the data collection disposition of vendor surveys that we could not complete.

TABLE D-20: ENBRIDGE VENDOR SURVEY DATA COLLECTION – NOT COMPLETED

	No Vendor	Attempted, Not Completed # Vendors in Participant Sample	Not Attempted # Vendors in Participant Sample
Not Completed	5	20	5

Vendor Survey Questions & Responses

A vendor interview is triggered if a customer reports that the vendor recommendation(upselling) or price had influenced their decision (Indirect path B). Then, the vendor is also asked questions regarding upselling and price (Indirect path A). Indirect attribution from both path A and path B are used in the final indirect attribution score.

Upselling

Upselling refers to the influence of the vendor on the customer due to the vendor's recommendation to consider program qualifying equipment over other options, like less efficiency equipment or doing nothing at all, in the case of add-on measures. If the customer allocates any points to upselling, the customer is asked to explain the recommendations the vendor provided to assist their decision. If the vendor interview is triggered, the following questions are asked of the vendor:

3. U2: "In situations where you are selling <project_n>, about what percent of the time are you recommending the high-efficiency equipment?"
4. U4: "For <project_n> measure, what percent of the time would you recommend the high-efficiency equipment option without the program?"

Price

The purpose of this question is to see if any vendor rebate passed onto the customer has an influence on the customer's decision to participate in the program. If the customer allocates any points to pricing, follow up questions are asked, where the customer must identify if their involvement in the project would change due to increase in cost by incremental amounts of the vendor incentive – either by 20%, 40%, 60%, 80% or 100% of the vendor incentive.

If the vendor interview is triggered, then the vendor is asked the following question:

2. P5: "On average, what percent of the rebate is passed on to the buyer for <project_n>, either directly or indirectly?"

The responses of ten participants with vendors that completed an interview are listed in Table D-21. Five of the ten participants received positive vendor attribution scores, with one participant receiving a score of 1.0. Only one score received price attribution, while the source of the other scores were from upselling.

TABLE D-21: ENBRIDGE VENDOR COMPLETES RESPONSES AND RESULTS

Questions to customers:								
If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:								
VT1. <Vendor> recommendation regarding equipment selection?								
VT2. Price of the equipment								
VT3. Other								
Questions to vendors:								
U2: "In situations where you are selling <project_n>, about what percent of the time are you recommending the high-efficiency equipment?"								
U4: "For <project_n> measure, what percent of the time would you recommend the high-efficiency equipment option without the program?								
P5: "On average, what percent of the rebate is passed on to the buyer for <project_n>, either directly or indirectly?"								
Priority Measure Group	**VT 1.**	**VT 2.**	**U 2**	**U 4**	**P5**	**Upselling Attribution (VT1 * (U2-U4)/U4)**	**Price Attribution (if P5 * Vendor Rebate > Amt more cust would pay, then VT2)**	**Vendor Indirect Attribution**
Kitchen Ventilation	1	0	1	0	1	1	0	1
Kitchen Ventilation	0.5	0.3	0.8	0.5	NA	0.1875	0	0.1875
Infrared	0.6	0.3	1	1	1	0	0.3	0.3
Kitchen Ventilation	0.25	0.5	1	0	1	0.25	0	0.25
Kitchen Ventilation	0.5	0.3	1	1	0	0	0	0
DCV	0.2	0.2	0.8	1	NA	0	0	0
Kitchen Ventilation	0.5	0.5	0.1	0.1	REF	0	0	0
Infrared	0.1	0.4	0	0	DK	0	0	0
Infrared	0.6	0	0.5	0.5	0	0	0	0
Kitchen Ventilation	0.2	0.3	0.8	0.5	NA	0.075	0	0.075

D.4 ENBRIDGE SPILLOVER

Participants were asked the spillover battery of questions, of which the responses for five participants indicated possible spillover. Upon further inquiries (based on the skip patterns in the survey guide), it was evident that none of the spillover responses were indicative of actual spillover. This was either due to the participants receiving (or being in the process of applying for) an incentive for a completed measure(s), or due to them indicating that participating in the 2017 C&I prescriptive program had no influence on their pursuit of the completed measure(s). None of these five participants needed an engineer's call-back to quantify the effect of spillover.

Only one respondent indicated that they did not receive any incentives for a completed measure, triggering both inside and outside spillover probes. When asked about the likelihood of pursuing this additional energy efficiency measure, the customer responded, "very likely", which implied an attribution factor=0.00 for participant spillover; therefore, we did not pursue a call-back to quantify the effect of spillover for this respondent.

Attribution of claimed spillover is based on the following 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 Attribution Factor is assigned in the following way:

1. Not likely at all- Attribution Factor=1.00
2. Not very likely- Attribution Factor=0.90
3. Somewhat likely- Attribution Factor=0.55
4. Very likely- Attribution Factor=0.00

Spillover Savings = Estimate Spillover Measure Savings X Attribution Factor

The findings from spillover battery are provided below in Table D-22 for inside spillover responses and in Table D-23 for outside spillover responses.

TABLE D-22: ENBRIDGE INSIDE SPILLOVER RESPONSES

Enbridge Program with Incentive	Incentive Through Electric Utility	Not a Source of Spillover	Action Inside Spillover	Timing Inside Spillover	Incentive Inside Spillover	Source Inside Spillover	Score Inside Spillover
1	0	0	HVAC and Boiler	2017	Yes	Enbridge	2
0	1	0	Lighting	2018	Yes	Electric Utility	4
0	1	0	HVAC	2018	Yes	Electric Utility	4
1	0	0	Boiler	2018	In progress	Enbridge	4
0	0	1	Envelope	2017	No		NA

TABLE D-23: ENBRIDGE OUTSIDE SPILLOVER RESPONSES

Enbridge Program with Incentive	Incentive Through Electric Utility	Not a Source of Spillover	Action Outside Spillover	Timing Outside Spillover	Incentive Outside Spillover	Source Outside Spillover	Score Outside Spillover
1	0	0	DCKV	2018	Yes	Enbridge	0
0	0	1	Water Conservation				0
1	0	0	Envelope	2018	In progress	Enbridge	NA
0	0	1	Envelope	2017	No		NA

APPENDIX E – UNION GROSS IMPACT REPORTS

E.1 BOILERS

Union_Boilers_Final.pdf

E.2 ENERGY RECOVERY VENTILATION

Union_ERV_Final.pdf

E.3 INFRARED HEATING

Union_Infrared Heating_Final.pdf

E.4 AIR CURTAINS

Union_Air Curtains_Final.pdf

APPENDIX F – UNION NTG STUDY DETAILS

F.1 UNION NET-TO-GROSS DATA COLLECTION

The Net-to-Gross analysis for Union was conducted for the following four Priority Measure Groups:

- Boilers
- ERV
- Infrared Heating
- Air Curtains

The number targeted completes for Union NTG data collection (146) was determined using a 90/10 relative precision with a CoV of 0.8, as detailed on pages 2-24 and 2-25 of the embedded workplan in Appendix A. Due to lower than expected response rates, a total of 127 of the targeted 146 projects completed NTG interviews.

Some customers represented multiple projects. The 127 completed NTG interviews entailed 100 customers. Of the data collection not completed, 130 projects attempted a NTG interview without success, while dialing was not attempted on 255 boiler and infrared heating projects.

The verified lifecycle savings of projects with completed NTG data collection represents at total of 37,018,493 CCM, which is approximately 20% of total population savings in 2017, on a lifecycle CCM basis.

Across all four Union Priority Measure Groups, vendors for 25 projects completed a vendor NTG survey. Table F-1 summarizes Union NTG data collection.

TABLE F-1: UNION NET-TO-GROSS DATA COLLECTION

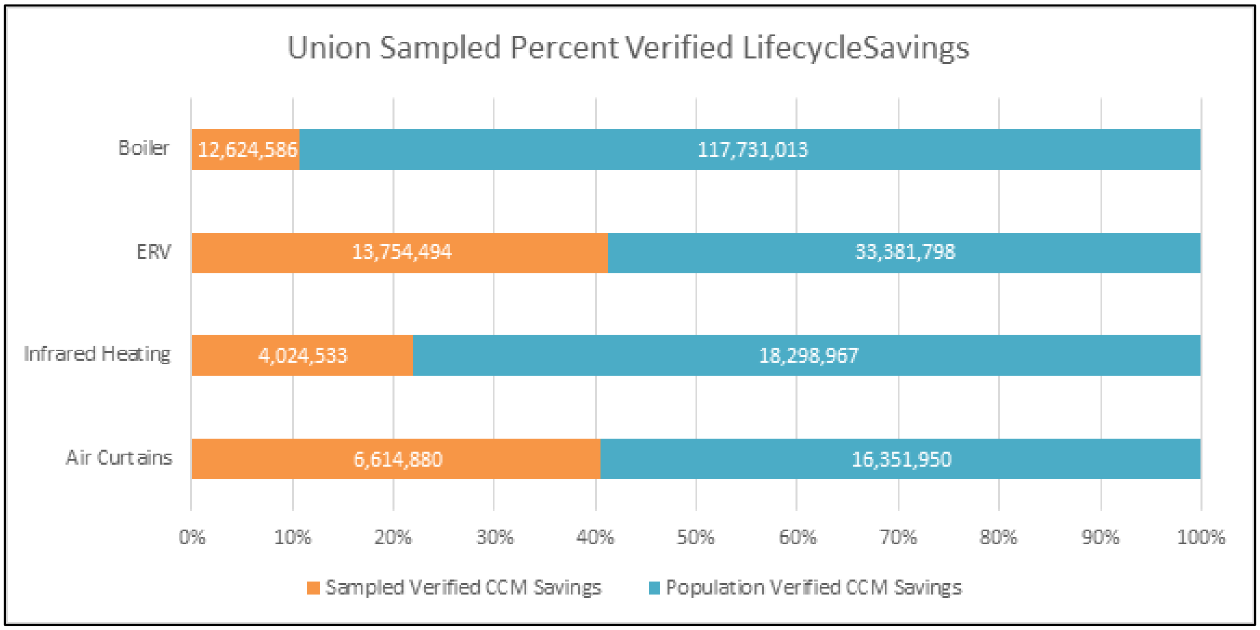
	Total Pop			Target	Completed				Not Completed	
Priority Measure Group	Number of Projects	Number of Unique Customers	Lifecycle Verified CCM of Population	Number of Projects	Number of Projects	Number of Unique Customers*	Lifecycle Verified CCM of Survey Completes	Vendor Survey Completes (# Projects)**	Attempted, Not Completed # Projects	Not Attempted # Projects
Boiler	380	350	117,731,013	44	41	32	12,624,586	5	63	276
ERV	53	49	33,381,798	40	45	30	13,754,494	11	8	0
Infrared Heating	184	179	18,298,967	43	28	28	4,024,533	5	34	122
Air Curtains	28	26	16,351,950	19	13	10	6,614,880	4	15	0
Total	645	604	185,763,728	146	127	100	37,018,493	25	120	398

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

** A vendor can appear multiple times if their responses varied by measures, resulting in a total greater than the number of vendors interviewed.

Figure F-1 displays the proportion of sampled verified lifecycle CCM savings in relation to the population verified lifecycle CCM savings for Union. NTG survey data encompasses ~11% of Boiler population savings, ~41% of ERV population savings, ~22% of Infrared Heating population savings, and ~40% of Air Curtain population savings.

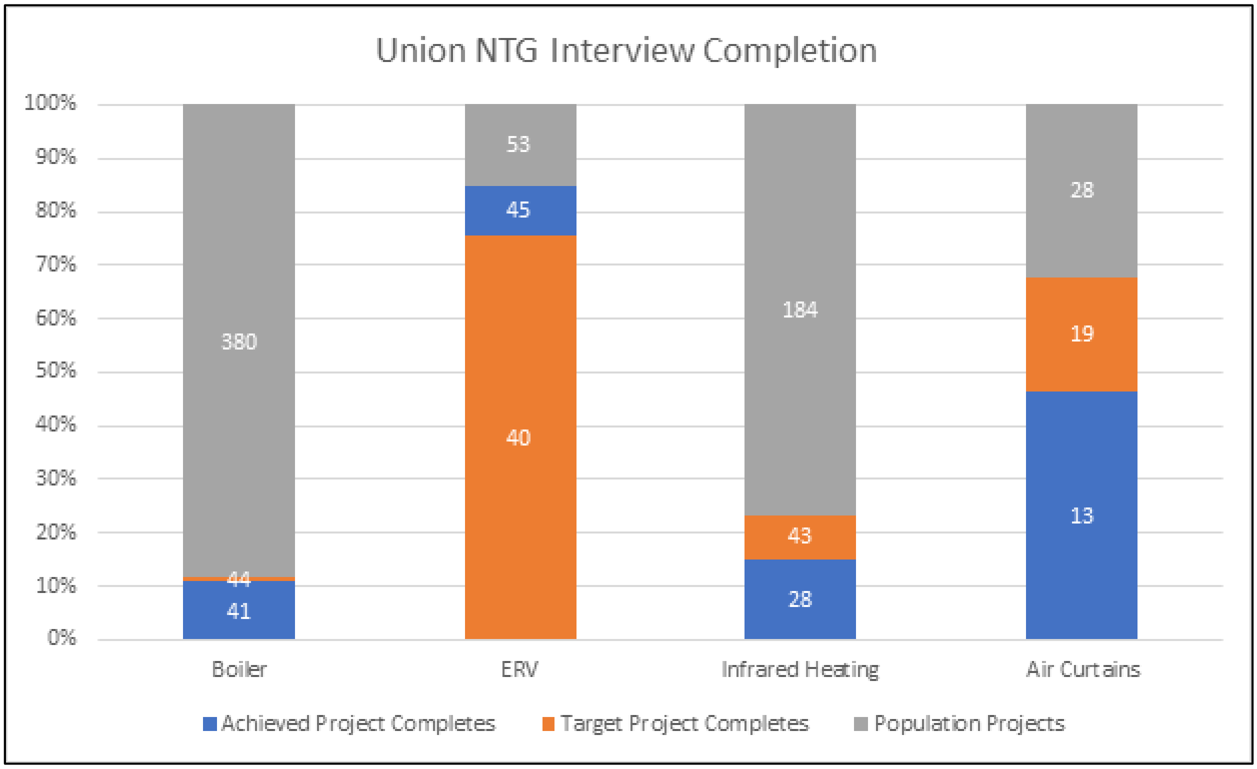
FIGURE F-1: UNION NET-TO-GROSS SAMPLED PERCENT VERIFIED LIFECYCLE SAVINGS



In Figure F-2, the achieved NTG survey completes are compared to targets in relation to the overall population.

- The target number of completed Boiler surveys was 44, while 41 were achieved. Approximately 11% of the population of Boiler projects was sampled.
- The target number of completed ERV surveys was 40, while 45 were achieved. Approximately 85% of the population of ERV projects was sampled.
- The target number of completed Infrared Heating surveys was 43, while 28 were achieved. Approximately 15% of the population of Infrared Heating projects was sampled.
- The target number of completed Air Curtain surveys was 19, while 13 were achieved. Approximately 50% of the population of Air Curtain projects was sampled.

FIGURE F-2: UNION NET-TO-GROSS INTERVIEW COMPLETION



*Note that the project counts in the figure above are cumulative, where the top value includes the counts of the bottom value.

F.2 UNION NET-TO-GROSS RATIOS

Table F-2 summarizes Enbridge NTG ratios along with confidence interval and absolute precision statistics. The free-ridership ratio is 76% for Boilers measure group, 70% for the ERV measure group, 93% for the Infrared Heating measure group, and 50% for the Air Curtains measure group. Based on the participant IDIs, no evidence of spillover was found in the analysis. Therefore, the Net-to-Gross ratios are 24%, 30%, 7%, and 50% respectively for Boilers, ERV, Infrared Heating, and Air Curtains.

Absolute precisions are calculated with and without FPC[15]. The absolute precisions with the FPC are 9%, 8%, 6%, and 19% respectively for Boilers, ERV, Infrared Heating, and Air Curtains. The absolute precisions without the FPC are 9%, 13%, 6%, and 24% respectively for Boilers, ERV, Infrared Heating, and Air Curtains.

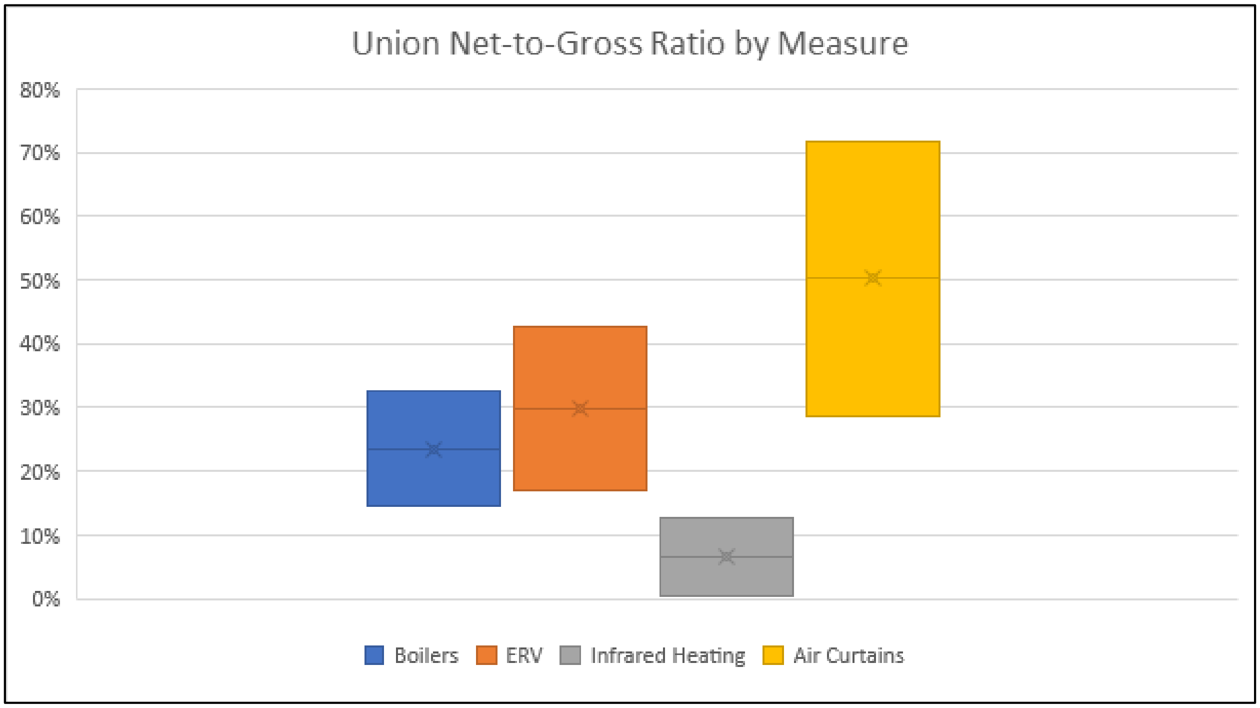
TABLE F-2: UNION NET-TO-GROSS RESULTS

Priority Measure Group	Free Ridership Rate	Spillover	NTGR	90% Confidence Interval			Absolute Precision (w/ FPC) (+/-)	Absolute Precision (w/o FPC) (+/-)
			= [(1 – FR) + SO]	+/-	Lower Bound	Upper Bound		
Boilers	76%	0%	**24%**	9%	15%	32%	9%	9%
ERV	70%	0%	**30%**	13%	17%	43%	8%	13%
Infrared Heating	93%	0%	**7%**	6%	1%	13%	6%	6%
Air Curtains	50%	0%	**50%**	22%	29%	72%	19%	24%

The Net-To-Gross results along with their confidence intervals are presented in Figure F-3, which displays the results at 90% confidence, meaning that the probability that the true NTGR is within the confidence interval range is 90%. Unlike the variation seen with the gross realization rates, the variation seen with the NTGR are higher due to the larger range of customer responses regarding program influence. For example, the variation seen with infrared heating interview responses is lower than the variation of interview responses for other measures. This indicates that customers generally had similar interview responses, where the NTGR for each project remained +/- 6% within the average NTGR value of 7%.

[15] Results from this study with FPC will be applied to the lost revenue calculations for the 2017 program. Those without FPC will be applied to future study year shareholder incentive and lost revenue calculations.

FIGURE F-3: UNION NET-TO-GROSS RESULTS



The breakdown of the components of the NTG score is summarized below in Table F-3. Not all measures have the efficiency component on a bracketed basis (i.e., providing actual range of values). Only customers with Boilers and some ERV projects were asked the bracketed efficiency questions.

Of the sampled group of projects, 60% responded that timing, efficiency, and quantity had no influence on their decision to purchase the equipment under the Union Prescriptive Program. Of the remaining 40%, 78% indicate that they were influenced by timing, and 8% indicate that they were influenced by quantity. Of the Boilers and ERV Priority Measure Group respondents that were asked the efficiency question that had program influence, 26% indicate that efficiency was a factor of influence.

TABLE F-3: UNION TEQ OVERVIEW

Timing	Efficiency*	Quantity	Customers**	Projects
YES	YES	YES	1	1
YES	YES	NO	6	7
YES	NO	YES	1	1
YES	NO	NO	11	16
NO	YES	YES	0	0
NO	YES	NO	7	11
NO	NO	YES	0	0
NO	NO	NO	30	38
YES	NA	YES	2	2
YES	NA	NO	10	13
NO	NA	YES	0	0
NO	NA	NO	32	38
Total			**100**	**127**

* Efficiency not asked for all measures.

** A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

An overview of the Union timing, efficiency, and quantity data collection responses are listed below in Table F-4, Table F-5, and Table F-6, respectively. Detailed results by Priority Measure Group are presented in the subsequent tables (Table F-7 through Table F-16). Based on table values, Union influenced ~27% of sampled projects overall with regards to timing, ~15% of sampled projects in regard to efficiency, and ~10% of sampled projects with regards to quantity. Boilers and air curtains were influenced the most by Union. Regarding the timing question, ~46% of boilers, and ~69% of air curtain sampled projects would have installed the equipment at a later time without the program.

TABLE F-4: UNION TIMING OVERVIEW

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	69	87	None
Later	Months (Cap at 48 mo.)	16	20	0-4 (mo. Converted to years)
	Don't Know/ Refused	3	3	Timing Attribution of avg. of DAT1b
Never	NA	7	11	Full
Don't Know/Refused	NA	5	6	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-5: UNION EFFICIENCY OVERVIEW

Dat2a. Without the utility, would you have installed the same, higher, or lower efficiency?

Dat2b. Without the utility, what efficiency would you have installed?

Dat2a	Dat2b	Customers*	Projects	Efficiency Attribution
Same	NA	36	46	None
Lower	Standard Efficiency	4	5	Full
	Between Standard and High	4	5	Half
	Don't know / Refused	6	9	Average of Dat2b
Don't Know/Refused	NA	6	9	Average of Dat2a
Not Applicable	NA	44	53	Not Asked

TABLE F-6: UNION QUANTITY OVERVIEW

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	79	99	None
Less	% Less	5	6	(% Less)/(1 + % Less)
	Don't know / Refused	3	3	Average of DAT3a
More	% More	3	3	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	1	1	Full
Don't Know/Refused	NA	9	15	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

F.2.1 Union Boilers: Timing, Efficiency, Quantity Response Summary

TABLE F-7: TIMING UNION BOILERS

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	20	27	None
Later	Months (Cap at 48 mo.)	8	9	0-4 (mo. Converted to years)
	Don't Know/ Refused	1	1	Timing Attribution of avg. of DAT1b
Never	NA	2	3	Full
Don't Know/Refused	NA	1	1	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-8: EFFICIENCY UNION BOILERS

Dat2a. Without the utility, would you have installed the same, higher, or lower efficiency?

Dat2b. Without the utility, what efficiency would you have installed?

Dat2a	Dat2b	Customers*	Projects	Efficiency Attribution
Same	NA	22	26	None
Lower	Standard Efficiency	0	0	Full
	Between Standard and High	2	2	Half
	Don't know / Refused	3	5	Average of Dat2b
Don't Know/Refused	NA	5	8	Average of Dat2a
Not Applicable	NA	0	0	Not Asked

*A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-9: QUANTITY UNION BOILERS

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	26	32	None
Less	% Less	2	3	(% Less)/(1 + % Less)

	Don't know / Refused	0	0	Average of DAT3a
More	% More	0	0	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	0	0	Full
Don't Know/Refused	NA	3	5	Average of DAT3
Not Applicable	NA	1	1	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

F.2.2 Union ERV: Timing, Efficiency, Quantity Response Summary

TABLE F-10: TIMING UNION ERV

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	22	33	None
Later	Months (Cap at 48 mo.)	3	4	0-4 (mo. Converted to years)
	Don't Know/ Refused	0	0	Timing Attribution of avg. of DAT1b
Never	NA	4	7	Full
Don't Know/Refused	NA	1	1	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-11: EFFICIENCY UNION ERV

Dat2a. Without the utility, would you have installed the same, higher, or lower efficiency?

Dat2b. Without the utility, what efficiency would you have installed?

Dat2a	Dat2b	Customers*	Projects	Quantity Attribution
Same	NA	14	20	None
Lower	Standard Efficiency	4	5	Full
	Between Standard and High	2	3	Half
	Don't know / Refused	3	4	Average of Dat2b
Don't Know/Refused	NA	1	1	Average of Dat2a
Not Applicable	NA	6	12	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-12: QUANTITY UNION ERV

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	23	37	None
Less	% Less	1	1	(% Less)/(1 + % Less)
	Don't know / Refused	2	2	Average of DAT3a
More	% More	1	1	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	1	1	Full
Don't Know/Refused	NA	1	2	Average of DAT3
Not Applicable	NA	1	1	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

F.2.3 Union Infrared Heating: Timing, Quantity Response Summary

TABLE F-13: TIMING UNION INFRARED HEATING

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	25	25	None
Later	Months (Cap at 48 mo.)	0	0	0-4 (mo. Converted to years)
	Don't Know/ Refused	0	0	Timing Attribution of avg. of DAT1b
Never	NA	1	1	Full
Don't Know/Refused	NA	2	2	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-14: QUANTITY UNION INFRARED HEATING

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	25	25	None
Less	% Less	1	1	(% Less)/ (1 + % Less)

	Don't know / Refused	1	1	Average of DAT3a
More	% More	0	0	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	0	0	Full
Don't Know/Refused	NA	1	1	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

F.2.4 Union Air Curtains: Timing, Quantity Response Summary

TABLE F-15: TIMING UNION AIR CURTAINS

Dat1a. Without the utility, how different would the timing have been?

Dat1b. Approximately how many months later?

Dat1a	Dat1b	Customers*	Projects	Timing Attribution
Same Time	NA	2	2	None
Later	Months (Cap at 48 mo.)	5	7	0-4 (mo. Converted to years)
	Don't Know/ Refused	2	2	Timing Attribution of avg. of DAT1b
Never	NA	0	0	Full
Don't Know/Refused	NA	1	2	Timing Attribution of avg. of DAT1a

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

TABLE F-16: QUANTITY UNION AIR CURTAINS

Dat3a. Without the utility, how different would the quantity/size have been?

Dat3b. By what percentage did you change the amount installed because of the utility?

Dat3a	Dat3b	Customers*	Projects	Quantity Attribution
Same	NA	5	5	None
Less	% Less	1	1	(% Less)/(1 + % Less)
	Don't know / Refused	0	0	Average of DAT3a

More	% More	2	2	% More
	Don't know / Refused	0	0	Average of DAT3a
None	NA	0	0	Full
Don't Know/Refused	NA	2	5	Average of DAT3
Not Applicable	NA	0	0	Not Asked

* A customer may appear multiple times if their responses varied by measures, resulting in a total greater than the number of customers interviewed.

F.3 UNION VENDOR SURVEYS AND RESULTS

The decision to pursue a vendor interview is dependent on participant questions VT1 and VT2. VT1, VT2, and VT3 are the participant's scores for upselling, price, and other influence respectively. Combined, all three scores total to 100%. VT1, VT2, and VT3 ask the following:

> Now, I am going to ask you some questions about factors that influenced your decision-making process. If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:

- VT1. <Vendor> recommendation regarding equipment selection?
  - VT1a. What specific recommendations did <Vendor> provide that influenced your decision to purchase the equipment?
- VT2. Price of the equipment
  - VT2x. I would like to get a sense of your price sensitivity for the equipment. Let's say the project would have cost <20% vendor rebate in dollars> more, would you have still done it? What about <40% vendor rebate in dollars>? What about <60% vendor rebate in dollars>? <80% vendor rebate in dollars>? <100% vendor rebate in dollars>?
- VT3. All other influences
  - VT3a. What other factors influenced your decision to purchase the equipment?

How Participants Trigger Vendor Interviews

When the sum points of VT1 and VT2 are greater than 50%, given that VT1>0 and/or VT2x is valid (participant indicates that the additional amount they would spend on the equipment is equal to or less than the vendor rebate), then that vendor is given priority to be contacted for an interview.

These vendors are prioritized by being the first group of vendors to dial, with more allotted calling attempts (6 attempts). Participants that allocate VT1+VT2 with less points are also contacted after the high priority vendors are contacted.

Vendors with participant VT1+VT2 scores ranked less than 30% were generally not contacted, unless those vendors happened to overlap with a vendor of a different customer with a high score. Vendor interviews were scheduled after the NTG IDI is completed. Also, if the participant NTG ratio was already 1.0, then the vendor was not contacted for an interview.

Distribution of Participant Responses on Upselling and Price (VT1 & VT2)

The distribution of VT1 and VT2 responses are displayed in Table F-17 and Table F-18. Of VT1 upselling responses, 74% of sampled projects allocate 50% or less points to upselling.

TABLE F-17: UNION CUSTOMER DISTRIBUTION OF VT1, VT2, & VT3 POINT ALLOCATION

	VT1	VT2	VT3
0-10%	16	28	49
11-20%	4	10	18
21-30%	6	24	16
31-40%	15	13	5
41-50%	23	19	5
51-60%	4	1	1
61-70%	8	0	0
71-80%	10	3	2
81-90%	3	2	1
91-100%	11	0	3
Total Customers	**100**	**100**	**100**

TABLE F-18: PERCENT OF SAVINGS OF UNION PROJECTS WITH VENDOR TO PARTICIPANT INFLUENCE (VT1)

	% Energy Savings Influenced by Vendor
Fully Influenced (VT1 100%)	8%
High Influence (VT1 76-99%)	5%
Moderate Influence (VT1 51-75%)	14%
Low Influence (VT1 1-50%)	60%
No Influence (VT1 0%)	14%

In order to receive price attribution, the additional amount that the customer would spend on the energy efficient equipment must be less than the amount of vendor rebate that the vendor passes to the customer. Once these criteria are met, the price attribution is VT2, the amount of points the participant allocates to price.

The following 15 customers represented in Table F-19 indicated that the additional amount they would spend was equal to or less than the vendor rebate. The vendors for these customers were given high priority contact for an interview. However, if there was no vendor, or the participant already received full attribution from the TEQ score, then the vendor was not contacted.

TABLE F-19: UNION VT2 PRICE RESPONSES

Questions to customers:				
If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:				
VT1. <Vendor> recommendation regarding equipment selection?				
VT2. Price of the equipment				
VT3. Other				
VT2	**Customers***	**Average Vendor Rebate ($)**	**Avg Additional Amount Customer Would Spend ($)**	**Average VT1 Score**
0-20%	6	400	300	0.68
21-40%	6	540	300	0.42
41-60%	2	150	130	0.48
61-80%	0	-	-	-
81-100%	1	1300	1300	0

F.3.1 Utility to Vendor Influence

Vendor Surveys Data Collection

Twenty-five Union vendors completed interviews representing 32 projects. There were five participants that did not purchase program qualifying equipment through a vendor. Fifty-four vendors were contacted without success. Fifteen vendors were not contacted.

TABLE F-20: UNION VENDOR SURVEY DATA COLLECTION – COMPLETED

	# Vendors	# Projects
Completed	25	32

There were 15 vendors where Itron did not attempt an interview due to varying reasons such as participant score being 1.0, or if the VT1+VT2 scores were <30%, or due to the timing of the interview. Table F-21 provides the summary of the data collection of vendor surveys that we could not complete.

TABLE F-21: UNION VENDOR SURVEY DATA COLLECTION – NOT COMPLETED

	No Vendor	Attempted, Not Completed # Vendors in Participant Sample	Not Attempted # Vendors in Participant Sample
Not Completed	5	54	15

Vendor Survey Questions & Responses

A vendor interview is triggered if a customer reports that the vendor recommendation(upselling) or price had influenced their decision (Indirect path B). Then, the vendor is also asked questions regarding upselling and price (Indirect path A). Indirect attribution from both path A and path B are used in the final indirect attribution score.

Upselling

Upselling refers to the influence of the vendor on the customer due to the vendor's recommendation to consider program qualifying equipment over other options, like less efficiency equipment or doing nothing at all, in the case of add-on measures. If the customer allocates any points to upselling, the customer is asked to explain the recommendations the vendor provided to assist their decision. If the vendor interview is triggered, the following questions are asked of the vendor:

5. U2: "In situations where you are selling <project_n>, about what percent of the time are you recommending the high-efficiency equipment?"
6. U4: "For <project_n> measure, what percent of the time would you recommend the high-efficiency equipment option without the program?"

Price

The purpose of this question is to see if any vendor rebate passed onto the customer has an influence on the customer's decision to participate in the program. If the customer allocates any points to pricing, follow up questions are asked, where the customer must identify if their involvement in the project would change due to increase in cost by incremental amounts of the vendor incentive – either by 20%, 40%, 60%, 80% or 100% of the vendor incentive.

If the vendor interview is triggered, then the vendor is asked the following question:

3. P5: "On average, what percent of the rebate is passed on to the buyer for <project_n>, either directly or indirectly?"

The responses of 25 participants with vendors that completed an interview are listed in Table F-22. Three of the 25 participants received positive vendor upselling attribution scores. None of the respondents received a price attribution score.

TABLE F-22: UNION VENDOR RESPONSES AND RESULTS

Questions to customers:
If you were to allocate 100 points among the various factors that influenced your decision to install the equipment you did, how many 'influence points' would you give to:
VT1. <Vendor> recommendation regarding equipment selection?
VT2. Price of the equipment
VT3. Other
Questions to vendors:
U2: "In situations where you are selling <project_n>, about what percent of the time are you recommending the high-efficiency equipment?"
U4: "For <project_n> measure, what percent of the time would you recommend the high-efficiency equipment option without the program?
P5: "On average, what percent of the rebate is passed on to the buyer for <project_n>, either directly or indirectly ?"

Priority Measure Group	VT1.	VT2.	U2	U4	P5	Upselling Attribution (VT1 * (U2-U4)/U4)	Price Attribution (if P5 * Vendor Rebate > Amt more cust would pay, then VT2)	Vendor Indirect Attribution
Infrared	0.5	0.25	0.5	0.5	NA	0	0	0
Air Curtains	0.25	0.25	0.05	0.5	NA	0	0	0
ERV	0.5	0.25	1	0.75	0	0.125	0	0.125
ERV	0.3	0.4	0.8	0.5	NA	0.1125	0	0.1125

Priority Measure Group	VT1.	VT2.	U2	U4	P5	Upselling Attribution (VT1 * (U2-U4)/U4)	Price Attribution (if P5 * Vendor Rebate > Amt more cust would pay, then VT2)	Vendor Indirect Attribution
ERV	0.9	0.1	0.7	0.7	NA	0	0	0
ERV	0.9	0.1	1	1	1	0	0	0
Boiler	1	0	1	1	DK	0	0	0
ERV	0.5	0.3	0.5	1	NA	0	0	0
Boiler	0.6	0.4	1	1	1	0	0	0
Boiler	0.5	0.5	1	DK	NA	0	0	0
Air Curtains	0.4	0.4	1	1	0	0	0	0
Infrared	0	0.25	0	0	NA	0	0	0
Infrared	0.8	0	0	0	0.5	0	0	0
Air Curtains	0	0	1	1	0	0	0	0
ERV	0.6	0.2	0.5	0.5	0	0	0	0
Air Curtains	1	0	1	1	0	0	0	0
Boiler	0	0	0.7	0.7	NA	0	0	0
Boiler	1	0	0.95	0.95	NA	0	0	0
Infrared	0.6	0.3	1	1	DK	0	0	0
Infrared	1	0	0	0	NA	0	0	0
ERV	0.95	0	0.7	0.7	NA	0	0	0
ERV	0.75	0	0.7	0.7	NA	0	0	0
ERV	0.7	0.2	1	0.85	DK	0.105	0	0.105
ERV	0.5	0.25	1	1	1	0	0	0
ERV	0.33	0.33	0.75	0.75	NA	0	0	0

F.4 UNION SPILLOVER

Participants were asked the spillover battery of questions, of which the responses for seven participants indicated possible spillover. Upon further inquiries (based on the skip patterns in the survey guide), it was evident that none of the spillover responses were indicative of actual spillover. This was either due to the participants receiving (or being in the process of applying for) an incentive for a completed measure(s), or due to the completed measure(s) being an electric fuel measure. None of these seven participants needed an engineer's call-back to quantify the effect of spillover.

Only one respondent indicated that they did not receive any incentives for a completed measure, triggering both inside and outside spillover probes. When asked about the completed measure, the customer responded that the measure is electric powered, which implied an attribution factor=0.00 for participant spillover; therefore, we did not pursue a call-back to quantify the effect of spillover for this respondent.

Attribution of claimed spillover is based on the following 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 Attribution Factor is assigned in the following way:

1. Not likely at all- Attribution Factor=1.00
2. Not very likely- Attribution Factor=0.90
3. Somewhat likely- Attribution Factor=0.55
4. Very likely- Attribution Factor=0.00

Spillover Savings = Estimate Spillover Measure Savings X Attribution Factor

The findings from spillover battery are provided below in Table F-23 for inside spillover responses and in Table F-24 for outside spillover responses.

TABLE F-23: UNION INSIDE SPILLOVER RESPONSES

Union Program with Incentive	Incentive Through Electric Utility	Not a Source of Spillover	Action Inside Spillover	Timing Inside Spillover	Incentive Inside Spillover	Source Inside Spillover	Score Inside Spillover
1	0	0	Boiler and HVAC	2018	In progress	Union	2
0	1	0	Lighting	Ongoing	Yes	Electric Utility	4
1	0	0	Lighting	NA	Yes	Union	NA
1	0	0	HVAC Controls	2018	Yes	Union	3
1	0	0	Furnace	2017	Yes	Union	3
0	0	1	Plug-Ins	2016	No		4
0	1	0	Furnace	2018	Yes	Electric Utility	4

TABLE F-24: UNION OUTSIDE SPILLOVER RESPONSES

Union Program with incentive	Incentive through electric utility	Not a source of spillover	Action Outside spillover	Timing Outside Spillover	Incentive Outside Spillover	Source Outside Spillover	Score Outside Spillover
1	0	0	HVAC and Boiler	2018	Yes	Union	4

APPENDIX G – DATA COLLECTION INSTRUMENTS

The embedded documents below are the interview guides used for participant and vendor data collection for the NTG portion of the evaluation.

2017 CIPMSV Participant Survey In

2017 CIPMSV Vendor Survey Instru