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ENBRIDGE

March 13, 2009

VIA RESS, EMAIL and Courier

Ms. Kirsten Walli
Board Secretary
Ontario Energy Board
2300 Yonge Street, Suite 2700
Toronto, ON M4P 1E4

Re: Ontario Energy Board (the "Board") File No.: EB-2008-0346
Comments of Enbridge Gas Distribution Inc. on the Draft
Measures and Assumptions for Demand Side Management (DSM) Planning

On February 6, 2009 the Board issued the Draft Measures and Assumptions for Demand Side Management Planning report and requested comments from interested parties to be submitted by March 13, 2009.

In accordance with the Board's request, enclosed please find the following:

- Submission of Enbridge Gas Distribution
- Appendix A – Revised Assumptions
- Appendix B – Substantiation Sheets
- Appendix C – Revised Assumptions with Board 2008 References
- Appendix D – Summit Blue Report titled *"Third Party Review of Measures and Assumptions for DSM Planning in Ontario"*
- Appendix E – Indeco Report titled "*Measures and Assumptions for DSM Planning*"

Please contact the undersigned if you have any questions.

Sincerely,

Bonnie Jean Adams

Bonnie Jean Adams
Regulatory Coordinator

cc: EB-2008-0346 Intervenors

ONTARIO ENERGY BOARD

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

AND IN THE MATTER OF a Consultation on the Draft Measures and Assumptions for Demand Side Management to be used by Natural Gas Distributors

SUBMISSIONS OF ENBRIDGE GAS DISTRIBUTION INC.

Introduction

1. This is the submission of Enbridge Gas Distribution Inc. ("EGDI" or the "Company") in response to the "Board Staff's Draft Measures and Assumptions for DSM Planning" (the "Draft Assumptions") dated February 11, 2009. EGDI commends the Ontario Energy Board ("OEB" or the "Board") and Navigant Consulting Inc. ("Navigant") for compiling the Draft Assumptions under a short timeframe and appreciates the opportunity to provide updates for the Draft Assumptions based on the most current and applicable information related to the natural gas utilities ("Utilities") service territories in Ontario. EGDI believes that this process is consistent with the process outlined in the DSM Generic Hearing (EB-2006-0021)[1].

2. The Draft Assumptions document developed by Navigant provides a good foundation and was an essential piece to obtain the time sensitive approvals needed to have programs continue in 2010. EGDI would like to reinforce the comments it provided to Board Staff during the November 26, 2008 Consultation session. Based on the streamlined 2006 set of framework rules, EGDI believed

[1] EB-2006-0021 Decision with Reasons, dated August 25, 2006. Page 56.

that it would need at least 2 months to develop its next DSM Plan, following Board approval of the 2010 Input Assumptions, including all relevant assumptions. The Draft DSM Guidelines released by the Board for comment January 26, 2009 contemplate significantly more administrative and procedural requirements incumbent on the Utilities. These issues are outlined in EGDI's submission to the Board dated February 20, 2009. If the Guidelines ultimately approved by the Board are not streamlined in the final version, it would significantly increase the time needed for EGDI to create and submit its next DSM Plan.

Format of Submission

3. This submission is formatted into three parts, plus supporting appendices. This first part contains EGDI's submissions regarding the process for reviewing input assumptions. This references the process that the OEB has used over the past decade to review measures and assumptions and the way EGDI has approached the review of the Draft Assumptions. This section also identifies other issues relevant to the approval process for the 2010 Input Assumptions. The second part provides submissions directly on the Navigant Consulting Inc. ("Navigant") report, dated February 6, 2009.

4. Lastly, EGDI provides revisions or updates to the Draft Assumptions where information was incorrect, missing or where best available information was not previously available. EGDI attaches at Appendix "A" of this submission, a clean copy of the Measures and Input Assumption table ("Revised Assumptions") that has been updated to reflect the best available information relevant to EGDI and Union Gas for 2010 input assumptions. Where an input has been updated from the Draft Assumptions, it has been highlighted in yellow and a corresponding Substantiation Sheet has also been provided in Appendix "B" to reference the best available information. EGDI and Union Gas worked collaboratively on this

common list. Where program delivery differs for a technology, there is a separate row to identify the differences that occur due to program delivery (e.g. contractor delivered TAPS vs. showerhead distribution through ESK). This is consistent with the streamlined format that the Board approved in the Generic Hearing. For comparison purposes, a similar copy is provided at Appendix "C" which also includes the Board Approved 2008 Measure Assumptions and Inputs shaded as grey.

5. EGDI retained Summit Blue Consulting, LLC ("Summit Blue") to undertake an independent third party expert review of the Draft Assumptions based on their expertise in both Ontario and the across North America. The Summit Blue report provides guidance for an objective process that can be used by parties including EGDI and the Board to assess what "best available information" is as it relates to Ontario. A copy of the Summit Blue report, including *curriculum vitae* is attached as Appendix "D". EGDI also retained Indeco Strategic Consulting Inc. ("Indeco") to undertake an independent expert review and provide recommendations related to the Draft Assumptions. Indeco's recommendations are based on their Ontario specific experience and expertise, and a review of relevant DSM decisions of the Board from EBO 169-III to the most recent and extensive DSM Generic Hearing. A copy of the Indeco report, including *curriculum vitae* is attached as Appendix "E".

6. The Revised Assumptions continue to divide the assumptions into specific customer segments targeted. It is recognized that Navigant did not have access to all current and relevant information related to the input assumptions. This meant that Navigant had to leave gaps in the assumptions where this information was not available to them. Navigant indicated in its report that the Utilities were in the best position to provide values that relate to their programs. EGDI and Union Gas have filled those gaps in the Revised Assumptions. Approval of the complete assumptions table is essential to conduct cost-effectiveness tests and for the Utilities to move forward their DSM Plans for 2010.

7. EGDI has attempted to respond to all issues related to the Draft Assumptions. If additional issues outside those in the Draft Assumptions are brought into this process, EGDI reserves the right to respond with a further brief submission.

1.0 REVIEW OF INPUT ASSUMPTIONS

1.1 Process

This is the first time that Board Staff have led the input assumption update process for gas DSM. As supported by EGDI and accepted by the Board in the DSM Generic Hearing, this process provides a streamlined way for all parties to propose information for consideration and removes the inherent delays of the previous Consultative and EAC processes. The previous process placed the Utilities in a difficult situation trying to balance ongoing discussion with stakeholders (including the EAC and Consultative) with the schedule needed to run actual programs in a timely manner. The Board has resolved this dilemma by adopting a clear process with specific timelines for the 2010 input assumptions. This process has resulted in efficiencies that would likely not have otherwise occurred. Even though it required a short extension to the timelines, several intervenors including the Green Energy Coalition (GEC) have agreed to work together to reduce duplication of efforts and costs to ratepayers. Clear timelines and cost boundaries appear to be a good incentive for promoting this cooperation.

1.2 Stakeholder Input

EGDI spends significant time and effort to solicit input for its DSM portfolio. This includes direct discussions with customers and business partners, industry professionals, government, research firms, intervenors and other stakeholders.

Each stakeholder brings their own perspective to the table and when this combined perspective is balanced with relevant local research and program insights, EGDI is able to develop and operate effective programs for its customers. In addition to EGDI's perspective, the Board will also have access to a few of the individual pieces of the puzzle in the form of submissions by some of the other stakeholders. This includes industry experts Summit Blue and Indeco, EAC and non-EAC intervenors. EGDI continues to welcome advice from these parties at any time as one of the components it considers for its DSM initiatives. This advice becomes more helpful to EGDI when stakeholders' opinions are also supported by relevant local backup.

EGDI has facilitated the EAC and Consultative processes as a formal way for the intervenor subset of stakeholders to provide advice on a variety of issues. The EAC has met with EGDI on a more regular basis than other intervenors and has had the most formal opportunity to provide advice on issues related to input assumptions. EAC members are not typically gas DSM experts, but represent an additional avenue for intervenor input. For several years GEC has been a stakeholder on the EAC (or its predecessor). Mr. Chris Neme with the Vermont Energy Investment Corporation (VEIC) in Burlington, Vermont, has been the primary representative of GEC on the EAC for many years. While EGDI does commend intervenors for cooperating to reduce duplication and cost to ratepayers by selecting Mr. Neme and VEIC to review the assumptions, the choice does create the following potential problems for the Board.

- VEIC is based in Vermont, and has not, to EGDI's knowledge, ever operated a gas program in Ontario. Advice provided may not be directly applicable to the Ontario marketplace.

- Mr. Neme represents GEC on the EAC and the work he does on behalf of GEC cannot be viewed as independent.

- Mr. Neme's role on the EAC involves advice on assumptions, audits and negotiations on behalf of intervenors for clearance of accounts. This provides a conflict of interest (real or perceived) should Mr. Neme or VEIC choose to be viewed as an objective expert. How can Mr. Neme be asked to provide advice on his own work or the work of GEC?

When EGDI receives advice on inputs from EAC members, it does not usually come with the back-up needed for EGDI to rely on in a typical Board proceeding. EGDI realizes that Board mandated timelines may increase the priority for GEC and other intervenors to spend the time to provide references, even if they are only based on foreign jurisdictions or internet searches. EGDI encourages these stakeholders to work more consistently with EGDI to provide the type of credible back-up that EGDI needs to support assumptions.

Even with the input of the EAC and other stakeholders, EGDI still needs to balance this information with other research, program and customer information to ensure that input assumptions are truly based on best available information. It appears that both Navigant and Summit Blue suggest that the utilities are in the best position to provide the information relevant to their programs. EGDI agrees. In fact, practically all recent Board approvals for EGDI input assumptions match those substantiated by best available information compiled by the utility.

1.3 Lessons Learned

The Board has conducted many proceedings to evaluate DSM input assumptions. These assumptions have been tested over time. EGDI submits that part of the reason that this list has become more stable (i.e. requiring smaller changes over time) is that the evidence for these assumptions has increasingly been based on good information relevant to the Ontario jurisdiction. This means that foreign assumptions from other jurisdiction or untested internet search results have not overridden good local information. Although there has not been a formal hierarchy identified to deem what “best available information” is, a review of previous input assumption approvals supports the use of relevant local information in priority to data from foreign jurisdictions.

There are times where it is expedient to use input assumptions from foreign jurisdictions since it is administratively simple and requires little effort. For example, it may be appropriate for new programs where time and cost constraints do not allow more relevant local values to be determined. However, for the majority of input assumptions, the good local information represents the best available information.

For illustration purposes, a recent example is included below that reinforces the value of this time tested principles. EGDI retained EcoNorthwest to conduct its 2007 DSM Audit. EcoNorthwest was selected by EGDI based on a competitive bid process and unanimous advice from the 2007 EAC (included GEC, SEC and Pollution Probe). In early 2008, the audit was in its final stages and the LRAM case based on best available information was being conducted. At this time EcoNothwest proposed updating the savings value for multi-residential clothes washers. EcoNorthwest recommended a value references from the Energy Trust of Oregon. Although not all recommendations from EcoNorthwest were supported by the EAC, this change was accepted. EGDI ultimately accepted this EAC recommendation as there was no time for further review.

The savings values from the Energy Trust of Oregon (Energy Trust) suggested 79 cubic meters of natural gas savings per multi-residential washer due to reduced hot water requirement and reduced drying time. The typical back-up documentation required by the Board to support this savings value was not available at the time. Following the DSM audit, EGDI followed up with staff at the Energy Trust in order to fully document this assumption for future use. Energy Trust staff did not know that these values had been proposed for use in Ontario.

Since Energy Trust delivers electric and gas conservation programs, the values were developed to reflect the mix of electric water heaters and dryers in Oregon and does not match the gas DSM situation in Ontario. Energy Trust was very helpful in walking EGDI staff through their methodology and highlighting what changes would have to be made to make a value relevant for Ontario. Some of these changes include the application of relevant equipment specification, adjustment for water inlet temperature, adjustment for usage patterns, etc. If the time had been spent to make sure that this input assumption was relevant to Ontario, it would have resulted in a significantly different value. The updated values and substantiation is provided in Appendix “A”.

EGDI recognizes that the EAC members are elected to represent intervenors from the Consultative and may have little or no Ontario experience in respect of DSM input assumptions. However, EcoNorthwest also made the same mistake by proposing an assumption change without ensuring that it was relevant for Ontario. Had EcoNothwest applied the same diligence that the Board has traditionally used in ensuring that foreign values are not used without ensuring that they actually reflect Ontario conditions, this situation could have been avoided. In short, the lessons learned are:

- Do not change input assumption for the sake of change.
- Do not assume that an assumption based in another jurisdiction has relevance in Ontario.
- When available, use good local information first.

1.4 An Objective Framework for Decision Making

That being said, it remains appropriate to weigh the tradeoffs between cost and quantitative perfection and strike a balance so that the process does not lead to "paralysis by analysis". Determining what input assumptions are best applied to a utilities DSM portfolio includes an assessment of how well they fit to the programs being delivered. However, there are several principles that have been identified by Summit Blue that provide good guidance on how to arrive at the best available information. These are outlined in detailed in the Summit Blue report "Third Party Review of Measures and Assumptions for DSM Planning in Ontario", attached in Appendix "D". A high level summary of these principles includes:

- *Use pertinent local data*
- *Focus on what matters* – use the 80/20 rule
- When foreign information is referenced – *assure that data from other jurisdictions are appropriate to use for the gas DSM programs delivered in Ontario*

These principles are consistent with the approach that EGDI used to develop the Revised Assumptions. These principles were also applied by Summit Blue when they did a technical review of the Revised Assumptions and compared them to Navigant's Draft Assumptions.

2.0 COMMENTS ON NAVIGANT REPORT

The Draft Assumptions prepared by Navigant provide a good starting point. Although EGDI was asked to provide back-up information related to the Board approved 2008 assumption and input list, this process did not include an opportunity for EGDI to provide Navigant with current best available information related to the 2010 list. It appears that Navigant did a third party review of publicly available information to derive the Draft Assumptions, and did not have an opportunity to have discussions with stakeholders such as EGDI. Although this approach did not enable Navigant to get access to the most up to date information, it still serves as a useful starting point from which to build on. In some cases this caused Navigant to rely on data from foreign jurisdictions which was accessible within the prescribed timelines. It is unlikely that Navigant would have chosen to use references from foreign jurisdictions, if it had access to more relevant local information. Since the process did not enable Navigant to access more recent (post 2008) or relevant information from the Utilities, there are some input assumptions that should be revised based on the best available information relevant to this Ontario jurisdiction. Where better information has been identified, it has been included in the Revised Assumptions attached to this submission.

There are also several input assumptions missing from the Draft Assumptions that are required to complete a 2010 DSM Plan. These assumptions may be missing either because Navigant thought that the Utilities were in a better position to provide an estimate of the value, or because it was it may not have been evident that the missing assumptions were needed before EGDI can develop its next DSM Plan. Regardless of the reason, these missing assumptions have been added to the Revised Assumption table included in this submission.

2.1 Missing Assumptions

There are several input assumptions that were missing from the Draft Assumptions completed by Navigant that are required in order for EGDI to develop its 2010 DSM Plan. The missing information includes free ridership, spillover, known measure lives for commercial and industrial technologies and in some cases entire measures. Trying to develop a DSM Plan without the missing assumptions is like trying to bake a cake without key ingredients. EGDI has added the missing input assumptions on the Revised Assumption list and has provided substantiation for them. Past assumption approvals by the Board have provided certainty on all relevant assumptions. Indeco has done a policy review based on their knowledge and expertise and made the following recommendations:

Recommendation #1: The Board should indicate that the input assumptions are to be locked in for the purposes of determining TRC and SSM.

Recommendation #2: The Board should approve input assumptions for measures that include assumptions for free ridership and spillover.

Recommendation #3: Free ridership and spillover assumptions should be approved at the same time as the Board approves other input assumptions.

Recommendation #4: The input assumptions should be determined taking into account existing DSM programs. Where a gas distributor proposes a new DSM program that is significantly different from the existing set of programs used in determining the input assumption, then the input assumptions for the new program should be assessed for reasonableness before the new program input assumptions are approved by the Board.

This appears to also be consistent with the Board's most recent decision in EB-2006-0021 where it indicated,

"The free ridership rate for custom projects will be determined as part of the process that will determine the input assumptions"[2].

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[2] EB-2006-0021 Decision with Reasons, dated August 25, 2006. Page 44.

"In the Board's view it is clear that TRC input assumptions will have to be determined before any DSM plans can be finalized."[3].

EGDI requests that the Board approve the Revised Assumptions that include all the input assumptions needed to develop its 2010 DSM Plan.

2.2 Market Share Information

EGDI noticed that Navigant decided to include some market share estimates. Some of this research is based on foreign jurisdictions. It is unclear if Navigant was adding this as ancillary data for potential Market Transformation purposes.

EGDI asked Summit Blue to provide their advice on the use of market share data and they indicated that the use of market share data for resource acquisition programs has little relevance. This seems particularly true where free ridership and spillover values have been developed specific to the Ontario market.

3.0 UPDATED INPUT ASSUMPTIONS

EGDI in cooperation with Union Gas undertook a detailed review of the Draft Assumptions. EGDI and Union Gas are only proposing changes where the best available information clearly suggests that a revision is warranted. This also includes the addition of input assumptions that were missing from the Draft Assumption list but are required by the Utilities to develop the next DSM Plan. This review focused on the best available information with the most relevance to the Ontario jurisdiction. It is generally understood that a utility is in the best position to provide estimates for input assumptions based on local research, market knowledge and program experience.

[3] EB-2006-0021 Decision with Reasons, dated August 25, 2006. Page 55.

Even though the utility technical review team included engineers, program managers, evaluation professionals and field staff, an additional reality check was conducted by Summit Blue to identify any additional areas for improvement. Professional advice from Summit Blue that had the ability to make the Revised Assumptions even stronger was incorporated. It should be noted that this detailed and balanced approach resulted in some cases of no changes to Navigant recommendations, increases to some values and decreases to values in other cases. In some cases Summit Blue suggested that an input assumption in the Revised Assumptions would likely result in more savings. EGDI left the conservative value in the Revised Assumptions where additional research was not yet available to backup a higher number.

Appendix "A" of this submission includes a clean copy of the Measures and Input Assumption table ("Revised Assumptions") that has been updated to reflect the best available information relevant to EGDI and Union Gas for 2010. Where an input has been updated from the Draft Assumptions, it has been highlighted in yellow and a corresponding Substantiation Sheet has also been provided in Appendix "B" to reference the best available information. EGDI and Union Gas collaboratively worked on this common list. Where program delivery is different there is a separate row to identify the differences that occur due to program delivery (e.g. contractor delivered TAPS vs. showerhead distribution through ESK). This is consistent with the streamlined format that the Board approved in the Generic Hearing. For reference purposes, a copy is provided at Appendix "C" which also identifies the Board Approved 2008 Measure Assumptions and Inputs shaded as grey.

Summit Blue undertook a detailed review of the Revised Assumptions that EGDI and Union Gas collaboratively developed and compared them against the Draft Assumptions. Details of this review are included in the Summit Blue report attached in Appendix "D". In some cases Summit Blue made recommendations that were added to the Revised Assumption tables. Based on this independent review, Summit Blue has confirmed that the Revised Assumption represent the best available information for use in Ontario. The only items that Summit Blue identified that are different than the Revised Assumptions are outlined in Section 3, Exhibit 1 of the Summit Blue report.

All of which is respectfully submitted.

Dated: March 13, 2009

Norm Ryckman, Director, Regulatory Affairs
Enbridge Gas Distribution Inc.

Appendix A

Union Gas and Enbridge Gas Distribution: Review and Proposed Changes to Navigant's Report "Appendix B"
Draft Report: Measures and Assumptions for Demand Side Management (DSM) Planning,
Ontario Energy Board, February 6, 2009

Legend: - cells with proposed changes are highlighted
- values from Navigant's Appendix B are shown in brackets next to the proposed change

	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.+	Free Ridership	Spillover	
	Residential Space Heating															
1	Residential	Existing	Air Sealing	Air infiltration reduction (6 ACH50)	Existing infiltration controls	(8 ACH50)	231	101	0	15	$1,000	8.3	Med			
2	Residential	Existing	Basement Wall	R-1 Insulation	R-12 Insulation		237	87	0	25	$2 / ft^2	13.4	High			
3	Residential	Existing	Ceiling	R-40 Insulation	R-10 Insulation		348	214	0	20	$0.7 / ft^2	3.2	Med			
4	Residential	Existing	Enhanced Furnace	ECM (continuous)	Mid-efficiency furnace	PSC motor	-183	1,387	0	15	$960	22*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
5	Residential	Existing	Enhanced Furnace	ECM (non continuous)	Mid-efficiency furnace	PSC motor	-26	324	0	15	$960	51*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
6	Residential	New	Enhanced Furnace	Furnace only (continuous)	Mid-efficiency furnace		-166	1,403	0	15	$960	18*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
7	Residential	New	Enhanced Furnace	Furnace only (non continuous)	Mid-efficiency furnace		-26	207	0	15	$960	137*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
8	Residential	Existing	Energy Star Windows	Low E, argon filled (R-3.8)	Standard windows	Double pane, standard glazing (R-2.0)	121	206	0	20	$150 / unit	28	High			
9	Residential	Existing	Reflector Panels		No reflector panels		143	0	0	18	($213) 238	3.1	Low	0%		Adjustments: Updated incremental cost based on cost of panels plus shipping ($238); FR of 0% as per EB 2008-0384 and 0385
10	Residential	Existing	High Efficiency Furnace	AFUE 90	Mid-efficiency furnace	AFUE 80	268	0	0	18	$667	4.8	Med			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
11	Residential	Existing	High Efficiency Furnace	AFUE 92	Mid-efficiency furnace	AFUE 80	317	0	0	18	$1,067	6.5	Med			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
12	Residential	Existing	High Efficiency Furnace	AFUE 96	Mid-efficiency furnace	AFUE 80	407	0	0	18	$2,433	11.5	Med			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
13	Residential	Existing	Programmable Thermostat		Standard Thermostat		146	(182) 123	0	15	($25) 50	0.3	65%	43%	14%	Adjustments: Electricity savings adjusted to reflect market penetration of central air conditioning in Ontario (57% as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008); incremental cost increased to reflect full cost of unit; FR as per EB 2008-0384 and 0385, Spillover as per SB FR & Spillover Study - June 4, 2008
14	Residential	Existing	Wall Insulation	R-8 Insulation	R-19 Insulation		405	194	0	30	$2.5 / ft^2	11.2	High			
	Residential Water Heating															

Appendix A

	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
15	Residential	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	38	0	7,797	10	($2) 1	0.1	90%	UG 33%; EGD 31%	ESK 17% TAPS 7%	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385; Spillover as per SB FR & Spillover study June 4, 2008
16	Residential	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	10	0	2,004	10	($2) 1	0.4	90%	UG 33%; EGD 31%	ESK 17% TAPS 7%	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385; Spillover as per SB FR & Spillover study June 4, 2008
17	Residential	Existing	Low-flow showerhead	1.5 GPM (distributed, e.g., ESK)	Average existing stock	2.2 GPM	33	0	6,334	10	($6) 4	0.4	65%	10%	19% (distributed)	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385; Spillover as per SB FR & Spillover study June 4, 2008
18	Residential	Existing	Low-flow showerhead	1.25 GPM (distributed, e.g., ESK)	Average existing stock	2.2 GPM	60	0	10,570	10	($13) $4	0.4	65%	10%	19% (distributed)	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385. Spillover as per SB FR & Spillover study June 4, 2008
19	~~Residential~~	~~Existing~~	~~Low-flow showerhead~~	~~1.25 GPM (installed)~~	~~Average existing stock~~	~~2.0 GPM~~	~~49~~	~~0~~	~~8,817~~	~~10~~	~~$13~~	0.5	65%			See below, line 20 and line 21
20	Residential	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	2.25 GPM (2.0 to 2.5 GPM)	(62) 66	0	10,886	10	($13) $19	0.4	65%	10%	8% (installed)	Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385.
21	Residential	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	3.0 GPM - 2.6 GPM and higher	(102) 116	0	17,168	10	($13) $19	0.3	65%	10%	8% (installed)	Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385.
22	Residential	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes	R-1	25	0	0	10	($2) $1 / $4	0.2	47%	4%		Adjustments: Measure life as per EB2008-0384 and 0385. Incremental cost as per utility bulk purchase price, customer and contractor installed. Free ridership as per EB 2008-0384 and 0385
23	Residential	New/Existing	Solar Pool Heater	Solar Heating System	Conventional Gas-fired Heating System	50% seasonal efficiency	493	-57	0	20	$1,450	5.7	Med			
24	Residential	Existing	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.575	137	0	0	18	$750	10.5	Low			
25	Residential	New	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.575	137	0	0	18	$750	10.5	Low			
	Low Income Space Heating															
26	Low Income	Existing	Programmable Thermostat		Standard manual thermostat		146	(182) 123	0	15	($25) $69	0.3	65%	1%		Adjustments: Electricity savings adjusted to reflect market penetration of central air conditioning in Ontario (57% as per Summit Blue study, June 2008); incremental cost increased to reflect full cost of unit and installation; FR as per EB 2008-0384 and 0385
27	Low Income	Existing	Weatherization	full weatherization	No Weatherization		(1134) 1234	(165) 255	0	23	($2284) $2667	3.9	Med	0%		Adjustments: Gas savings and incremental costs adjusted to reflect results from first two years of program operation. FR as per EB 2008-0384 and 0385
	Low Income Water Heating															
28	Low Income	Existing	Faucet Aerator	Kitchen, 1.5 GPM (distributed)	Average existing stock	2.5 GPM	38	0	7,797	10	($2) $1	0.1	90%	1%		Adjustments: Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385
29	Low Income	Existing	Faucet Aerator	Bathroom, 1.5 GPM (distributed)	Average existing stock	2.2 GPM	10	0	2,004	10	($2) $1	0.4	90%	1%		Adjustments: Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385

Appendix A

	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
30	Low Income	Existing	Low-flow showerhead	1.5 GPM (distributed, e.g.,ESK)	Average existing stock	2.2 GPM	33	0	6,334	10	($6) $4	0.4	65%	Union 1%, EGD 5%		Adjustments: Incremental cost as per utility bulk purchase price. FR as per EB 2008-0384 and 0385
31	~~Low Income~~	~~Existing~~	~~Low-flow showerhead~~	~~1.25 GPM (installed)~~	~~Average existing stock~~	~~2.0 GPM~~	~~49~~	~~0~~	~~8,817~~	~~10~~	~~$13~~	0.5	65%			See below, line 32 and 33
32	Low Income	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in 1 of 2 ranges.	2.25 GPM (2.0 to 2.5 GPM)	(62) 66	0	10,886	10	($13) $19	0.4	65%	Union - 1%; EGD - 5%		Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385.
33	Low Income	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in 1 of 2 ranges.	3.0 GPM (2.6 GPM and above)	(102) 116	0	17,168	10	($13) $19	0.3	65%	Union - 1%; EGD - 5%		Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385.
34	Low Income	Existing	Low-flow showerhead	1.25 GPM (distributed)	Average existing stock	2.2 GPM	60	0	10,570	10	($13) $4	0.4	65%	Union 1%, EGD 5%		Adjustments: Incremental cost as per 2009 utility bulk purchase price. FR as per EB 2008-0384 and 0385
35	Low Income	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes (R-1)		25	0	0	10	($2) $4	0.2	47%	1%		Adjustments: Incremental cost as per utility bulk purchase price plus installation. Free ridership as per EB 2008-0384 and 0385
	Commercial Cooking															
36	Commercial	New/Existing	Energy Star Fryer	50% cooking efficiency	Standard fryer	35% cooking efficiency	(1099) 916	-546	0	(12) 7	($3250) $1500	5.9	Med			Adjustments: Updatedsavings values, measure life and incremental cost based on best available information.
37	Commercial	New/Existing	High Efficiency Griddle	40% cooking efficiency	Standard griddle	32% cooking efficiency	503	0	0	12	$1,570	6.2	Med			
	Commercial Space Heating															
38	Commercial	Existing	Air Curtains	Single door	Non-air curtain doors		2,191	172	0	15	$1,650	1.5	Med	5%		Adjustments: FR as per EB 2008-0384 and 0385
39	Commercial	Existing	Air Curtains	Double door	Non-air curtain doors		4,661	1,023	0	15	$2,500	1.1	Med	5%		Adjustments: FR as per EB 2008-0384 and 0385
40	Commercial	New / Existing	Condensing Boilers	(88%) 90% estimated seasonal efficiency	Non-condensing boiler	76% estimated seasonal efficiency	(0.0104) .0119 / Btu/hr	0	0	25	$12 / kBtu/hr	2.3	High	5%		Adjustments: Details of Efficient Equipment and savings values updated. FR as per 2008-0384 and 0385
41	Commercial	Existing	Demand Control Kitchen Ventilation	(5,000 CFM) 0 - 4,999 CFM	Kitchen ventilation without DCKV		(4801) 3972	(13521) 7231	0	(10) 15	($10000) $5000	4.2	Low	5%		Adjustments: Updated savings values, measure life and incremental cost. FR as per EB 2008-0384 and 0385
42	Commercial	Existing	Demand Control Kitchen Ventilation	(10,000 CFM) 5,000 - 9,999 CFM	Kitchen ventilation without DCKV		(11486) 10,347	(30901) 23,051	0	(10) 15	($15000) $10000	2.6	Low	5%		Adjustments: Updated savings values, measure life and incremental cost. FR as per EB 2008-0384 and 0385
43	Commercial	Existing	Demand Control Kitchen Ventilation	(15,000 CFM) 10,000 - 15,000 CFM	Kitchen ventilation without DCKV		(18924) 18,941	(49102) 40,692	0	(10) 15	($20000) $15000	2.1	Low	5%		Adjustments: Updated savings values, measure life and incremental cost. FR as per EB 2008-0384 and 0385
43b	Commercial	New	Demand Control Kitchen Ventilation	0 - 4,999 CFM	Ventilation without DCKV		3,972	7,190	0	15	$5,000			5%		Adjustments: included item from EB2008-0384 and 0385. FR as per 2008-0384 and 0385.
43c	Commercial	New	Demand Control Kitchen Ventilation	5,000 - 9,999 CFM	Ventilation without DCKV		6,467	22,791	0	15	$10,000			5%		Adjustments: included item from EB2008-0384 and 0385. FR as per 2008-0384 and 0385.
43d	Commercial	New	Demand Control Kitchen Ventilation	10,000 - 15,000 CFM	Ventilation without DCKV		11,838	40,217	0	15	$15,000			5%		Adjustments: included item from EB2008-0384 and 0385. FR as per 2008-0384 and 0385.
44	Commercial	New / Existing	Destratification Fans		No destratification fans		(6129) 7,020	(-511) -123	0	15	$7,021	2.3	Low	10%		Adjustments: Updated savings based on Enbridge research, Prescriptive Destratification Fan Program, Agviro Inc., February, 2009 . Free ridership as per EB-2008-0384 & 0385.
45	Commercial	Existing	Energy Recovery Ventilator		Ventilation without ERV		3.95 / CFM	0	0	20	$3 / cfm	1.5	Low	5%		Adjustments: Free ridership based on EB-2008-0384 and 0385.

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
46	Commercial	New	Energy Recovery Ventilator		Ventilation without ERV		3.75 / CFM	0	0	20	$3 / cfm	1.6	Low	5%		Adjustments: Free ridership based on EB-2008-0384 and 0385.
47	Commercial	Existing	Enhanced Furnace	ECM (continuous)	Standard PSC Motor		(-)2.7 kBtu/hr	20.5/kBtu/hr	0	15	$960	14*	Low			
48	Commercial	Existing	Enhanced Furnace	ECM (non-continuous)	Standard PSC Motor		(-)0.4 / kBtu/hr	4.8 / kBtu/hr	0	15	$960	31*	Low			
49	Commercial	New	Enhanced Furnace	ECM (continuous)	Standard PSC Motor		(-)2.5 kBtu/hr	20.8/kBtu/hr	0	15	$960	11*	Low			
50	Commercial	New	Enhanced Furnace	ECM (non-continuous)	Standard PSC Motor		(-)0.3 / kBtu/hr	3.1 / kBtu/hr	0	15	$960	55*	Low			
51	Commercial	Existing	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		3.77 / CFM	0	0	20	$3.40	1.8	Low	5%		Adjustments: FR as per EB 2008-0384 and 0385
52	Commercial	New	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		3.49 / CFM	0	0	20	$3.40	2.0	Low	5%		Adjustments: FR as per EB 2008-0384 and 0385
53	Commercial	Existing	High Efficiency Furnace	AFUE 90			3.6 / kBtu/hr	0	0	18	$6.7 / kBTu/h	3.7	Med			
54	Commercial	Existing	High Efficiency Furnace	AFUE 92			4.2 / kBtu/hr	0	0	18	$11 / kBTu/h	5.2	Med			
55	Commercial	Existing	High Efficiency Furnace	AFUE 96			5.4 / kBtu/hr	0	0	18	$22 / kBTu/h	8.1	Med			
56	Commercial	New / Existing	Infrared Heaters	0 - (75,000) 49,000 BTUH	Regular Unit Heater		(0.015) 0.0102/ Btu/hr	(245) 236	0	20	($0.0122 / Bth/hr) $0.009/$10^3$ Btu/hr	1.6	Med	33%		Adjustments: Updated savings values and incremental costs. Free ridership based on EB-2008-0384 and 2008-0385.
57	Commercial	New / Existing	Infrared Heaters	(76,000 - 150,000 BTUH) 49,000 - 164,999 BTUH	Regular Unit Heater		(0.015) 0.0102/ Btu/hr	(559) 534	0	20	($0.0122 / Bth/hr) $0.009/$10^3$ Btu/hr	1.6	Med	33%		Adjustments: Updated savings values and incremental costs. Free ridership based on EB-2008-0384 and 2008-0385.
58	Commercial	New / Existing	Infrared Heaters	(151,000 - 300,000 BTUH) >165,000 BTUH	Regular Unit Heater		(0.015) 0.0102/ Btu/hr	(870) 833	0	20	($0.0122 / Bth/hr) $0.009/$10^3$ Btu/hr	1.6	Med	33%		Adjustments: Updated savings values and incremental costs. Free ridership based on EB-2008-0384 and 2008-0385.
59	Commercial	New / Existing	Rooftop Unit	Two-stage rooftop unit - up to and including 5 tons of cooling	Single stage rooftop unit	Single stage rooftop unit - 80% efficient	(255) 300	0	0	15	$375	2.9	Med	5%		Adjustments: Navigant gas savings were incorrectly calculated based on their own efficiency assumptions. The new substantiation document reflects this correction. FR as per EB 2008-0384 and 0385
60	~~Commercial~~	~~Existing~~	~~Programmable Thermostat~~		~~Standard thermostat~~		~~239~~	~~251~~	~~0~~	~~15~~	~~$110~~	0.9	Med			See below, line 60a and 60b
60a	Commercial	New / Existing	Programmable Thermostat (Warehouse, Recreation, Agriculture, Industrial)		Standard thermostat		674	524	0	15	$40			20%		Adjustments: New savings values developed on a sector basis. Incremental costs as per utility bulk purchase price. FR as per EB-2008-0384 and 0385.
60b	Commercial	New / Existing	Programmable Thermostat (Other, eg. Retail, Office)		Standard thermostat		191	246	0	15	$40			20%		Adjustments: New savings values developed on a sector basis. Incremental costs as per utility bulk purchase price. FR as per EB-2008-0384 and 0385.
61	Commercial	Existing	Prescriptive Boilers for Schools - Elementary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		10,830	0	0	25	($5646) $8646	1.0	Low	12% (EGD) 27% (Union)	10% (EGD & Union)	Adjustments: Incemental costs based on weighted average of boiler types as per EB 20080384 and 0385. FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study, October 2008

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
62	Commercial	Existing	Prescriptive Boilers for Schools - Secondary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		43,859	0	0	25	($8470) $14470	0.4	Low	12% (EGD) 27% (Union)	10% (EGD & Union)	Adjustments: Incemental costs based on weighted average of boiler types as per EB 20080384 and 0385. FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study, October 2008
	Commercial Water Heating															
63	~~Commercial~~	~~New / Existing~~	~~Condensing Gas Water Heater~~	~~95% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~338~~	~~0~~	~~0~~	~~13~~	~~$2,230~~	13	Low			See below, line 65a
64	~~Commercial~~	~~New / Existing~~	~~Condensing Gas Water Heater~~	~~95% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~905~~	~~0~~	~~0~~	~~13~~	~~$2,230~~	5.0	Low			See below, line 65a
65	~~Commercial~~	~~New / Existing~~	~~Condensing Gas Water Heater~~	~~95% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~1,614~~	~~0~~	~~0~~	~~13~~	~~$2,230~~	2.8	Low			See below, line 65a
65a	Commercial	New / Existing	Condensing Gas Water Heater	95% thermal efficiency	Conventional storage tank water heater	80% thermal efficiency	1,543	0	0	13	$2,230			5%		Adjustments; Savings updated. Measure life and incremental cost updated to reflect Navigant research, FR as per EB 2008-0384 and 0385
66	Commercial	Existing	Pre-Rinse Spray Nozzle	1.6 GPM	Standard pre-rinse spray nozzle	3.0 GPM	387	0	116,086	5	$41	0.2	Med			See below
67	~~Commercial~~	~~Existing~~	~~Pre-Rinse Spray Nozzle~~	~~1.24 GPM~~	~~Standard pre-rinse spray nozzle~~	~~3.0 GPM~~	~~486~~	~~0~~	~~145,937~~	~~5~~	~~$60~~	0.3	Low			See below, line 67a to 67f
67a	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Full Service)	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	931	0	182,000	5	$100			12.4%	3%	Adjustments: New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group); Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67b	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Limited)	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	278	0	55,000	5	$100			12.4%	3%	Adjustments: New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group); Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67c	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Other)	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	272	0	53,000	5	$100			12.4%	3%	Adjustments: New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group); Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67d	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	1,286	0	252,000	5	$88			0.0%		Adjustments: Relatively new product; currently only aware of one manufacturer - propose 0% FR; Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67e	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	339	0	66,400	5	$88			0.0%		Adjustments: Relatively new product; currently only aware of one manufacturer - propose 0% FR; Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67f	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	318	0	62,200	5	$88			0.0%		Adjustments: Relatively new product; currently only aware of one manufacturer - propose 0% FR; Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
68	~~Commercial~~	~~New / Existing~~	~~Tankless Water Heater 100 gal/day~~	~~84% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~215~~	~~0~~	~~0~~	~~18~~	~~$1,570~~	~~0.0~~	~~Low~~			See below, line 70a
69	~~Commercial~~	~~New / Existing~~	~~Tankless Water Heater (500 gal/day)~~	~~84% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~57~~	~~0~~	~~0~~	~~18~~	~~$510~~	~~18~~	~~Low~~			See below, line 70a
70	~~Commercial~~	~~New / Existing~~	~~Tankless Water Heater (1000 gal/day)~~	~~84% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~142~~	~~0~~	~~0~~	~~18~~	~~$2,590~~	~~N/A~~	~~Low~~			See below, line 70a

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
70a	Commercial	New / Existing	Tankless Water Heater 50-150 USG gal/day	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	221	0	0	20	-$1,570	0.0	Low	2%		Adjustments: Updated savings and measure life. FR as per EB2008-0384 and 0385.
	Multi-Family Water Heating															
71	Multi-Family	Existing	(Energy Star Clothes Washer) CEE qualified washers	(MEF=1.72, WF=8.0) MEF=2.20, WF=5.33	Conventional top-loading, vertical axis clothes washer	MEF=1.26, WF=9.5	(79) 222m3	(201) 296	(19814) 80,000	11	($150) $600	3.8	High	10%		Adjustments: Savings recalculated based on equipment in Enbridge program. FR as per EB 2008-0384 and 0385
72	Multi-Family	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	26	0	5,377	10	$2	0.2	90%	10%		Adjustments: FR as per EB 2008-0384 and 0385
72a	Multi-Family	Existing	Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	39	0	8,072	10	$2			10%		Adjustments: Savings calculation applied to a 1.0GPM aerator. FR as per EB 2008-0384 and 0385
73	Multi-Family	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	7	0	1,382	10	$2	0.5	90%	10%		Adjustments: FR as per EB 2008-0384 and 0385
73a	Multi-Family	Existing	Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	11		2,371	10	($2) $1.50			10%		Adjustments: Savings calculation applied to a 1.0GPM aerator. Incremental costs to reflect utility bulk purchase price. FR as per EB 2008-0384 and 0385
74	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (distributed, e.g., ESK)	Average existing stock	2.2 GPM	(23) 30	0	(4369) 5345	10	($6) $4	0.5	65%	10%		Adjustments: Savings adjusted to account for percentage of showers taken with efficient unit in Multi-residential setting (92%) compared to 76% in low rise residential as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008. Incremental costs as per utility bulk purchase price. FR as per EB 2008-0384 and 0385
75	~~Multi-Family~~	~~Existing~~	~~Low-flow showerhead~~	~~1.25 GPM (installed)~~	~~Average existing stock~~	~~2.0 GPM~~	~~34~~	~~0~~	~~6,081~~	~~10~~	~~$13~~	0.7	65%			See below, line 76 to 77g
76	Multi-Family	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	2.25 GPM (2.0 to 2.5 GPM)	(43) 53	0	(7507) 9078	10	($13) $17	0.6	65%	10%		Adjustments: Savings adjusted to account for percentage of showers taken with efficient unit in Multi-residential setting (92%) compared to 76% in low rise residential as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008. Incremental cost as per utility bulk purchase plus installation cost. FR as per EB 2008-0384 and 0385
77	Multi-Family	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	3.0 GPM (2.6 GPM and above)	(70) 87	0	(11840) 14341	10	($13) $17	0.4	65%	10%		as above
77a	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	2.25 GPM (2.0 to 2.5 GPM)	28	0	5,197	10	$17			10%		Adjustments: Navigant method used to calculate savings for 1.5 GPM showerhead with adjustment for percentage of showers influenced in Multi-residential application. Incremental cost as per utility bulk purchase plus installation cost. FR as per EB 2008-0384 and 0385
77b	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	2.75 GPM (2.6 to 3.0 GPM)	55	0	9,490	10	$17			10%		as above
77c	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	3.25 GPM (3.1 to 3.5 GPM)	79	0	13,250	10	$17			10%		as above
77d	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	3.6 GPM (3.6 GPM and above)	91	0	15,114	10	$17			10%		as above

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	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
77e	Multi-Family	Existing	Low-flow showerhead	2.0 GPM (installed)	Average existing stock in one of three ranges.	2.75 GPM (2.6 to 3.0 GPM)	4	0	1,727	10	$17			10%		Adjustments: Navigant method used to calculate savings for 2.0 GPM showerhead with adjustment for percentage of showers influenced in Multi-residential application. Incremental cost as per utility bulk purchase plus installation cost. FR as per EB 2008-0384 and 0385
77f	Multi-Family	Existing	Low-flow showerhead	2.0 GPM (installed)	Average existing stock in one of three ranges.	3.25 GPM (3.1 to 3.5 GPM)	28	0	5,487	10	$17			10%		as above
77g	Multi-Family	Existing	Low-flow showerhead	2.0 GPM (installed)	Average existing stock in one of three ranges.	3.6 GPM (3.6 GPM and above)	40	0	7,351	10	$17			10%		as above
78	Multi-Family	Existing	Low-flow showerhead (distributed, e.g., ESK)	1.25 GPM	Average existing stock	2.2 GPM	(42) 53.8	0	(7289) 8916	10	($6) $4	0.6	65%	10%		Adjustments: Savings adjusted to account for percentage of showers taken with efficient unit in Multi-residential setting (92%) compared to 76% in low rise residential as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008. FR as per EB 2008-0384 and 0385
	All	New / Existing	CFL	13W	60W incandescent		-	45	-	8	$0			24%		Adjustments: Measure as per EB 2008-0384 and 0385
	All	New / Existing	CFL	23W	75W incandescent		-	50	-	8	$0			24%		Adjustments: Measure as per EB 2008-0384 and 0385
	Residential	New	Energy Star New Homes	Energy Star for New Homes V4	New home built to OBC as of Jan 1, 2009		881	734		25	$4,275			5%		Adjustments: 2008 measure updated to reflect changes to Energy Star and Ontario Building Code and based on E Star V4
	Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	300 MBH 83-84% efficient	boiler with 80% combustion efficiency		1,075	0	0	25	$3,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
	Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	600 MBH 83-84% efficient	boiler with 80% combustion efficiency		1,777	0	0	25	$5,800			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
	Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1000 MBH 83-84% efficient	boiler with 80% combustion efficiency		3,136	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.

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Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1500 MBH 83-84% efficient	boiler with 80% combustion efficiency		4,317	0	0	25	$5,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	300 MBH 85-88% efficient	boiler with 80% combustion efficiency		1,766	0	0	25	$4,500			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	600 MBH 85-88% efficient	boiler with 80% combustion efficiency		2,290	0	0	25	$6,000			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1000 MBH 85-88% efficient	boiler with 80% combustion efficiency		5,155	0	0	25	$10,300			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1500 MBH 85-88% efficient	boiler with 80% combustion efficiency		7,095	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	300 MBH 83-84% efficient	boiler with 80% combustion efficiency		2,105	0	0	25	$3,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	600 MBH 83-84% efficient	boiler with 80% combustion efficiency		3,994	0	0	25	$5,800			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1000 MBH 83-84% efficient	boiler with 80% combustion efficiency		7,310	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.

Appendix A

Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1500 MBH 83-84% efficient	boiler with 80% combustion efficiency		11,554	0	0	25	$5,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	2000 MBH 83-84% efficient	boiler with 80% combustion efficiency		16,452	0	0	25	$4,950			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	300 MBH 85-88% efficient	boiler with 80% combustion efficiency		3,125	0	0	25	$4,500			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	600 MBH 85-88% efficient	boiler with 80% combustion efficiency		5,930	0	0	25	$6,000			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1000 MBH 85-88% efficient	boiler with 80% combustion efficiency		10,856	0	0	25	$10,300			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1500 MBH 85-88% efficient	boiler with 80% combustion efficiency		17,157	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	2000 MBH 85-88% efficient	boiler with 80% combustion efficiency		24,431	0	0	25	$7,050			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Commercial	Existing	Custom Retrofit											EGD 12% Union 59%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2008
Commercial	Existing	Custom Multi-family											EGD 20% Union 42%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2009
Commercial	New	Custom New Build											EGD 26% Union 33%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2010

Appendix A

Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.+	Free Ridership	Spillover	
Agriculture	New/Existing	Custom Agriculture											EGD 40% Union 0%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2011
Industrial	New/Existing	Custom Industrial											EGD 50% Union 56%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2012
See also: Custom Resource Acquisition Technologies - Measure Life Assumptions															

* Payback for measures with natural gas savings is based on natural gas savings only; payback for measures that increase natural gas consumption (ie, furnaces with ECMs) is based on net energy cost savings (ie, electricity savings less incremental natural gas costs)

+ When available, the current market penetration or market share percentage is provided, else, an estimated “low”, “medium” or “high” scale is used, where “low” is below 5%, “medium” is between 5 and 50%, and “high” is greater than 50%.

Custom Resource Acquisition Technologies

Measure Life Assumptions
March, 2009

	Commercial	Industrial	Multi-residential
Boiler Related			
Boilers – DHW	25[1]	n/a	25[1]
Boilers - Industrial Process	n/a	20	n/a
Boilers – Space Heating	25[1]	25[1]	25[1]
Combustion Tune-up	5	5	n/a
Controls	15	15	15
Steam pipe/tank insulation	n/a	15	n/a
Steam trap	13[3]	13[3]	n/a
Building Related			
Building envelope	25	25	25
Windows	25	25	25
Greenhouse curtains	na	10	na
Double Poly greenhouse	n/a	5	n/a
HVAC Related			
Dessicant cooling	15	n/a	n/a
Heat Recovery	15	15	n/a
Infra-red heaters	10	10	n/a
Make-up Air	15	15	15
Novitherm panels	15	n/a	15
Furnaces (gas-fired)	18[2]	n/a	18[2]
Re-Commissioning	**5[4]**	n/a	**5[4]**
Process Related			
Furnaces (gas-fired)	n/a	18[2]	n/a

Source: RP-2002-0133 Settlement Proposal, Ex N1, Tab 1, Schedule 1, page 70.
Board approved in EB-2006-0021.

[1]updated in RP-2006-0001 – Source: ASHRAE

[2]new item - Source: ASHRAE updated in EB-2006-0021

[3]Source: Measure Life of Steam Traps Research Study, Enbridge Gas Distribution, November, 2007.

[4]Source: Measure Life For Retro-Commissioning And Continuous Commissioning Projects, Finn Projects, December, 2008.

Appendix B:

Substantiation Documents for Input Assumptions

HEAT REFLECTOR PANELS

Residential Existing Homes

Efficient Technology & Equipment Description
A saw tooth panel made of clear PVC with a reflective surface placed behind a gas radiator reducing heat lost to poorly insulated exterior walls.
Base Technology & Equipment Description
Existing housing with radiant heat with no reflector panels.

Resource Savings Assumptions

Natural Gas (Updated)	**143 m^3**
As per EB 2008-0384 & 0385 and by Navigant Consulting.[1]	
Electricity	**kWh**
Water	**L**

Other Input Assumptions

Equipment Life	**18 Years**
Based on average space heat measure life.[1] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Customer Install)	**$238**
As per utility program costs. (Cost of panels plus shipping)	
Free Ridership	**0 %**
Product not currently available to end-use consumers through typical retail channels. As approved in EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-39-41, Feb. 6, 2009.

PROGRAMMABLE THERMOSTAT

Residential Existing Homes

Efficient Technology & Equipment Description
Programmable thermostat
Base Technology & Equipment Description
Standard thermostat

Resource Savings Assumptions

Natural Gas (Updated)	**146 m^3**
Savings adjustment recommended by Navigant Consulting.[1]	
Electricity (Updated)	**123 kWh**
Savings adjustment calculated by using a combination of Summit Blue and Navigant assumptions.[1, 2] Navigant electricity savings are based on OPA 2009 assumptions of 100% market penetration of central air.[1] Summit Blue reports a penetration rate of 57% for CAC across the province based on information from EGD and NRCan.[2] Using 57% penetration the electricity savings are (44 + (138*.57) = 122.7kWh.[1,2]	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**15 Years**
Equipment life recommended by Summit Blue Consulting and as approved in EB 2008-0384 & 0385. Also recommended by Navigant Consulting.[1]	
Incremental Cost (Contr. Install) (UG/EGD)	**$50**
Based on average thermostat cost from Union survey of hardware chains.	
Free Ridership	**43 %**
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.	
Spillover	**14 %**
Spillover rate recommended by Summit Blue Consulting[3].	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-50-53, Feb. 6, 2009.

[2] "Resource Savings Values in Selected DSM Prescriptive Programs", Summit Blue Consulting, pg. 28, June 2008.

[3] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.5 GAL/MIN FAUCET AERATOR (Kitchen)

Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.5 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**38 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water (Updated)	**7,797 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. Install) (UG/EGD)	**$1**
As per utility program costs, bulk purchase of aerators.	
Free Ridership (Updated) (UG/EGD)	**33/31 %**
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.	
Spillover (TAPS/ESK)	**7/17 %**
Spillover rate recommended by Summit Blue Consulting[3].	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-65-68, Feb. 6, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

[3] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.5 GAL/MIN FAUCET AERATOR (Bathroom)

Residential Existing Homes

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**10 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water (Updated)	**2,004 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 Years**
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. Install) (UG/EGD)	**$1**
As per utility program costs, bulk purchase of aerators.	
Free Ridership (Updated) (UG/EGD)	**33/31 %**
Free Ridership rate recommended by Summit Blue Consulting.[3] As approved in EB 2008-0384 & 0385.	
Spillover (TAPS/ESK)	**7/17 %**
Spillover rate recommended by Summit Blue Consulting[3].	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-61-64, Feb. 6, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

[3] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.5 GAL/MIN LOW-FLOW SHOWERHEAD

Residential Existing Homes (Distribution)

Efficient Technology & Equipment Description
Low-flow showerhead (1.5 gal/min)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas	**33 m³**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water	**6,334 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 Years**
Low flow showerheads have an estimated service life of 10 years.[1] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. Install)	**$4**
As per utility program costs, bulk purchase of showerheads.	
Free Ridership	**10 %**
Free Ridership rate recommended by Summit Blue Consulting.[2] As approved in EB 2008-0384 & 0385.	
Spillover (distributed – Union & EGD)	**19 %**
Spillover rate recommended by Summit Blue Consulting[2].	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-69-72, Feb. 6, 2009.

[2] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.25 GAL/MIN LOW-FLOW SHOWERHEAD

Residential Existing Homes (Distribution)

Efficient Technology & Equipment Description
Low-flow showerhead (1.25 gal/min)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas	**60 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water	**10,570 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 Years**
Low flow showerheads have an estimated service life of 10 years.[1] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. Install)	**$4**
As per utility program costs, bulk purchase of showerheads.	
Free Ridership	**10 %**
Free Ridership rate recommended by Summit Blue Consulting.[2] As approved in EB 2008-0384 & 0385.	
Spillover (distributed – Union & EGD)	**19 %**
Spillover rate recommended by Summit Blue Consulting[2].	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-79-82, Feb. 6, 2009.

[2] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.25 GAL/MIN LOW-FLOW SHOWERHEAD

Residential Existing Homes (Installed per Household)

Efficient Technology & Equipment Description
Low-flow showerhead (1.25 gal/min)
Base Technology & Equipment Description
Average existing stock – see below for flow rates.

Resource Savings Assumptions

Natural Gas (Updated)	**See Below** m^3

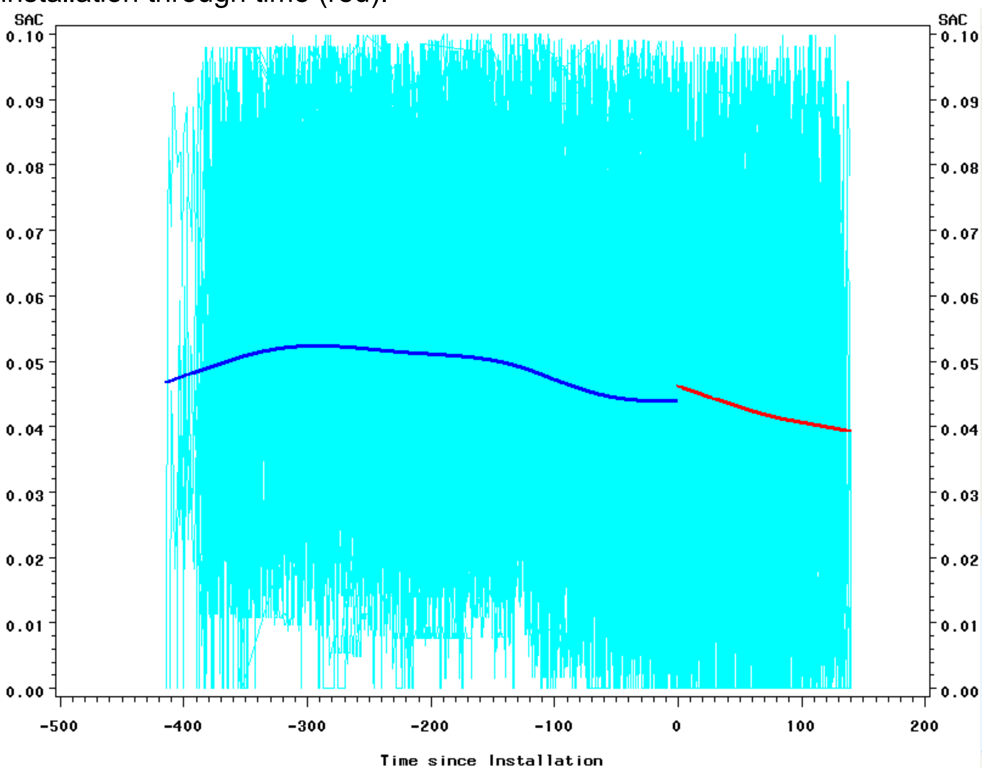
Gas savings as per results of EGD load research.

Data was analyzed for 69 households pre and post installation of low-flow shower-heads. Data records began on August 31 2007 until December 31 2008 date. Showerheads were installed between 13 August 2008 and 18 October 2008.
A simple paired t-test (before-after installation) was used to test for the magnitude and statistical significance of installation effect on consumption.

Longitudinal mixed models were used to explore relationships between inputs and low flow showerhead installation on consumption.

RESULTS

Data Exploration
A plot of seasonally adjusted consumption (SAC) by time shows that consumption is generally lower after low-flow showerhead installation (red) than before installation (blue). Surprisingly, immediately after installation (close to time 0) there appears to be an initial increase in consumption. But note the decreasing trend in consumption post-installation through time (red).



Paired T-Tests

Before-After Test on Seasonally Adjusted Data on 68 Households.

ALL DATA

paired t-test

	Average hourly difference m^3/hour	Average daily difference m^3/day	Average annual difference m^3/year
	0.0102	**0.245**	**89.35**
Lower 95% Confidence Bound			
	0.0065	**0.156**	**56.94**
Upper 95% Confidence Bound			
	0.0138	**0.331**	**120.89**

Longitudinal Mixed Model

The T-Test results above do not control for household attributes or time since installation. The following shows predictions from two mixed models explained in the Final Report.

Predictions Derived by comparing low-flow to normal shower heads at the mean value of all other attributes, and the mean value of time pre and post installation.

INTERACTION MODEL

MEAN Average	m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
LOW FLOW - YES	0.0583	1.399	510.5	0.0533	0.0633
LOW FLOW - NO	0.0478	1.147	418.8	0.0428	0.0528
		Daily Savings	0.251		
		Annual Savings	91.7		

Longitudinal Mixed Model: Accounting for Pre-Installation Flow

We added information on pre-existing showerheads (AVGFLOW) to estimate savings due to low-flow installation by previous showerhead flow-rates.

Three buckets were originally proposed. However, the lowest flow bucket (2.0 gpm or less) had too few observations and are rare in the population of households. Further, Enbridge will not be installing low-flow shower heads in homes with existing low flow heads (less than 2.0 gpm). Therefore two buckets were used instead: 2.0 to 2.5 gpm heads (preflow=1) and greater than 2.5 gpm (preflow=0).

The FREQ Procedure

preflow	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	35	49.30	35	49.30
1	36	50.70	71	100.00

There were statistically significant effects of flow category of pre-existing showerheads on consumption.

The following prediction table shows that savings in consumption is greater for the 2.5 + gpm group of houses (0.316848 per day) than in the 2.0-2.5 gpm group (0.179616 per day).

Predictions Derived by comparing low-flow to normal shower heads at the mean value of all other attributes, **for homes with pre-existing showerheads 2.0-2.5 gpm.**

PREFLOW=LOW (2-2.5 gpm)	**SIMPLE MODEL**				
MEAN Average	m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
LOW FLOW -NO	0.0517	1.240	452.5	0.0446	0.0587
LOW FLOW -YES	0.0442	1.060	387.0	0.0370	0.0513
		Daily Savings	0.180		
		Annual Savings	65.6		

Homes with pre-existing showerheads 2.0-2.5 gpm.

PREFLOW=HIGH (> 2.5 gpm)	**SIMPLE MODEL**				
MEAN Average	m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
LOW FLOW -NO	0.0660	1.583	577.8	0.0589	0.0730
LOW FLOW -YES	0.0528	1.266	462.2	0.0456	0.0599
		Daily Savings	0.317		
		Annual Savings	115.6		

Participants to be tracked, and gas savings assigned, as per the following table:

Scenario	Flow Rate of 'OLD' showerhead (GPM)	Flow Rate of 'NEW' showerhead (GPM)	Gas Savings (m3)
1	2.0-2.5	1.25	65.6
2	2.6 +	1.25	115.6

Electricity	**n/a kWh**

Water (Updated)	**See Below L**

Savings recommended by Navigant Consulting
And approved in EB 2008-0384 and 0385.

Participants to be tracked, and water savings assigned, as per the following table:

Scenario	Flow Rate of 'OLD' showerhead (GPM)	Flow Rate of 'NEW' showerhead (GPM)	Water Savings (L)
2	2.0-2.5	1.25	10,886
3	2.6 +	1.25	17,168

Other Input Assumptions

Equipment Life	**10 Years**

As recommended by Navigant and
as approved in EB 2008-0384 & 0385.

Incremental Cost (Contr. Install)	**$19**

As per utility program costs, bulk purchase of showerheads plus cost of installation.

Free Ridership	**10 %**

As approved in EB 2008-0384 & 0385.

Spillover (installed - Union & EGD)	**8 %**

Spillover rate recommended by Summit Blue Consulting[1].

[1] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

PIPE WRAP (R-4)

Existing Residential

Efficient Technology & Equipment Description
Insulated hot water pipe for conventional gas storage tank-type hot water heater (R-4).
Base Technology & Equipment Description
Conventional gas storage tank-type hot water heater without pipe wrap (R-1).

Resource Savings Assumptions

Natural Gas	**25 m³**

Assumptions and inputs:

- Gas savings calculated using method set out in 2006 Massachusetts study[1] except where noted.
- Average water heater energy factor: 0.57[2]
- Average household size: 3.1 persons[3]
- Assumed diameter of pipe to be wrapped: 0.75 inches
- Length of pipe to be wrapped: 6 feet.
- Surface area of pipe to be wrapped: 1.18 square feet.
- Ambient temperature around pipes: 16 °C (60 °F) [4]
- Average water heater set point temperature: 54 °C (130 °F)[5]
- Hot water temperature in outlet pipe: 52 °C (125 °F)[6]

Annual gas savings calculated as follows:

$$Savings = \left(\frac{1}{R_{base}} - \frac{1}{R_{eff}}\right) * Sa * \left(T_{pipe} - T_{amb}\right) * 24 * 365 * \frac{1}{EF} * 10^{-6} * 27.8$$

Where:

R_{base} = R-value of base equipment
R_{eff} = R-value of efficient equipment
Sa = Surface area of outlet pipe (ft^2)
T_{pipe} = Temperature of water in outlet pipe (°F)
T_{amb} = Ambient temperature around pipe (°F)
24 = Hours per day
365 = Days per year
EF = Water heater energy factor
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

Gas savings were determined to be 75% over base measure

$$Percent\ Savings = \frac{\left(G_{base} - G_{eff}\right)}{G_{base}}$$

Where:

G_{eff} = Annual natural gas use with efficient equipment, 8 m^3
G_{base} = Annual natural gas use with base equipment, 33 m^3

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1 RLW Analytics, *Final Market Potential Report Of Massachusetts Owner Occupied 1-4 Unit Dwellings*, July 2006 http://www.cee1.org/eval/db_pdf/575.pdf

2 Assumption of the Ministry of Energy of Ontario. See Table 4,

Electricity	**n/a kWh**
Water	**0 L**
Navigant has assumed that adopting the measure would not affect the quantity of water consumed.	

Other Input Assumptions

Equipment Life	**10 years**
Based on the estimated measure lifetimes used in four other jurisdictions (Iowa - 15 years, Puget Sound Energy - 10 years, Efficiency Vermont – 10 years, and NYSERDA7 – 10 years). Navigant also recommends using an EUL of 10 years.	
Incremental Cost (Cust. / Contr. Install)	**$1 / $4**
As per EB-2008-0384, EB-2008-0385, and as per utility bulk purchase price.	
Free Ridership	**4 %**
Free-ridership rate as per EB-2008-0384 and 0385	

http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.guide13

[3] Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, June 2008.

[4] RLW Analytics (2006). Given geographic proximity, Massachusetts temperatures used unchanged for Ontario.

[5] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4

[6] From source: "It is common to find a 5 - 10 F temperature drop from the water heater to the furthest fixtures in the house." Chinnery, G. *Policy recommendations for the HERS Community to consider regarding HERS scoring credit due to enhanced effective energy factors of water heaters resulting from volumetric hot water savings due to conservation devices/strategies,* EPA Energy Star for Homes, Sept 2006 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Volumetric_Hot_Water_Savings_Guidelines.pdf

PROGRAMMABLE THERMOSTAT

Low Income

Efficient Technology & Equipment Description
Programmable thermostat
Base Technology & Equipment Description
Standard thermostat

Resource Savings Assumptions

Natural Gas (Updated)	146 m^3
Savings recommended by Navigant Consulting.[1]	
Electricity (Updated)	**123 kWh**
Savings adjustment calculated by using a combination of Summit Blue and Navigant assumptions.[1, 2] Navigant electricity savings are based on OPA 2009 assumptions of 100% market penetration of central air.[1] Summit Blue reports a penetration rate of 57% for CAC across the province based on information from EGD and NRCan.[2] Using 57% penetration the electricity savings are (44 + (138*.57) – 122.7 kWh.[1,2]	
Water	**n/a L**

Other Input Assumptions

Equipment Life	15 years
Equipment life recommended by Summit Blue Consulting[2] and as approved in EB 2008-0384 & 0385.	
Incremental Cost (Contr. Install) (UG/EGD)	**$69**
As per utility program costs, bulk purchase of thermostats plus cost of installation.	
Free Ridership	**1 %**
As per EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-100-103, Feb. 6, 2009.

[2] "Resource Savings Values in Selected DSM Prescriptive Programs", Summit Blue Consulting, pg. 28, June 2008.

WEATHERIZATION

Low Income

Efficient Technology & Equipment Description
Energy audits to identify and implement the most cost-effective energy retrofit to improve building envelope efficiencies.
Base Technology & Equipment Description
No weatherization.

Resource Savings Assumptions

Natural Gas (Updated)	1,234 M^3
Based on the average actual results per participant from the 284 weatherized homes completed in 2007 & 2008 homes.	
Electricity (Updated)	**255 kWh**
Based on the average actual results per participant from the 284 weatherized homes completed in 2007 & 2008 homes	
Water	**N/A L**

Other Input Assumptions

Equipment Life (Updated)	23 Years
Based on average measure life of measures installed in 61 2007 program participant homes. (EB 2008-0384 & 0385) Measures included attic insulation, wall insulation, door and weather stripping and caulking.[1]	
Incremental Cost (Contr. Install) (Updated)	**$2,667**
Based on the average actual results per participant from the 284 weatherized homes completed in 2007 & 2008 homes	
Free Ridership	**0 %**
As per Generic Hearing EB 2006-0021 & EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-1104-106, Feb. 6, 2009.

1.5 GAL/MIN FAUCET AERATOR (Kitchen)

Low Income (Distributed)

Efficient Technology & Equipment Description
Faucet Aerator (Kitchen) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.5 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**38 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water (Updated)	**7,797 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.	
Incremental Cost **Customer Install**	**$1**
As per utility program costs, bulk purchase of aerators.	
Free Ridership	**1 %**
As per EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-112-115, Feb. 6, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

1.5 GAL/MIN FAUCET AERATOR (Bathroom)

Low Income (Distributed)

Efficient Technology & Equipment Description
Faucet Aerator (Bathroom) (1.5 GPM)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas (Updated)	**10 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water (Updated)	**2,004 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 years**
Faucet aerators have an estimated service life of 10 years.[1, 2] As approved in EB 2008-0384 & 0385.	
Incremental Cost **Customer Install**	**$1**
As per utility program costs, bulk purchase of aerators.	
Free Ridership	**1 %**
As per EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-108-111, Feb. 6, 2009.

[2] U.S. DOE – FEMP, Energy Cost Calculator for Faucets and Showerheads, http://www.eere.energy.gov/femp

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1.5 GAL/MIN LOW-FLOW SHOWERHEAD

Low Income (Distribution)

Efficient Technology & Equipment Description
Low-flow showerhead (1.5 gal/min)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas	**33 m^3**
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water	**6,334 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	**10 Years**
Low flow showerheads have an estimated service life of 10 years.[1] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. Install)	**$4**
As per utility program costs, bulk purchase of showerheads.	
Free Ridership (UG/EGD)	**1/5 %**
Free Ridership rate recommended by Summit Blue Consulting.[2] As approved in EB 2008-0384 & 0385.	

[1] Draft Report "Measures and Assumptions for Demand Side Management (DSM) Planning", Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-69-72, Feb. 6, 2009.

[2] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

1.25 GAL/MIN LOW-FLOW SHOWERHEAD

Low Income (Installed per Household)

Efficient Technology & Equipment Description
Low-flow showerhead (1.25 gal/min)
Base Technology & Equipment Description
Average existing stock – see below for flow rates.

Resource Savings Assumptions

Natural Gas (Updated)	**See Below m^3**

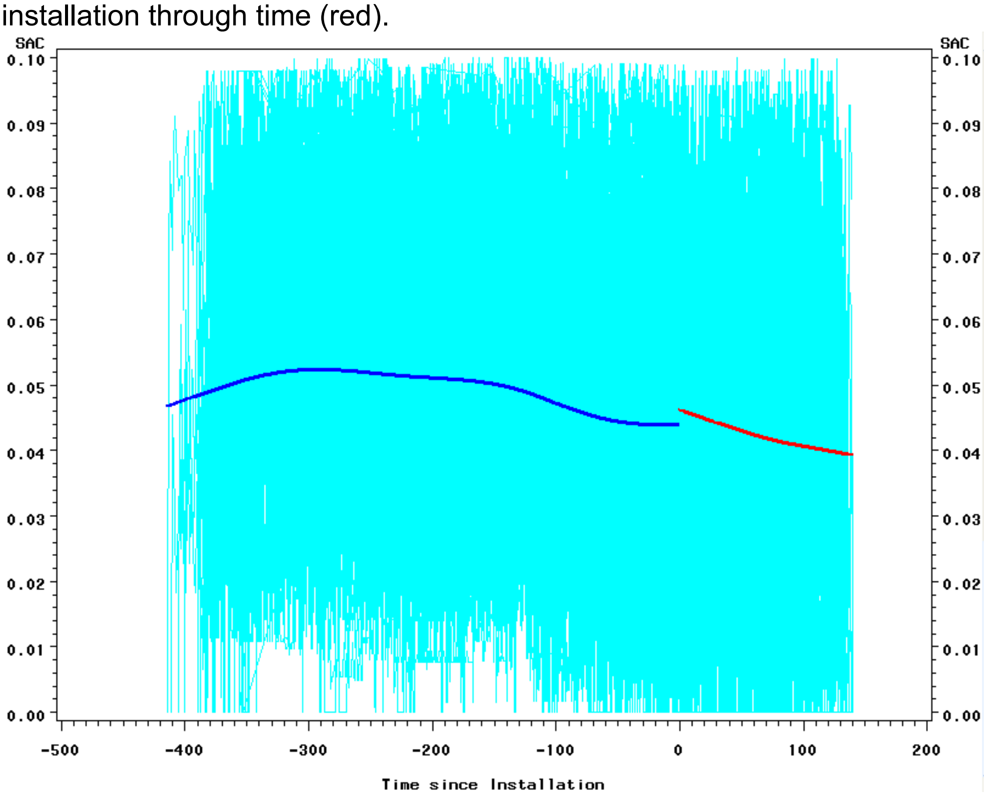
Gas savings as per results of EGD load research.

Data was analyzed for 69 households pre and post installation of low-flow shower-heads. Data records began on August 31 2007 until December 31 2008 date. Showerheads were installed between 13 August 2008 and 18 October 2008.
A simple paired t-test (before-after installation) was used to test for the magnitude and statistical significance of installation effect on consumption.

Longitudinal mixed models we used to explored relationships between inputs and low flow showerhead installation on consumption.

RESULTS

Data Exploration
A plot of seasonally adjusted consumption (SAC) by time shows that consumption is generally lower after low-flow showerhead installation (red) than before installation (blue). Surprisingly, immediately after installation (close to time 0) there appears to be an initial increase in consumption. But note the decreasing trend in consumption post-installation through time (red).



Paired T-Tests

Before-After Test on Seasonally Adjusted Data on 68 Households.

ALL DATA

paired t-test

Average hourly difference m^3/hour	Average daily difference m^3/day	Average annual difference m^3/year
0.0102	**0.245**	**89.35**
Lower 95% Confidence Bound		
0.0065	**0.156**	**56.94**
Upper 95% Confidence Bound		
0.0138	**0.331**	**120.89**

Longitudinal Mixed Model

The T-Test results above do not control for household attributes or time since installation. The following shows predictions from two mixed models explained in the Final Report.

Predictions Derived by comparing low-flow to normal shower heads at the mean value of all other attributes, and the mean value of time pre and post installation.

INTERACTION MODEL

MEAN Average	m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
LOW FLOW - YES	0.0583	1.399	510.5	0.0533	0.0633
LOW FLOW - NO	0.0478	1.147	418.8	0.0428	0.0528
		Daily Savings	0.251		
		Annual Savings	91.7		

Longitudinal Mixed Model: Accounting for Pre-Installation Flow

We added information on pre-existing showerheads (AVGFLOW) to estimate savings due to low-flow installation by previous showerhead flow-rates.

Three buckets were originally proposed. However, the lowest flow bucket (2.0 gpm or less) had too few observations and are rare in the population of households. Further, Enbridge will not be installing low-flow shower heads in homes with existing low flow heads (less than 2.0 gpm). Therefore two buckets were used instead: 2.0 to 2.5 gpm heads (preflow=1) and greater than 2.5 gpm (preflow=0).

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The FREQ Procedure

                                                 Cumulative    Cumulative
                 preflow    Frequency     Percent     Frequency      Percent
                 ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
                       0          35       49.30            35        49.30
                       1          36       50.70            71       100.00
```

There were statistically significant effects of flow category of pre-existing showerheads on consumption.

The following prediction table shows that savings in consumption is greater for the 2.5 + gpm group of houses (0.316848 per day) than in the 2.0-2.5 gpm group (0.179616 per day).

Predictions Derived by comparing low-flow to normal shower heads at the mean value of all other attributes, **for homes with pre-existing showerheads 2.0-2.5 gpm.**

PREFLOW=LOW (2-2.5 gpm)	**SIMPLE MODEL**				
MEAN Average	m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
LOW FLOW -NO	0.0517	1.240	452.5	0.0446	0.0587
LOW FLOW -YES	0.0442	1.060	387.0	0.0370	0.0513
		Daily Savings	0.180		
		Annual Savings	65.6		

Homes with pre-existing showerheads 2.0-2.5 gpm.

PREFLOW=HIGH (> 2.5 gpm)	**SIMPLE MODEL**				
MEAN Average	m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
LOW FLOW -NO	0.0660	1.583	577.8	0.0589	0.0730
LOW FLOW -YES	0.0528	1.266	462.2	0.0456	0.0599
		Daily Savings	0.317		
		Annual Savings	115.6		

Participants to be tracked, and gas savings assigned, as per the following table:

Scenario	Flow Rate of 'OLD' showerhead (GPM)	Flow Rate of 'NEW' showerhead (GPM)	Gas Savings (m3)
1	2.0-2.5	1.25	65.6
2	2.6 +	1.25	115.6

Electricity	**n/a kWh**

Water (Updated)	**See Below L**

Savings recommended by Navigant Consulting
And approved in EB 2008-0384 and 0385.

Participants to be tracked, and water savings assigned, as per the following table:

Scenario	Flow Rate of 'OLD' showerhead (GPM)	Flow Rate of 'NEW' showerhead (GPM)	Water Savings (L)
2	2.0-2.5	1.25	10,886
3	2.6 +	1.25	17,168

Other Input Assumptions

Equipment Life	**10 Years**

As recommended by Navigant and
as approved in EB 2008-0384 & 0385.

Incremental Cost (Contr. Install)	**$19**

As per utility program costs, bulk purchase of showerheads plus cost of installation.

Free Ridership (Union/EGD)	**1/5 %**

As approved in EB 2008-0384 & 0385.

1.25 GAL/MIN LOW-FLOW SHOWERHEAD

Low Income (Distribution)

Efficient Technology & Equipment Description
Low-flow showerhead (1.25 gal/min)
Base Technology & Equipment Description
Average existing stock (2.2 GPM)

Resource Savings Assumptions

Natural Gas	60 m^3
Savings recommended by Navigant Consulting.[1]	
Electricity	**n/a kWh**
Water	**10,570 L**
Savings recommended by Navigant Consulting.[1]	

Other Input Assumptions

Equipment Life	10 Years
Low flow showerheads have an estimated service life of 10 years.[1] As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. Install)	**$4**
As per utility program costs, bulk purchase of showerheads.	
Free Ridership (UG/EGD)	**1/5 %**
Free Ridership rate recommended by Summit Blue Consulting.[2] As approved in EB 2008-0384 & 0385.	

[1] Draft Report “Measures and Assumptions for Demand Side Management (DSM) Planning”, Navigant Consulting Inc., Ontario Energy Board, Appendix C: Substantiation Sheets, pg. B-79-82, Feb. 6, 2009.

[2] “Residential Measure Free Ridership And Inside Spillover Study - Final Report”, Summit Blue Consulting, June 2008.

PIPE WRAP (R-4)

Low-Income Residential - Existing

Efficient Technology & Equipment Description
Insulated hot water pipe for conventional gas storage tank-type hot water heater (R-4).
Base Technology & Equipment Description
Conventional gas storage tank-type hot water heater without pipe wrap (R-1).

Resource Savings Assumptions

Natural Gas	**25 m^3**

Assumptions and inputs:

- Gas savings calculated using method set out in 2006 Massachusetts study[7] except where noted.
- Average water heater energy factor: 0.57[8]
- Average household size: 3.1 persons[9]
- Assumed diameter of pipe to be wrapped: 0.75 inches
- Length of pipe to be wrapped: 6 feet.
- Surface area of pipe to be wrapped: 1.18 square feet.
- Ambient temperature around pipes: 16 °C (60 °F) [10]
- Average water heater set point temperature: 54 °C (130 °F)[11]
- Hot water temperature in outlet pipe: 52 °C (125 °F)[12]

Annual gas savings calculated as follows:

$$Savings = \left(\frac{1}{R_{base}} - \frac{1}{R_{eff}}\right) * Sa * \left(T_{pipe} - T_{amb}\right) * 24 * 365 * \frac{1}{EF} * 10^{-6} * 27.8$$

Where:

R_{base} = R-value of base equipment
R_{eff} = R-value of efficient equipment
Sa = Surface area of outlet pipe (ft^2)
T_{pipe} = Temperature of water in outlet pipe (°F)
T_{amb} = Ambient temperature around pipe (°F)
24 = Hours per day
365 = Days per year
EF = Water heater energy factor
10^{-6} = Factor to convert Btu to MMBtu
27.8 = Factor to convert MMBtu to m^3

Gas savings were determined to be 75% over base measure

$$Percent\ Savings = \frac{\left(G_{base} - G_{eff}\right)}{G_{base}}$$

Where:

G_{eff} = Annual natural gas use with efficient equipment, 8 m^3
G_{base} = Annual natural gas use with base equipment, 33 m^3

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7 RLW Analytics, *Final Market Potential Report Of Massachusetts Owner Occupied 1-4 Unit Dwellings*, July 2006 http://www.cee1.org/eval/db_pdf/575.pdf

8 Assumption of the Ministry of Energy of Ontario. See Table 4, http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.guide13

Electricity	**n/a kWh**
Water	**0 L**
Navigant has assumed that adopting the measure would not affect the quantity of water consumed.	

Other Input Assumptions

Equipment Life	**10 years**
Based on the estimated measure lifetimes used in four other jurisdictions (Iowa - 15 years, Puget Sound Energy - 10 years, Efficiency Vermont – 10 years, and NYSERDA7 – 10 years). Navigant also recommends using an EUL of 10 years.	
Incremental Cost (Contr. Install)	**$ 4**
Incremental cost as per utility bulk purchase price plus installation	
Free Ridership	**1 %**
Free-ridership rate as per EB-2008-0384 and 0385	

[9] Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, June 2008.
[10] RLW Analytics (2006). Given geographic proximity, Massachusetts temperatures used unchanged for Ontario.
[11] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4
[12] From source: "It is common to find a 5 - 10 F temperature drop from the water heater to the furthest fixtures in the house." Chinnery, G. *Policy recommendations for the HERS Community to consider regarding HERS scoring credit due to enhanced effective energy factors of water heaters resulting from volumetric hot water savings due to conservation devices/strategies,* EPA Energy Star for Homes, Sept 2006 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Volumetric_Hot_Water_Savings_Guidelines.pdf

HIGH EFFICIENCY COMMERCIAL FRYER

New/Existing Commercial

Efficient Technology & Equipment Description
Energy Star commercial fryer (at least 50% cooking efficiency[13]) or at least 50% efficiency and less than 9,000 BTU/H idle energy rate according to ASTM2144-07[14].
Base Technology & Equipment Description
Standard commercial fryer (35% cooking efficiency)

Resource Savings Assumptions

Natural Gas	**916 m³**

The natural gas savings is based on the Energy Star calculator, by market research specific to UG Territory. Input parameters for the calculator can be found below, along with their sources.

Category	**Value Data**		**Source**
Power ENERGY STAR Qualified Unit			
Initial Cost	**$3,740**		**Union Gas Contractors, Consortium for Energy Efficiency (NGTC 130908 report)**
Cooking Energy Efficiency	50%		ENERGY STAR Specification
Cooking Energy	114,000	Btu/day	Calculated - Cooking energy is fryer energy input while cooking, not energy absorbed by food
Production Capacity 6	5	lb/hour	FSTC 2004
Idle Energy Rate	9,000 B	tu/hour	ENERGY STAR Specification
Total Idle Time	9.26	hour/day	Calculated
Idle Energy	83,354	Btu/day	Calculated
Energy to Food	570	Btu/lb	FSTC 2004
Heavy Load	3	lb	FSTC 2004
Preheat Energy	15,500	Btu/day	FSTC 2004
Preheat Time	15	minutes	FSTC 2007
Total Energy	212,854	Btu/day	Calculated
Lifetime 7		years	Garland (Frymaster) estimate to Victoria Falvo, Union Gas, October 2008
Conventional Unit			
Initial Cost	**$2,240**		**Union Gas contractors**
Cooking Energy Efficiency 35%			FSTC 2004
Cooking Energy	162,857	Btu/day	Calculated - Cooking energy is fryer energy input while cooking, not energy absorbed by food
Production Capacity	60 lb	/hour	FSTC 2007
Idle Energy Rate 14	,000	Btu/hour	FSTC 2004

[13] Cooking energy efficiency is defined as the quantity of energy input to the food products expressed as a percentage of the quantity of energy input to the appliance.

14 NGTC, DEVELOPMENT OF MARKET INFORMATION AND DSM MEASURE FOR HIGH EFFICIENCY GAS FRYERS Final Report ver 1.2, October 30, 2008, Pg 36

Total Idle Time	9.13	hour/day	Calculated
Idle Energy	127,867	Btu/day	Calculated
Energy to Food	570	Btu/lb	FSTC 2004
Heavy Load	3	lb	FSTC 2004
Preheat Energy	16,000	Btu/day	FSTC 2004
Preheat Time	15	minutes	FSTC 2007
Total Energy	306,724	Btu/day	Calculated
Lifetime 7		years	Garland (Frymaster) estimate to Victoria Falvo, Union Gas, October 2008
Maintenance			
Labor cost (per hour) $	20		EPA 2004
Labor time (hours)	0		EPA 2004
Usage			
Average number of operating hours per day	11.05	hours/day	Restaurants on Union Gas' territory
Average number of operating hours per year	3,832	hours/year	Restaurants on Union Gas' territory
Number of Days of operation	346.75 day	s/year	Restaurants on Union Gas' territory
Number of Preheats per day	1	preheat/day	FSTC 2004
Pounds of Food Cooked per day	100	lb/day	Restaurants on Union Gas' territory

The duty cycle of fryers was estimated by obtaining the operating hours of twenty restaurants on Union's territory.[15] The figure of 100 lbs/fryer/day correlates very well with FSTC 2007 estimate of 150 lbs/fryer/day used in the Energy Star calculator when one takes into account the reduced operating hours of Union Gas territory restaurants relative to US restaurants:
150 lbs/dryer/day * 11.05 hours / 16 hours = 103.6 lbs/dryer/day.

Electricity	**-546.3 kWh**

The difference in electricity usage, obtained separately from a simple calculation based on the manufacturer-specified power consumption, showed that high efficiency fryers use slightly more electricity than the base case fryer.[14]

Water	**n/a L**

Other Input Assumptions

Equipment Life	**7 years**

[15] NGTC, DEVELOPMENT OF MARKET INFORMATION AND DSM MEASURE FOR HIGH EFFICIENCY GAS FRYERS Final Report ver 1.2, October 30, 2008, Pg 33

Equipment life (7 yrs) was estimated by local distributor, Garland, October 8, 2008.	
Incremental Cost (Cust. / Contr. Install)	**1500 $**
The incremental installed costs were estimated by surveying five contractors in UG territory.[14] This figure disagrees with the value used in the Energy-Star calculator, $6,206. We do not find it possible to substitute this hard field data by the number, almost three times as high, of the Energy-Star calculator. As noted before, fryer prices are heavily dependent on accessories, and it seems that the Energy-Star calculator chose a much better equipped base model than what is actually sold in the Union Gas market.[15]	
Free Ridership	**%**

CONDENSING BOILERS

Commercial New Building Construction and Building Retrofit

Efficient Technology & Equipment Description
Condensing Boiler (90% estimated seasonal efficiency)
Base Technology & Equipment Description
Non-condensing Boiler (76% estimated seasonal efficiency)

Resource Savings Assumptions

Natural Gas	0.0119 m^3 / Btu/hr
The natural gas savings are based on the reduction in space heating gas consumption from using a condensing boiler relative to a non-condensing boiler. The principle assumption in the calculation of the savings is that the condensing boiler is properly oversized by 20%. The heating load for the entire heating season can be determined from the installed capacity and boiler seasonal efficiency using degree day analysis. A generic rate of savings of 0.0119 m3 / Btu/hr of capacity was determined from this analysis. The single savings number is the weighted average of Union Gas South (70%) and Union Gas North (30%) savings estimates.	
Electricity	**n/a kWh**
Water	**n/a L**

Other Input Assumptions

Equipment Life	25 years
Condensing boilers have an estimated service life of 25 years.[16]	
Incremental Cost	**$12 / 10^3 Btu/hr**
A generic incremental cost of $14,000 per million Btu / hr (adjusted for the US/CDN exchange by a factor of 1.10) was used based on information recently published in the ASHRAE Journal.[17] Local Canadian manufacturers reported $9,800 for 230,000 Btu/hour condensing boilers[18], which is $43 / kBtu/hour. Baseline cost (conventional boilers) is $31/kBtu/hr. Incremental cost is $12 kBtu/hour.	
Free Ridership	**5 %**
Free Ridership as per 2008-0384 and 0385	

[16] ASHRAE Applications Handbook – 2003, Chapter 36 – Owning and Operating Costs, Table 3.
[17] "Boiler System Efficiency", Thomas H. Durkin, ASHRAE Journal - July 2006
[18] Veissmann Group, http://www.viessmann.ca/en

Demand Control Kitchen Ventilation (DCKV)

Building Retrofit

Efficient Technology & Equipment Description
Ventilation with DCKV
Base Technology & Equipment Description
Ventilation without DCKV

Resource Savings Assumptions

Natural Gas		
	3,972 m3	**0 – 4999 CFM**
	10,347 m3	**5000-9999 CFM**
	18,941 m3	**10000-15000 CFM**

The demand control kitchen ventilation savings were determined using the methodology described in the Detailed Energy Savings Report (www.melinkcorp.com). The savings were generated for three ranges of total range hood exhaust: 0 – 4999 CFM; 5000 – 9999 CFM; and 10,000 – 14,999 CFM. The midpoint of each exhaust range was used to generate the savings (both gas and electrical). The inputs for the savings calculations were supplied by MELINK as typical for each application range.

Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency, 2.5 hp motor, and 3.0 COP for cooling,
· Using design weather data from the Outdoor Airload Calculator, baseline net heating loads for an exhaust volumes were determined for two locations: London (Union South) and North Bay (Union North)
· Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

			Savings			
CFM	range		London	North Bay	**70/30 blend**	
Existing Building	up to 4999	Natural Gas	3,660	4,699	**3,972**	m3
		Electricity	7,281	7,115	**7,231**	kWh
	5000-9,999	Natural Gas	9,535	12,240	**10,347**	m3
		Electricity	23,180	22,748	**23,051**	kWh
	10,000-15,000	Natural Gas	17,455	22,406	**18,941**	m3
		Electricity	40,929	40,138	**40,692**	kWh

Electricity		
	7,231 kWh	**0 – 4999 CFM**
	23,051 kWh	**5000-9999 CFM**
	40,692 kWh	**10000-15000 CFM**

(see table above)

Water	**n/a L**

Other Input Assumptions

Equipment Life	**15 years**	
Melink web site states "Each Optic Sensor enclosure has a purge fan that keeps the environment inside the enclosure under a positive air pressure. This prevents contaminated air from entering the sensor unit". Melink Canada representative George McGrath estimates their system life at 15 years[19].		
Incremental Cost	**$5,000**	**0 – 4999 CFM**
	$10,000	**5000-9999 CFM**
	$15,000	**10000-15000 CFM**
Typical costing information was provided by MELINK.		
Free Ridership	**5 %**	
FR as per 2008-0384 and 0385		

[19] MELINK Canada, February, 2009

Demand Control Kitchen Ventilation (DCKV)

New Building Construction

Efficient Technology & Equipment Description
Ventilation with DCKV
Base Technology & Equipment Description
Ventilation without DCKV

Resource Savings Assumptions

Natural Gas		
	3,972 m3	0 – 4999 CFM
	6,467 m3	5000-9999 CFM
	11,838 m3	10000-15000 CFM

The demand control kitchen ventilation savings were determined using the methodology described in the Detailed Energy Savings Report (www.melinkcorp.com). The savings were generated for three ranges of total range hood exhaust: 0 – 4999 CFM; 5000 – 9999 CFM; and 10,000 – 14,999 CFM. The midpoint of each exhaust range was used to generate the savings (both gas and electrical). The inputs for the savings calculations were supplied by MELINK as typical for each application range.

Assuming the DCKV system is operating 16 hours/day, 7 days/week, 52 weeks/year, at 80% heating efficiency, 2.5 hp motor, and 3.0 COP for cooling,
• Using design weather data from the Outdoor Airload Calculator, baseline net heating loads for exhaust volumes were determined for two locations: London (Union South) and North Bay (Union North)
• Weighted average natural gas savings is calculated by assigning 70% to Union Gas South consumption and 30% to Union Gas North consumption based on the customer population of Union Gas service territories.

These gas values were modified to take into account OBC-2006:
Modified so that 50 % of the Makeup Air is conditioned to (i.e., 50% of the exhaust air is offset with unconditioned makeup air) for 5000-9999 CFM and 10000-15000 CFM savings assumptions. The 0-4999 CFM gas savings was unmodified[20],[21].

			Savings			
CFM	range		London	North Bay	**70/30 blend**	
New Building	up to 4999	Natural Gas	3,660	4,699	**3,972**	m3
		Electricity 7,229		7,098	**7,190**	kWh
	5000-9,999	Natural Gas	5,960	7,650	**6,467**	m3
		Electricity 22,855		22,643	**22,791**	kWh
	10,000-15,000	Natural Gas	10,910	14,004	**11,838**	m3
		Electricity 40,334		39,945	**40,217**	kWh

Electricity		
	7,190 kWh	0 – 4999 CFM
	22,791 kWh	5000-9999 CFM
	40,217 kWh	10000-15000 CFM

(see Natural Gas) All capacity categories were modified to reflect the OBC-2006 increase in minimum efficiency of the air conditioning COP from 3.0 to 3.81 (SEER = 13)[21]

Water	n/a L

Other Input Assumptions

Equipment Life	15 years

[20] from Ontario Building Code (OBC) 2006 via ASHRAE 90.1-2004 clause 6.5.7.1
[21] Caneta Research Inc, Quasi-Tool Changes and Commentary, August, 2008

Melink web site states "Each Optic Sensor enclosure has a purge fan that keeps the environment inside the enclosure under a positive air pressure. This prevents contaminated air from entering the sensor unit". Melink Canada representative George McGrath estimates their system life at 15 years[22].		
Incremental Cost	**$5,000**	**0 – 4999 CFM**
	$10,000	**5000-9999 CFM**
	$15,000	**10000-15000 CFM**
Typical costing information was provided by MELINK.		
Free Ridership	**5**	**%**
FR as per 2008-0384 and 0385		

[22] MELINK Canada, February, 2009

DESTRATIFICATION FAN

Commercial New Buildings

Efficient Technology & Equipment Description
Destratification Fan. (per fan) For fans with minimum diameter of 20' located in warehousing, manufacturing, industrial or retail buildings with forced air space heating, including unit heaters.
Base Technology & Equipment Description
No destratification fan.

Resource Savings Assumptions

Natural Gas	**7,020 m^3**
Based on Agviro's report "Prescriptive Destratification Fan Program - Prescriptive Savings Analysis", by Agviro Inc., February 2009, which was based largely on an analysis of energy savings due to destratification fans installed at the commercial manufacturing and warehousing facility of Hunter Douglas during the winter of 2008. The results of this evaluation are included in the report "Cold Weather Destratification; Hunter Douglas Monitoring Results, Final Report, May 2008". The analysis showed an area of destratification influence of approximately 100' diameter (7,850 ft2). This would be considered as conservative energy savings versus the average installation since the fans were operated at a maximum 15 Hz instead of the typical 20 Hz. The energy savings is assumed to be an average for destratification fans installed in warehouses that have ceiling heights of 30'. Electrical savings are determined for reduced use of items that includes blower motors on space heating equipment. Savings were determined for a 1.5 hp destratification fan motor and the auxiliary electrical savings due to the heating energy savings.	
Electricity	**(123) kWh**
Based on Agviro's report and the same input parameters as above.	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**15 years**
The estimated equipment life for destratification fans is 15 years [SEED Program Guidelines. J-20. December. 2004]. This value is also supported by ASHRAE [ASHRAE Handbook, HVAC Applications SI Edition. Chapter 36 -Table 4. Pg. 36.3. 2007], which lists the service life for propeller fans as 15 years. As approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust. / Contr. Install)	**$ 7,021**
Weighted average of 20' and 24' diameter fans based on market data and cost data[23] As approved in EB 2008-0384 & 0385.	
Free Ridership	**10 %**
Based on market & total sales data for Ontario[24] and building type data from UG's Customer database. As per EB 2008-0384 & 0385.	

[23] Targeted Market Study. HVLS fans on Wisconsin Dairy Farms. State of Wisconsin Department of Administration Division of Energy. June 12, 2006., RSMeans. Mechanical Cost Data - 29th Annual Edition. 2006, and communications with Manufacturers.
[24] Email from Joan Wood (EnviraNorth) to Victoria Falvo (UG), May 30, 2008

INFRARED HEATERS

New Building Construction

Efficient Technology & Equipment Description
Infrared Heater, Single Stage or High Intensity
Qualifier/Restriction
OBC 2006 requires infrared heaters for unenclosed spaces excluding loading docks with air curtains. Therefore, infrared heaters are not applicable to these conditions. (Caneta Research, Inc. August, 2008)
Base Technology & Equipment Description
Unit Heater

Resource Savings Assumptions

Natural Gas	**0.0102 m^3 / Btu/hr**

The infrared heater gas savings were based on the analysis procedures previously created by Agviro Inc. for Union. The analysis was supplemented by adding a 20% over sizing factor on the equipment in the analysis. A generic rate of savings of 0.0102 m3 / Btu/hr of capacity was determined from this analysis. The single savings number is the weighted average of Union Gas South (70%) and Union Gas North (30%) savings estimates.

Electricity		
	236 kWh	**0-49,999 Btu/hr**
	534 kWh	**50,000 – 164,999 Btu/hr**
	833 kWh	**> 165,000 Btu/hr**

Electricity savings are determined from the difference in electricity consumption of the infrared heater and a comparable unit heater.

		Blower Motor	Infrared Oper	ating Hours[25]		Blower Motor	Infrared S	avings
Capacity (BTU/H)		kW	kW	Unit Heater (hrs/yr)	Infrared (hrs/yr) k	Wh/yr	kWh/yr	kWh/yr
less than	50,000	0.125	0.031	2405	2044	299	64	236
less than	165,000	0.248	0.031	2405	2044	597	64	534
greater than	165000	0.373	0.031	2405	2044	897	64	833

Electricity based on 1/24 hp Solaronics Radiant Tube heaters.[26]

- Electricity savings = Unit heater capacity x operating hours – Infrared Capacity x operating hours, the savings are summarised above for three ranges of capacities.
- Electricity savings % = Electricity savings (kWh) / Baseline Consumption (kWh)

Water	**n/a L**

Other Input Assumptions

Equipment Life	**20 years**

Infrared Heaters have an estimated service life of 20 years.[27]

Incremental Cost	**\$0.009 / 10^3 Btu/hr**

Local retailers reported an average of \$0.009 / Btu/hr incremental cost as per Navigant's survey of local retailers.[28]

Free Ridership	**33 %**

Free Ridership based on EB-2008-0384 and 0385

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[25] from "Infrared Analysis (Agviro Replicated).xls", which included UG North & South climates as well as a 20% oversizing factor.
[26] http://solaronics.thomasnet.com/Asset/SSTG-SSTU-GB_200010_Spec_Sheet.pdf
[27] "Prescriptive Incentives for Select Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., Prepared by: Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.
[28] Navigant Consulting, MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - Draft Report, Pg 207

INFRARED HEATERS

Existing Building Construction

Efficient Technology & Equipment Description
Infrared Heater, Single Stage or High Intensity

Base Technology & Equipment Description
Unit Heater

Resource Savings Assumptions

Natural Gas	**0.0102 m^3 / Btu/hr**

The infrared heater gas savings were based on the analysis procedures previously created by Agviro Inc. for Union. The analysis was supplemented by adding a 20% over sizing factor on the equipment in the analysis. A generic rate of savings of 0.0102 m3 / Btu/hr of capacity was determined from this analysis. The single savings number is the weighted average of Union Gas South (70%) and Union Gas North (30%) savings estimates.

Electricity		
	236 kWh	**0-49,999 Btu/hr**
	534 kWh	**50,000 – 164,999 Btu/hr**
	833 kWh	**> 165,000 Btu/hr**

Electricity savings are determined from the difference in electricity consumption of the infrared heater and a comparable unit heater.

		Blower Motor	Infrared	Operating Hours[29]		Blower Motor	Infrared	Savings
Capacity (BTU/H)		kW	kW	Unit Heater (hrs/yr)	Infrared (hrs/yr) k	Wh/yr	kWh/yr	kWh/yr
less than	50,000	0.125	0.031	2405	2044	299	64	236
less than	165,000	0.248	0.031	2405	2044	597	64	534
greater than	165000	0.373	0.031	2405	2044	897	64	833

Electricity based on 1/24 hp Solaronics Radiant Tube heaters.[30]

- Electricity savings = Unit heater capacity x operating hours – Infrared Capacity x operating hours, the savings are summarised above for three ranges of capacities.
- Electricity savings % = Electricity savings (kWh) / Baseline Consumption (kWh)

Water	**n/a L**

Other Input Assumptions

Equipment Life	**20 years**

Infrared Heaters have an estimated service life of 20 years.[31]

Incremental Cost	**$0.009 / 10^3 Btu/hr**

Local retailers reported an average of $0.009 / Btu/hr incremental cost as per Navigant's survey of local retailers.[32]

Free Ridership	**33 %**

Free Ridership based on EB-2008-0384 and 0385

[29] from "Infrared Analysis (Agviro Replicated).xls", which included UG North & South climates as well as a 20% oversizing factor.
[30] http://solaronics.thomasnet.com/Asset/SSTG-SSTU-GB_200010_Spec_Sheet.pdf
[31] "Prescriptive Incentives for Select Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., Prepared by: Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.
[32] Navigant Consulting, MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - Draft Report, Pg 207

ROOFTOP UNIT

Commercial New/Existing

Efficient Technology & Equipment Description
Two-stage rooftop unit, up to and including 5 tons of cooling (85% efficient)
Base Technology & Equipment Description
Single-stage rooftop unit (80% efficient)

Resource Savings Assumptions

Natural Gas	**300**	**m^3**
The natural gas savings are estimated from the difference in annual gas consumption from single-stage to two-stage operation. Assuming the base case efficiency of 80% and the gas use for 5 rooftop units is 25,500 M3[33], the actual space heating load is 25,500*0.8 = 20,400 M3/y. A system of 85% efficiency would then use 20,400/0.85 = 24,000 for a savings of 1,500 M3 for 5 – 5 ton units or 300 M3 per unit.		
Electricity	**n/a**	**kWh**
Water	**n/a**	**L**

Other Input Assumptions

Equipment Life	**15**	**years**
As per Navigant Consulting[34] and ASHRAE Handbook, 2008		
Incremental Cost (Cust. / Contr. Install)	**-**	**$375**
The incremental cost of two-stage rooftop units compared with single-stage units is $250 per unit.[33] Local Canadian manufacturer disclosed an incremental cost of $500 for 2-stage rooftop units compared to single stage rooftop units. Therefore, an average cost of $375 is assumed (($250 + $500) / 2 = $375).[34]		
Free Ridership	**5**	**%**
Free-ridership rate as per EB-2008-0384 and 0385		

[33] "Prescriptive Incentives for Select Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., Prepared by: Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

[34] Navigant rooftop substantiation document, pg B-209 - EB-2008-0346 Ontario Energy Board DSM Assumptions, February 6, 2009

PROGRAMMABLE THERMOSTAT

New/Existing - Commercial (per thermostat)

Efficient Technology & Equipment Description
Programmable thermostat
Base Technology & Equipment Description
Standard manual thermostat

Resource Savings Assumptions

Natural Gas	**varies**	**m^3**

Energy use by market segment from space heating and cooling were based on NRCAN Energy intensity data[35],[36]. The percentage of gas savings are based on the assumption of 3% savings per degree F setback as applied in the Energy Star setback calculator and Honeywell commercial calculator, corrected for average outdoor heating season temperature to give a percentage savings of 2.4% per degree F for London, and 2.05% per degree F for North Bay[37],[38]. Setback duration was estimated for each market[39]. The actual setback temperatures used in each market were estimated based on best available information (72 degrees F to 64 degrees F for heating and 74 degrees F to 78 degrees F for cooling).

NRCAN Market Segment	Space Heating Energy Intensity (m3/ft2/yr)	Gas Savings %	Space Cooling Energy Intensity (kWh/ft2/yr)	Electrical Savings %	Space Cooling Market Saturation	Setback/ Forward Duration
1. Wholesale Trade	2.6	6.5%	5.1	6%	85%	7hrs/night
2. Retail Trade	2.2	6.5%	4.4	6%	85%	7hrs/night
3. Transportation and Warehousing 2.5		10.4%	3.2	11%	10%	12hrs/M-Sat night + 24hrs Sunday
4. Information and Cultural Industries	2.4 12.1%		4.8	12%	75%	12hrs/weekday night + 24hrs Sat & Sun
5. Offices	1.8	12.1%	3.6	12%	86%	12hrs/weekday night + 24hrs Sat & Sun
6. Educational Services	2.4 12.1%		4.9	12%	45%	12hrs/weekday night + 24hrs Sat & Sun
7. Health Care and Social Assistance	2.7	0.0%	5.4	0%	75%	0
8. Arts, Entertainment and Recreation	3.7	6.5%	7.5	6%	87%	7hrs/night
9. Accommodation and Food Services	3.5	6.5%	7.0	6%	70%	7hrs/night
10. Other Services	2.2	10.4%	4.3	6%	69%	7hrs/night

The market segments were converted from NRCAN to the UG market segments. In some cases a blend of up to 3 NRCAN market segments were used to describe the UG markets. The savings took into account typical heating/cooling zone areas covered by a thermostat for different market segments[40],[41],[42]. The institutional market varied so much that the floor areas were determined separately by its components[43]. Hospitals were not included, nor were Long Term Health Care Facilities, since many of the rooms are occupied 24/7 and would not benefit from temperature setback.

UG Market Segments	NRCAN Market Segment ID[44]	NRCAN Market Segment ID	NRCAN Market Segment ID	Thermostat Zone Area (SqFt)
1. Industrial	3 1		10	3,000
2. Warehouse	3			3,000
3. Multifamily	9			1,200
4. Office	4 5		6	650
5. Retail	1 2			600
6. Foodservice	9			1,175
7. Hotels/Motels	9			461
8. Institutional – (No Long Term Care), Schools, Universities, Colleges				
Information and Cultural Industries	4			650
Educational Services	6			986
9. Hospitals	7			NA
10. Recreation	8			2,500
11. Agriculture	10			3,000

The market segments were consolidated into segments below.

UG Market Segments	Gas Savings per Tstat (m3/yr/Tstat)
Warehouse, Recreation, Agriculture, Industrial	674
Office, Institutional (No Long Term Care), Multifamily, Foodservice, Hotels/Motels, Retail	191

Electricity	**varies**	**kWh**

The electricity savings is based on energy intensity from space cooling for different market segments[45] and the Energy Star/Honeywell Commercial calculator. Not all buildings have cooling, therefore the percentage of each segment that has cooling was included[46]. Otherwise, the electricity savings below were calculated in much the same way as the gas savings above.

UG Market Segments	Electrical Savings per Tstat (kWh/yr/Tstat)
Warehouse, Recreation, Agriculture, Industrial	524
Office, Institutional (No Long Term Care), Multifamily, Foodservice, Hotels/Motels, Retail	246

Water	**n/a**	**L**

Other Input Assumptions

Equipment Life	**15**	**years**

Sanchez, M., Webber, C., Brown, R. and Homan, G. *2007 Status Report: Savings Estimates for the ENERGY STAR® Voluntary Labelling Program,* LBNL-56380, Lawrence Berkeley Lab., March 2007.

Incremental Cost	**$40**

Incremental cost as per 2009 bulk purchase price.

Free Ridership	**20**	**%**

Free Ridership as per EB-2008-0384 and 0385

PRESCRIPTIVE SCHOOL BOILERS - ELEMENTARY

Commercial Existing Buildings

Efficient Technology & Equipment Description
Space Heating, Hydronic Boiler with Combustion Efficiency of 83% or higher
Base Technology & Equipment Description
Space Heating, Hydronic Boiler with Combustion Efficiency of 80% to 82%.

Resource Savings Assumptions

Natural Gas	**10,830 m^3**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Electricity	**N/A kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**25 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Install)	**$8,646**
Source: Elem entary Sc hools Prescriptive Savings Analysis Report, Agviro Inc., November 23, 2007. Increm ental costs are ba sed on the weighted average of boiler types as noted above.	
Free Ridership (EGD/Union)	**12/27 %**
As recommended by Summit Blue and approved in EB 2008-0384 & 0385.	
Spillover (UG and EGD)	**10 %**
As recommended by Summit Blue's Custom Projects Attribution Study, 2008.	

PRESCRIPTIVE SCHOOL BOILERS - SECONDARY

Commercial Existing Buildings

Efficient Technology & Equipment Description -
Space Heating, Hydronic Boiler with Combustion Efficiency of 83% or higher
Base Technology & Equipment Description
Space Heating, Hydronic Boiler with Combustion Efficiency of 80% to 82%.

Resource Savings Assumptions

Natural Gas	**43,859 m^3**
As recommended by Navigant and approved in EB 2008-0384 / 0385.	
Electricity	**N/A kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**25 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Install)	**$14,470**
Source: Secondary Schools Prescriptive Savings Analysis Report, Agviro Inc., November 23, 2007. Incremental costs are based on the weighted average of boiler types as noted above.	
Free Ridership (EGD/Union)	**12/27 %**
As recommended in Summit Blue and approved in EB 2008-0384 & 0385.	
Spillover (UG and EGD)	**10 %**
As recommended by Summit Blue's Custom Projects Attribution Study, 2008.	

CONDENSING GAS WATER HEATER

New/Existing Commercial

Efficient Technology & Equipment Description
Condensing Gas Water Heater[47] (95% thermal efficiency), 50 gallons. Resource savings were calculated for 950[48] USG/day hot water use[49]:
Base Technology & Equipment Description
Conventional storage tank gas water heater[50] (thermal efficiency[51]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	1543 m^3/Btu/hr

Assumptions and inputs:
- Daily hot water draw – 950 USG/day[48]
- Input rating for efficient and base equipment: 199,000 Btu.
- Average water inlet temperature: 7.22 DegC (45 degF)[52,53]
- Average water heater set point temperature: 54 degC (130 degF)[54]
- Stand-by loss of (condensing) Polaris PC 199-50 3NV: 244 Btu/hr.[55]
- Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[56]

Annual gas savings calculated as follows:

$$Savings = \left[W * 8.33 * (T_{out} - T_{in}) * \left(\frac{1}{Eff_{base}} - \frac{1}{Eff_{eff}} \right) + \left(Stby_{base} - Stby_{eff} \right) * 24 * 365 \right] * 10^{-6} * 27.8$$

Where:

W = Annual hot water use (gallons)
8.33 = Energy content of water (Btu/gallon/°F)
T_{out} = Water heater set point temperature (°F)
T_{in} = Water inlet temperature (°F)
Eff_{base} = Thermal efficiency of base equipment
Eff_{eff} = Thermal efficiency of efficient equipment
10^{-6} = Factor to convert Btu to MMBtu
$Stby_{base}$ = Stand-by loss per hour for base equipment (Btu)
$Stby_{eff}$ = Stand-by loss per hour for efficient equipment (Btu)
24 = Hours per day
365 = Days per year
27.8 = Factor to convert MMBtu to m^3

Electricity	n/a kWh

Water	n/a L

Other Input Assumptions

Equipment Life	**13 years**
Studies conducted in two different jurisdictions (Iowa[57] and Washington State[58]) use an EUL of 13 years, whereas one conducted for Enbridge and Union in 2000[59] uses an EUL of 15 years. Given that the two most recent studies both use 13 years, 13 years is deemed appropriate.	
Incremental Cost (Cust. / Contr. Install)	**$ 2230**
Incremental cost determined from communication with local distributor[60,61]	
Free Ridership	**5 %**
Free-ridership rate as per EB-2008-0384 and 0385	

Pre-Rinse Spray Nozzle (1.24 GPM)

Commercial, Existing/New Market

Efficient Technology & Equipment Description
Low-flow pre-rinse spray nozzle/valve (1.24 GPM)
Base Technology & Equipment Description
Standard pre-rinse spray nozzle/valve (3.0 GPM)

Resource Savings Assumptions

Natural Gas	See below m^3

Market Segment	Natural Gas (m^3/yr
Full Dining Establishments	931
Limited Service Establishments	278
Other Establishments	272

A field study was undertaken at 37 sites across 4 regions in Union Gas territory. Measurements of water pressure, incoming and leaving (at both burner On and Off setpoints) water temperature at the water heater and supplied to the pre-rinse spray valve, details of the make, model and type of water heater, and type of food service establishment, were collected at each site.

Flow rate vs. pressure curves for high-flow and nominal 1.6 USgpm (1.24 USgpm @ 60 psig) pre-rinse spray valves (PRSV) were developed from the Veritec studies in Waterloo[62] and Calgary[63]. An average flow rate vs pressure curve for high-flow PRSVs was developed from the Veritec Waterloo study.

Water savings were evaluated for each region based on the difference between the flow rates of the high-flow and low-flow PRSV at the average measured water pressure, and the average usage of the PRSV for each of 3 food service establishmentc types from the Veritec studies in Waterloo and Calgary.

Natural gas savings were determined using the US-DOE WHAM[64] model to establish water heater efficiency. Inputs to the model from site measurements included the average cold water and hot water setpoint temperatures for each region. Additional inputs to the model included water heater energy factor and rated water heater input (both average for the region), ambient air temperature (assumed at 70°F), and average daily volume of hot water. This last item was determined from a combination of research undertaken by FSTC[65], and ASHRAE[66] recommendations, for each food service establishment type. The proportion of hot water delivered to the PRSV was determined from the average measured mixed water temperature for each region.

Electricity	0 kWh

Water	See below L

Market Segment	Water (L)
Full Dining Establishments	182,000
Limited Service Establishments	55,000
Other Establishments	53,000

Assumptions and inputs:

- Water savings were evaluated for 3 food service establishment types: Full Service Restaurants, Limited Service Restaurants, and Other
- The PRSV water usage was based on the 2 Veritec studies, and incorporated the measured differences in usage time for the high-flow and low-flow PRSVs.

Other Input Assumptions

Equipment Life	5 years

This is consistent with other studies[67,68]

Incremental Cost (Cust. / Contr. Install)	100 $

The incremental cost is assumed to be $100 – the cost of the spray nozzle and installation. This is comparable to the incremental cost of $60 reported by the Region of Waterloo[69]

Free Ridership	12.4 %

New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group)

Spillover	3 %

New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group)

Pre-Rinse Spray Nozzle (0.64 GPM)

Commercial, Existing/New Market

Efficient Technology & Equipment Description
Low-flow pre-rinse spray nozzle/valve (0.64 GPM)
Base Technology & Equipment Description
Standard pre-rinse spray nozzle/valve (3.0 GPM)

Resource Savings Assumptions

Natural Gas	See below m³

Market Segment	Natural Gas (m³/yr)
Full Dining Establishments	1,286
Limited Service Establishments	339
Other Establishments	318

A field study was undertaken at 37 sites across 4 regions in Union Gas territory. Measurements of water pressure, incoming and leaving (at both burner On and Off setpoints) water temperature at the water heater and supplied to the pre-rinse spray valve, details of the make, model and type of water heater, and type of food service establishment, were collected at each site.

Flow rate vs. pressure curves for high-flow and nominal 0.64 USgpm pre-rinse spray valves (PRSV) were developed from the Veritec studies in Waterloo[70] and Calgary[71]. An average flow rate vs pressure curve for high-flow PRSVs was developed from the Veritec Waterloo study.

Water savings were evaluated for each region based on the difference between the flow rates of the high-flow and low-flow PRSV at the average measured water pressure, and the average usage of the PRSV for each of 3 food service establishment types from the Veritec studies in Waterloo and Calgary.

Natural gas savings were determined using the US-DOE WHAM[72] model to establish water heater efficiency. Inputs to the model from site measurements included the average cold water and hot water setpoint temperatures for each region. Additional inputs to the model included water heater energy factor and rated water heater input (both average for the region), ambient air temperature (assumed at 70°F), and average daily volume of hot water. This last item was determined from a combination of research undertaken by FSTC[73], and ASHRAE[74] recommendations, for each food service establishment type. The proportion of hot water delivered to the PRSV was determined from the average measured mixed water temperature for each region. Operating times are not
expected to be different between 1.24 & 0.64 (Bricor model B064) USgpm models based on cleanability times of 20-21 seconds according to the FTSC[75].

Electricity	0 kWh

Water	See below L

Market Segment	Water (L)[75]
Full Dining Establishments	252,000
Limited Service Establishments	66,400
Other Establishments	62,200

Assumptions and inputs:

- Water savings were evaluated for 3 food service establishment types: Full Service Restaurants, Limited Service Restaurants, and Other
- The PRSV water usage was based on the 2 Veritec studies, and incorporated the measured differences in usage time for the high-flow and low-flow PRSVs.

Other Input Assumptions

Equipment Life	**5 years**
This is consistent with other studies[76,77]	
Incremental Cost (Cust. / Contr. Install)	**$88**
$88 = ($50/pc* + $1/pc* shipping USD) x 1.28901** exchange rate + $22 installation*** *estimated by Bricor, March 2, 2009 **Exchange rate from March 2, 2009 - http://www.xe.com/ucc/convert.cgi ***estimated installation from Seattle Utilities ($21-23/pc), based on conversation with Bricor, March 2, 2009	
Free Ridership	**0 %**
Relatively new product; currently only aware one manufacturer. Propose 0% free ridership.	

TANKLESS WATER HEATER

Commercial – New Build

Efficient Technology & Equipment Description
Tankless Water Heater (84% thermal efficiency (77% adjusted thermal efficiency[80]), where approximately 50-150 USG/day will be used.
Base Technology & Equipment Description
Conventional storage tank gas water heater (thermal efficiency[78]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	**221 m^3/Btu/hr**

Resource savings were calculated for 100 USG/day hot water use[79]:
Assumptions and inputs:
- Daily hot water draw – 100 USG/day
- Input rating for efficient and base equipment: 199,000 Btu.
- Average water inlet temperature: 7.22 DegC (45 degF)[80],[81]
- Average water heater set point temperature: 54 degC (130 degF)[82]
- Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[83]

Annual gas savings calculated as follows[80],[84]:

$$Savings = \left[W * 8.33 * (T_{out} - T_{in}) * \left(\frac{1}{Eff_{base}} - \frac{1}{Eff_{eff}} \right) + \left(Stby_{base} - Stby_{eff} \right) * 24 * 365 \right] * 10^{-6} * 27.8$$

Where:

W = Annual hot water use (gallons)
8.33 = Energy content of water (Btu/gallon/°F)
T_{out} = Water heater set point temperature (°F)
T_{in} = Water inlet temperature (°F)
Eff_{base} = Thermal efficiency of base equipment
Eff_{eff} = Thermal efficiency of efficient equipment
10^{-6} = Factor to convert Btu to MMBtu
$Stby_{base}$ = Stand-by loss per hour for base equipment (Btu)
$Stby_{eff}$ = Stand-by loss per hour for efficient equipment (Btu)
24 = Hours per day
365 = Days per year
27.8 = Factor to convert MMBtu to m^3

Electricity	**n/a kWh**

Water	**n/a L**

Other Input Assumptions

Equipment Life	**20 years**
Equipment life is assumed to be 20 years based on manufacturer literature estimates of over 20 years[85], Canadian Building Energy End-Use Data and Analysis Centre[86], Energy Star's High Efficiency Water Heaters brochure[87], and Energy Star's website[88].	

Incremental Cost (Cust. / Contr. Install)	**-$1,570**
Commercial tankless water heaters are typically scaled up by unit - a commercial user would likely need several tankless water heaters to replace a single storage tank. The tankless model cited has a maximum flow rate of 4.7 – 7.4 GPM depending on temperature rise required. Any large commercial enterprise would likely require 2 – 3 tankless units to accommodate peak demand.[89] Costs for the two systems were determined to be: · WaiWela PH28CIFS tankless water heater and installation kit = $2,080[90] · Rheem G91-200 storage tank water heater = $3,650.[91],[92]	
Free Ridership	**2 %**
Free-ridership rate as per EB-2008-0384 and 0385	

TANKLESS WATER HEATER

Commercial - Existing

Efficient Technology & Equipment Description
Tankless Water Heater (84% thermal efficiency (77% adjusted thermal efficiency[80]), where approximately 50-150 USG/day will be used.
Base Technology & Equipment Description
Conventional storage tank gas water heater (thermal efficiency[93]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	**221 m^3/Btu/hr**

Resource savings were calculated for 100 USG/day hot water use[94]:
Assumptions and inputs:
- Daily hot water draw – 100 USG/day
- Input rating for efficient and base equipment: 199,000 Btu.
- Average water inlet temperature: 7.22 DegC (45 degF)[95],[96]
- Average water heater set point temperature: 54 degC (130 degF)[97]
- Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[98]

Annual gas savings calculated as follows[80],[99]:

$$Savings = \left[W * 8.33 * (T_{out} - T_{in}) * \left(\frac{1}{Eff_{base}} - \frac{1}{Eff_{eff}} \right) + \left(Stby_{base} - Stby_{eff} \right) * 24 * 365 \right] * 10^{-6} * 27.8$$

Where:

W = Annual hot water use (gallons)
8.33 = Energy content of water (Btu/gallon/°F)
T_{out} = Water heater set point temperature (°F)
T_{in} = Water inlet temperature (°F)
Eff_{base} = Thermal efficiency of base equipment
Eff_{eff} = Thermal efficiency of efficient equipment
10^{-6} = Factor to convert Btu to MMBtu
$Stby_{base}$ = Stand-by loss per hour for base equipment (Btu)
$Stby_{eff}$ = Stand-by loss per hour for efficient equipment (Btu)
24 = Hours per day
365 = Days per year
27.8 = Factor to convert MMBtu to m^3

Electricity	**n/a kWh**

Water	**n/a L**

Other Input Assumptions

Equipment Life	20 years
Equipment life is assumed to be 20 years based on manufacturer literature estimates of over 20 years[100], Canadian Building Energy End-Use Data and Analysis Centre[101], Energy Star's High Efficiency Water Heaters brochure[102], and Energy Star's website[103].	
Incremental Cost (Cust. / Contr. Install)	**-$1,570**
Commercial tankless water heaters are typically scaled up by unit - a commercial user would likely need several tankless water heaters to replace a single storage tank. The tankless model cited has a maximum flow rate of 4.7 – 7.4 GPM depending on temperature rise required. Any large commercial enterprise would likely require 2 – 3 tankless units to accommodate peak demand.[104] Costs for the two systems were determined to be: · WaiWela PH28CIFS tankless water heater and installation kit = $2,080[105] · Rheem G91-200 storage tank water heater = $3,650[106],[107]	
Free Ridership	**2 %**
Free-ridership rate as per EB-2008-0384 and 0385	

CEE QUALIFIED CLOTHES WASHER

Commercial Existing Buildings – Multi-Residential

Efficient Technology & Equipment Description
High Efficiency Front Load Washers for application in the Multi-residential sector. CEE qualified MEF = 2.20, WF = 5.33
Base Technology & Equipment Description
Conventional top loading vertical axis washers. MEF = 1.26, WF = 9..5

Resource Savings Assumptions

Natural Gas — **222 m^3**

To utilize the Navigant annual gas savings calculation to reflect the conditions of the Enbridge Gas Distribution Front Load Washer Program the following are the suggested Inputs:

- Average number of cycles (turns) per year 1,642 (4.5[108] cycles per day x 365)
- Water use per cycle, base equipment: 29.26[109] US Gallons
- Water use per cycle, CEE energy efficient washer : 16.39[4] US gallons
- Percentage of water used by base equipment which is hot water:18%[110]
- Percentage of water used by efficient equipment which is hot water: 10%[111]
- Average water inlet temperature:7.22°C (45oF)
- Average water heater set point temperature: 54°C (130°F)
- Water heater thermal efficiency: 65%[112]
- Gas use per cycle for commercial gas dryer with base equipment:0.138 m3
- Gas use per cycle for commercial gas dryer with CCE listed clothes washer:0.096m3[113]
- Gas dryer penetration in Ontario Multi-family and Laundromat market:60%[114]

$$Savings = \left[\left(W_{base} * Hot_{base} - W_{eff} * Hot_{eff} \right) * 8.33 * \frac{1}{Eff} * \left(T_{out} - T_{in} \right) + \left(Dr_{base} - Dr_{eff} \right) * Pene \right] * 10^{-6} * 27.8$$

Electricity — **296 kWh**

$$Savings = \left[\left(Wa_{base} - Wa_{eff} \right) + \left(Dr_{base} - Dr_{eff} \right) * (1 - Pene) \right] * Cyc$$

Water — **80,000 L**

$$Savings = \left(W_{base} - W_{eff} \right) * Cyc$$

Other Input Assumptions

Equipment Life	**11 years**
As recommended by Navigant.	
Incremental Cost (Cust. / Contr. Install)	**$600**
Enbridge route operator data.	
Free Ridership	**10 %**
EB 2008-0384 & 0385	

1.0 GAL/MIN FAUCET AERATOR (Kitchen)

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
1.0 GPM Faucet Aerator
Base Technology & Equipment Description
2.5 GPM Faucet Aerator

Resource Savings Assumptions

Natural Gas (Updated)	**39 m^3**
Based on Navigant savings calculation adjusted for a 1.0 GPM unit.	
Electricity	**n/a kWh**
Water (Updated)	**8,072 L**
Based on Navigant savings calculation adjusted for a 1.0 GPM unit.	

Other Input Assumptions

Equipment Life	**10 years**
As recommended by Navigant.	
Incremental Cost (Contractor Install)	**$2**
As per utility program costs.	
Free Ridership (Updated)	**10 %**
Free ridership – EB 2008-0384 & 0385	

1.0 GAL/MIN FAUCET AERATOR (Bathroom)

Commercial Building Retrofit (Installed) - Multi-Residential

Efficient Technology & Equipment Description
1.0 GPM Faucet Aerator
Base Technology & Equipment Description
2.2 GPM Faucet Aerator

Resource Savings Assumptions

Natural Gas (Updated)	**11 m^3**
Based on Navigant savings calculation adjusted for a 1.0 GPM unit.	
Electricity	**n/a kWh**
Water (Updated)	**2,371 L**
Based on Navigant savings calculation adjusted for a 1.0 GPM unit.	

Other Input Assumptions

Equipment Life	**10 years**
As recommended by Navigant.	
Incremental Cost (Contractor Install)	**$1.50**
As per utility program costs.	
Free Ridership (Updated)	**10 %**
Free ridership – EB 2008-0384 & 0385	

1.5 GAL/MIN LOW-FLOW SHOWERHEAD

Commercial Building Retrofit (Distributed) – Multi-Residential

Efficient Technology & Equipment Description
Low-flow showerhead 1.5 gal/min.
Base Technology & Equipment Description
Average existing stock. (2.2 gpm)

Resource Savings Assumptions

Natural Gas	**30 m3**	**2.2 GPM**
Based on Navigant savings calculation adjusted to account for percentage of showers taken with efficient unit in Multi-Residential setting (92 %) compared to 76 % in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Water	**5345 L**	**2.2 GPM**
Based on Navigant savings calculation adjusted to account for percentage of showers taken with efficient unit in Multi-Residential setting (92 %) compared to 76 % in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Electricity	**n/a kWh**	

Other Input Assumptions

Equipment Life	**10 years**
Low flow showerheads have an estimated service life of 10 years as recommended by Navigant and approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust Install)	**$4**
As per utility program costs.	
Free Ridership	**10 %**
As per EB 2008-00384 & 0385	

1.25 GAL/MIN LOW-FLOW SHOWERHEAD

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
Low-flow showerhead 1.25 gal/min.
Base Technology & Equipment Description
Average existing stock.

Resource Savings Assumptions

Natural Gas		
	53 m3	**2.0 - 2.5 GPM**
	87 m3	**2.6 +**
Based on Navigant savings calculation adjusted to account for percentage of showers taken with efficient unit in Multi-Residential setting (92 %) compared to 76 % in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Water	**9078**	**2.0 - 2.5 GPM**
	14341	**2.6 +**
Based on Navigant savings calculation adjusted to account for percentage of showers taken with efficient unit in Multi-Residential setting (92 %) compared to 76 % in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Electricity	**n/a kWh**	

Other Input Assumptions

Equipment Life	**10 years**
Low flow showerheads have an estimated service life of 10 years as recommended by Navigant and approved in EB 2008-0384 & 0385.	
Incremental Cost (Contractor Install)	**$17**
As per utility program costs.	
Free Ridership	**10 %**
As per EB 2008-0384 & 0385	

1.5 GAL/MIN LOW-FLOW SHOWERHEAD

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
Low-flow showerhead 1.5 gal/min.
Base Technology & Equipment Description
Average existing stock. (See below)

Resource Savings Assumptions

Natural Gas		
	28 m3	**2.0 - 2.5 GPM**
	55 m3	**2.6 - 3.0 GPM**
	79 m3	**3.1 – 3.5 GPM**
	91 m3	**3.6 + GPM**
Based on Navigant savings calculation adjusted to account for 1.5 gpm replacement unit and percentage of showers taken with efficient unit in Multi-Residential setting (92%) compared to 76% in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008		
Water		
	5197 L	**2.0 - 2.5 GPM**
	9490 L	**2.6 - 3.0 GPM**
	13250 L	**3.1 – 3.5 GPM**
	15114 L	**3.6 + GPM**
Based on Navigant savings calculation adjusted to account for 1.5 gpm replacement and percentage of showers taken with efficient unit in Multi-Residential setting (92%) compared to 76% in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Electricity	**n/a**	**kWh**

Other Input Assumptions

Equipment Life	**10 Years**
Low flow showerheads have an estimated service life of 10 years as recommended by Navigant and approved in EB 2008-0384 & 0385.	
Incremental Cost (Contractor Install)	**$17**
As per utility program costs.	
Free Ridership	**10 %**
As per EB 2008-00384 & 0385	

2.0 GAL/MIN LOW-FLOW SHOWERHEAD

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
Low-flow showerhead 2.0 gal/min.
Base Technology & Equipment Description
Average existing stock. (See below)

Resource Savings Assumptions

Natural Gas	**4 m3**	**2.6 – 3.0 GPM**
	28 m3	**3.1 – 3.5 GPM**
	40 m3	**3.6 + GPM**
Based on Navigant savings calculation adjusted for a 2.0 GPM unit.		
Water	**1727 L**	**2.6 – 3.0 GPM**
	5487 L	**3.1 – 3.5 GPM**
	7351 L	**3.6 + GPM**
Based on Navigant savings calculation adjusted for a 2.0 GPM unit.		
Electricity	**n/a kWh**	

Other Input Assumptions

Equipment Life	**10 years**
Low flow showerheads have an estimated service life of 10 years as recommended by Navigant and approved in EB 2008-0384 & 0385.	
Incremental Cost (Contractor Install)	**$17**
As per utility program costs.	
Free Ridership	**10 %**
As per EB 2008 -0384 & 0385	

1.25 GAL/MIN LOW-FLOW SHOWERHEAD

Commercial Building Retrofit (Distributed) – Multi-Residential

Efficient Technology & Equipment Description
Low-flow showerhead 1.25 gal/min.
Base Technology & Equipment Description
Average existing stock. (2.2 GPM)

Resource Savings Assumptions

Natural Gas		
	54 m3	**2.2 GPM**
Based on Navigant savings calculation adjusted to account for percentage of showers taken with efficient unit in Multi-Residential setting (92 %) compared to 76 % in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Water	**8916**	**2.2 GPM**
Based on Navigant savings calculation adjusted to account for percentage of showers taken with efficient unit in Multi-Residential setting (92 %) compared to 76 % in Low Rise residential as per Summit Blue, Resource Savings in selected Residential DSM Programs, June 2008.		
Electricity	**n/a kWh**	

Other Input Assumptions

Equipment Life	**10 years**
Low flow showerheads have an estimated service life of 10 years as recommended by Navigant and approved in EB 2008-0384 & 0385.	
Incremental Cost (Cust Install)	**$4**
As per utility program costs.	
Free Ridership	**10 %**
As per EB 2008-00384 & 0385	

CFL SCREW-IN (13W)

Existing/New developments in all sectors

Efficient Technology & Equipment Description
CFL screw-in 13W
Base Technology & Equipment Description
60W Incandescent

Resource Savings Assumptions

Natural Gas (Updated)	**0 m^3**
Electricity	**45 kWh**
Substantiation provided by the OPA, dated Septem ber 23, 2008 and approved in EB 2008-0384 & 0385.	
Water (Updated)	**0 L**

Other Input Assumptions

Equipment Life	**8 years**
Substantiation provided by the OPA, dated September 23, 2008 and approved in EB 2008-0384 & 0385.	
Incremental Cost Contractor/Customer Install	**0.00 $**
• Average cost of 60 W incandescent bulb = $0.75 / bulb based on Canadian Tire website (2007). OPA assumes each incandescent bulb has a one year life. • Supplied cost of 13 W CFL = $1.72 / bulb (based on 2009 distributor price to EGD) + $0.50 (Contractor Delivery Charge) = $2.22 $2.22 CFL cost – $6.00 (8 incandescent bulbs x .75) = ($3.78)	
Free Ridership	**24 %**
Based on the results of an OPA program evaluation and as approved in EB 2008-0384 & 0385.	

CFL SCREW-IN (23W)

Existing/New developments in all sectors

Efficient Technology & Equipment Description
CFL screw-in 23W
Base Technology & Equipment Description
75W Incandescent

Resource Savings Assumptions

Natural Gas (Updated)	0 m^3
Electricity	**49.7 kWh**
Substantiation provided by the OPA, dated October 17, 2008 and as approved in EB 2008-0384 & 0385.	
Water (Updated)	**0 L**

Other Input Assumptions

Equipment Life	8 years
Substantiation provided by the OPA, dated October 17, 2008 and as approved in EB 2008-0384 & 0385 .	
Incremental Cost Contractor/Customer Install	**0.00 $**
• Average cost of 75 W incandescent bulb = \$0.75 / bulb based on Canadian Tire website (2007). OPA assumes that each incandescent bulb has a one year life. • Supplied cost of a 23 W CFL = \$2.05 (based on 2009 distributor cost to EGD) + \$0.50 (Contractor Delivery Charge) = \$2.55 \$2.55 CFL cost - \$6.00 (8 incandescent bulbs x .75) = (\$3.45)	
Free Ridership	**24 %**
Based on the results of an OPA program evaluation and as approved in EB 2008-0384 & 0385.	

Energy Star for New Homes

Residential, New Construction

Efficient Technology & Equipment Description
Energy Star for New Homes, version 4, qualified home
Base Technology & Equipment Description
New Home built in Ontario, compliant to OBC-2006 (as of January 1, 2009)

Resource Savings Assumptions

Natural Gas	**881 m^3**

Gas savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house with London's climate, and another set in North Bay's climate. The sample houses are three houses which represent the mid-range of new homes built in UG Territory. The results were weighted 70% UG South and 30% UG North.[115] The software used for analysis is HOT2000 version 9.34c with weather file 9.10wthr. A mix of 90% AFUE furnace (weighted 80%) and 80% AFUE combo heater (weighted 20%) was assumed as the base case heating system. A 3.57 ACH50 air leakage was used to describe the simply OBC-2006 houses (default present in HOT2000), which is representative of average new home construction[116].

Most of the following specifications are based on the OBC 2009, specifically section 12.3: Some of the specifications are upgrades in excess of what is actually required in the code. These were established based on observations of what is representative of the market place for certain items. These items are marked with an asterisk.

Walls - 2x6 @ 16", R20 batt Insulation (Southern)
- 2x6 @ 16" R20 batt Insulation, R5 Code-board sheathing (Northern)
- ½" Gypsum interior
- 3/8" OSB Sheathing
- Brick Veneer

Roof - 2x4 Attic Truss w R40 Blown Insulation
- ½" Drywall interior on resilient channel

Basement: - Poured Concrete foundation
- R12 Insulation blanket to within 15" of floor slab

Windows: Double glazed, single low-E, air fill, metal spacer, vinyl frame
Ventilation: Exhaust fans (Kitchen & bath) without heat recovery
Heating: a) Combination Heating System
- hot-water air-handler
- Induced draft fan water heater with spark ignition
(Steady State efficiency = 80%, e.g. Rheem PV75ce)

b) Conventional Heating System*
- 90% AFUE forced air furnace, PSC Blower
The model presumes that 20% of houses are equipped with Combination Heating Systems (code minimum) and the 80% are equipped with Conventional Heating Systems*

Air Cond: -SEER 13 entry level 410a split system*
DHW: a) Combination Heating System
- Induced Draft spark ignition 75 usg tank (Rheem PV75ce).

b) Conventional Heating System
- Induced Draft spark ignition 40 usg tank (GSW 5G40)

Envelope: 3.57 Air changes per hour @ 50 pa. ("Present" air-tightness default in HOT2000)

- General mode in HOT2000 was used. This allows overrides of default ventilation and occupancy values
- The HOT 2000 Weather file "910wthr" was used. This is an older Canadian weather file that is consistent with Hot2000 version 9.34
- Occupancy was assumed to be 2 Adults and 1 child. This models the supposition that family size and average house hold size is less than the EnergyStar baseline of 2 adults and 2 children
- 50 cfm constant ventilation rate was assumed for all houses and for all ventilation systems. This

models the supposition that occupants in general do not operate their ventilation systems as intended, rather they tend to under-use them

- 13 SEER air conditioning systems were considered to be installed in all homes. The London area homes were considered to operate with 20% open windows and the North Bay homes were considered to operate with 50% open windows

The following upgrades from the OBC 2009 specification were applied to the three sample homes[117]

Southern House[118]

Walls No upgrade
Roof No upgrade
Basement: No upgrade
Windows: Upgrade to Energy Star Zone C windows
Ventilation: Upgrade to simplified HRV (0.65/0.55 efficiency)
Heating: Upgrade to 92% AFUE ECM Blower EnergyStar furnace
Supply & return trunk ducts sealed
Air Cond: Upgrade to SEER 14 from SEER 13
DHW: Upgrade to Instantaneous Gas water heater (Noritz N0751DV, E.F. = 0.83)
Envelope: 2.0 Air changes per hour @ 50 pa.
Electrical: No Upgrade

Northern House[119]

Walls No upgrade
Roof No upgrade
Basement: No upgrade
Windows: Upgrade to Energy Star Zone C windows
Ventilation: Upgrade to simplified HRV (0.65/0.55 efficiency)
Heating: Upgrade to 95% AFUE ECM Blower EnergyStar furnace
Supply & return trunk ducts sealed
Air Cond: Upgrade to SEER 14 from SEER 13
DHW: Upgrade to Instantaneous Gas water heater (Noritz N0751DV, E.F. = 0.83)
Envelope: 2.0 Air changes per hour @ 50 pa.
Electrical: No Upgrade

Electricity	**734 kWh**
Electrical saving were calculated from the same models as above.	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**25 years**
Energy Star homes have an estimated life of 25 years (before major renovations are expected).	
Incremental Cost (Cust. / Contr. Install)	**4275 $**

Cost estimates for the upgrade measures were obtained from HVAC Trades and Builders who are actively building energy star homes and based on a 70/30 UG South & North. The upgrade cost is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house.

The costs assigned to the particular upgrade follow:
Walls: $0.0/ft$_2$ upgrade from R20 to R25 (add codeboard to 2x6 wall)
$0.30/ft$_2$ upgrade from R25 to R27.5 (increase codeboard thickness)

s $0.00/$ft^2$ upgrade to 2x6 @ 20" c.c. R20 (possible savings)
Roof: $0.60/$ft^2$ upgrade from R40 to R50
Basement: $0.20/$ft^2$ coverage upgrade to R20 full height insulation
Windows: $1.00 per square foot of glazed surface upgrade to EnergyStar
Ventilation: $1,500 upgrade to simple HRV
$250 upgrade to 1.5 Sone Bath fan & Interlock
Heating: $871 upgrade to 92% afue Energy Star Furnace (ECM Blower)
$871 upgrade to 95% afue Energy Star Furnace (ECM Blower)
$250 duct sealing
$166 saving for furnace size reduction 60 MBH to 50 MBH
Air Cond. $61 saving for air conditioner size reduction 2.0 ton to 1.5 ton
$275 saving for air conditioner size reduction 2.5 ton to 2.0 ton
$194 upgrade to SEER 14 from SEER 13, 1.5 ton
$168 upgrade to SEER 14 from SEER 13, 2.0 ton
$80 upgrade to SEER 14 from SEER 13, 2.5 ton
DHW: $218 upgrade to instantaneous gas water heater
Envelope: $500 budget for increased air-tightness. This is highly variable from Builder to builder. Some builders will have no incremental costs.
Electrical: $2.00 per Compact Fluorescent Bulb
Consulting: $500 evaluation, testing, review and file processing.
Fees: $125 home enrolment fees.

Upgrade costs to ver 4.0

1 Storey Southern		$4,324
1 Storey Northern	$4,324	
2 Storey Southern		$4,292
2 Storey Northern	$4,198	
Reference House Southern	$4,292	
Reference House Northern		$4,105

Free Ridership	**5 %**
Free Ridership based on EB-2008-0384 and 0385	

Higher Efficiency Boilers – Domestic Water Heating

Existing and New Commercial and Multi- Residential

Efficient Technology & Equipment Description
Hydronic Boilers for water heating (Non Seasonal)
Base Technology & Equipment Description
80% Combustion Efficiency Domestic Water Heating Boiler

Resource Savings Assumptions

Natural Gas (Updated)

Boiler Size	Domestic Water Heating (Non Seasonal) M3 Savings by Combustion Efficiency 83-84%	85-88%
300 MBH	1,075	1,766
600 MBH	1,777	2,290
1,000 MBH	3,136	5,155
1,500 MBH	4,317	7,095

Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.

An iterative approach was used to determine the annual savings in the commercial sector. The following steps were taken:
a. The Rate 6 accounts were subdivided into bins of annual gas use. This provided the annual average gas use, number of accounts, seasonal, non-seasonal and total gas use.
b. The seasonal portion of the annual gas use was normalized to 30 year weather data. This normalized gas use was correlated to a seasonal boiler size required for gas consumption.
c. Categories of boiler sizes were selected to provide a suitable range of boilers available within the sector.
d. The Rate 6 accounts were subdivided using the normalized average seasonal gas use for the respective categories of boilers selected. This provided the annual average gas use, number of accounts, and total gas use per seasonal boiler size category.
e. Seasonal annual gas use normalization of the boiler size category accounts was completed.
f. Annual seasonal efficiency of the boiler size categories for each of the combustion efficiency ranges was determined.
g. Boiler costs for the boiler size categories was compiled.
h. A TRC analysis was completed for each of the boiler size categories.
i. A similar approached was used for the non-seasonal gas use with the exception of normalizing the data.

Electricity (Updated)	**0 kWh**
Water	**0 L**

Other Input Assumptions

Equipment Life	**25**	**years**
EB 2008-0384 & 0385		
Incremental Cost (Contr. Install)	**Boiler Size** **300 MBH** **600 MBH** **1,000 MBH** **1,500 MBH**	**Domestic Water Heating (Non Seasonal) Incremental Cost by Combustion Efficiency** **83-84% 85-88%** **$3,900 $ 4,500** **$5,800 $ 6,000** **$7,400 $10,300** **$5,900 $ 7,400**
Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.		
Free Ridership	**Small Commercial** **Large Commercial**	**EGD/Union 10%** **EGD 12%/Union 59%** **for all sectors except** **:Multi-family EGD 20%/Union 42%**
EB 2008-0384 - 0385		

Higher Efficiency Boilers –Space Heating

Existing and New Commercial and Multi- Residential

Efficient Technology & Equipment Description
Hydronic Boilers for space heating (Seasonal)
Base Technology & Equipment Description
80% Combustion Efficiency Space Heating Boiler

Resource Savings Assumptions

Natural Gas (Updated)

Boiler Size	Space Heating (Seasonal) M3 Savings by Combustion Efficiency 83-84%	85-88%
300 MBH	2,105	3,125
600 MBH	3,994	5,930
1,000 MBH	7,310	10,856
1,500 MBH	11,554	17,157
2,000 MBH	16,452	24,431

Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.

An iterative approach was used to determine the annual savings in the commercial sector. The following steps were taken:

a. The Rate 6 accounts were subdivided into bins of annual gas use. This provided the annual average gas use, number of accounts, seasonal, non-seasonal and total gas use.
b. The seasonal portion of the annual gas use was normalized to 30 year weather data. This normalized gas use was correlated to a seasonal boiler size required for gas consumption.
c. Categories of boiler sizes were selected to provide a suitable range of boilers available within the sector.
d. The Rate 6 accounts were subdivided using the normalized average seasonal gas use for the respective categories of boilers selected. This provided the annual average gas use, number of accounts, and total gas use per seasonal boiler size category.
e. Seasonal annual gas use normalization of the boiler size category accounts was completed.
f. Annual seasonal efficiency of the boiler size categories for each of the combustion efficiency ranges was determined.
g. Boiler costs for the boiler size categories was compiled.
h. A TRC analysis was completed for each of the boiler size categories.
i. A similar approached was used for the non-seasonal gas use with the exception of normalizing the data.

Electricity (Updated)	**0 kWh**
Water	**0 L**

Other Input Assumptions

Equipment Life	**25 years**
EB 2008-0384 & 0385	
Incremental Cost (Contr. Install)	**Space Heating (Seasonal) Incremental Cost by Combustion Efficiency** **Boiler Size / 83-84% / 85-88%** **300 MBH: $3,900 / $ 4,500** **600 MBH: $5,800 / $ 6,000** **1,000 MBH: $7,400 / $10,300** **1,500 MBH: $5,900 / $ 7,400** **2,000 MBH: $4,950 / $ 7,050**
Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.	
Free Ridership	**Small Commercial: EGD/Union 10%** **Large Commercial: EGD 12%/Union 59%** **for all sectors except** **:Multi-family EGD 20%/Union 42%**
EB 2008 - 0384 & 0385	

[35] NEUD database space heating for 1990-2006 & HHV of natural gas (as of January 2009)
[36] NEUD database space cooling using for 1990-2006, (as of January 2009)
[37] "UG Thermostat_calculator_rv2 - JO.xls"
[38] This analysis includes a weighted average of UG North 30% and UG South 70%.
[39] As per UG's understanding of typical operating schedules
[40] Kim Ellis, Sr. Salesperson at Engineered Air, London office, Feb 13, 2009
[41] Ian Dunbar, Feb 13, 2009 referring to a restaurant designed by Millennium Engineering, Burlington
[42] John Paleczny, March 6, 2009, from Yorkland Controls, London
[43] The "Institutional" market was assumed to comprise of "Information & Cultural Industries" and "Educational Services" for the purposes of this analysis.
[44] Refers to table above.
[45] National Energy Use Database, Commercial/Institutional Sectors, NRCAN, September 2008, covering 1990 to 2006.
[46] "Natural Gas Energy Efficiency Potential Commercial Sector –Draft Final Report", Dec 2, 2008, Marbek Resource Consultants
[47] Locally available commercial condensing gas water heater, trade name: Polaris, model #: PC 199-50 http://www.johnwoodwaterheaters.com/pdfs/GSW_PolarisSpecSheet.pdf
[48] as per typical full service restaurant draw (EB-2006-0021, pg 31, Appendix B)
[49] One of the input assumptions required for calculating resource savings for this measure is the stand-by heat loss of storage tank water heaters. Hourly stand-by losses are treated as constant using values drawn from GAMA's Consumer Directory (see citation below). This means that marginal percentage gas savings will fall as hot water use rises.
[50] Locally available commercial conventional (non-condensing) gas water heater with the same input rating as the Polaris. Manufacturer: Rheem, model #: G91-200.
[51] Although the required minimum thermal efficiency to be in compliance with ASHRAE 90.1 is 78%, http://www.energycodes.gov/comcheck/pdfs/404text.pdf, only an very small percentage of commercial gas water heaters listed in the GAMA Consumer's Directory of Certified Efficiency Ratings had a thermal efficiency of less than 80%. http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf
[52] Navigant draft report, pg B-224 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - February 6, 2009
[53] Chinnery, Glen. Policy Recommendations for the HERS Community to Consider regarding HERS point credit for Waste Water Heat Recovery Devices,EPA, Energy Star for homes, March 2004 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Waste_Water_Heat_Recovery_Guidelines.pdf
[54] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4
[55] Consumer's Directory of Certified Efficiency Ratings http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf In this case stand-by losses are constant. Recalculating gas savings using the WHAM algorithm, in which stand-by losses are afunction of water draw, results in less than 3% variation over the figures presented above. Lutz, J.D., C.D. Whitehead, A.B. Lekov, G.J. Rosenquist., and D.W. Winiarski. 1999. WHAM: Simplified tool for calculating water heater energy use. ASHRAE Transactions 105 (1): 1005-1015.
[56] Consumer's Directory of Certified Efficiency Ratings http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf
[57] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2
[58] Quantec Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027) Prepared for Puget Sound Energy
[59] Jacques Whitford Environment Ltd, Prescriptive Incentives for Select Natural Gas Technologies, Sept 2000
[60] Rheem G91-200: $3,650; Polaris PC 199-50: $5,880
[61] Navigant Consulting, Draft Report MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS, February 6, 2009, pg 225
[62] "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005
[63] "City of Calgary" – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., December 2005.
[64] Appendix D-2. Water Heater Analysis Model. Water Heater Rulemaking Technical Support Documents. http://www1.eere.energy.gov/buildings/appliance_standards/residential/waterheat_0300_r.html
[65] Charles Wallace and Don Fisher Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants. FSTC April 2007
[66] ASHRAE Handbook 2007HVAC Applications. Chapter 49
[67] CEE Commercial Kitchens Initiative - Program Guidance on Pre-Rinse Spray Valves
[68] Enbridge market survey of average usage
[69] "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005
[70] "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005
[71] "City of Calgary" – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., December 2005.
[72] Appendix D-2. Water Heater Analysis Model. Water Heater Rulemaking Technical Support Documents. http://www1.eere.energy.gov/buildings/appliance_standards/residential/waterheat_0300_r.html
[73] Charles Wallace and Don Fisher Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants. FSTC April 2007
[74] ASHRAE Handbook 2007HVAC Applications. Chapter 49
[75] pg 32 & 37 "Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles" by Energy Profiles, January 30, 2009.
[76] CEE Commercial Kitchens Initiative - Program Guidance on Pre-Rinse Spray Valves
[77] Enbridge market survey of average usage
[78] Although the required minimum thermal efficiency to be in compliance with ASHRAE 90.1 is 78%,

http://www.energycodes.gov/comcheck/pdfs/404text.pdf, only an very small percentage of commercial gas water heaters listed in the GAMA Consumer's Directory of Certified Efficiency Ratings had a thermal efficiency of less than 80%. http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf

[79] One of the input assumptions required for calculating resource savings for this measure is the stand-by heat loss of storage tank water heaters. Hourly stand-by losses are treated as constant using values drawn from GAMA's Consumer Directory (see citation below). This means that marginal percentage gas savings will fall as hot water use rises.

[80] Navigant draft report, pg B-237 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - February 6, 2009

[81] Chinnery, Glen. Policy Recommendations for the HERS Community to Consider regarding HERS point credit for Waste Water Heat Recovery Devices,EPA, Energy Star for homes, March 2004, pg 15 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Waste_Water_Heat_Recovery_Guidelines.pdf

[82] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4

[83] Consumer's Directory of Certified Efficiency Ratings http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf

[84] hot water heating - calculator - tankless comml - March 10 2009.xls

[85] "Introduction to Rinnai Water Heating Product – Course #101", page 7

[86] Canadian Building Energy End-Use Data and Analysis Centre - Domestic Water Heating and Water Heater Energy Consumption in Canada, C. Aguilar, D.J. White, and David L. Ryan, April 2005, http://www.ualberta.ca/~cbeedac/publications/documents/domwater_000.pdf

[87] Energy Star's High Efficiency Water Heaters brochure, http://www.energystar.gov/ia/new_homes/features/WaterHtrs_062906.pdf pg 2, March 10, 2009

[88] Energy Star website, http://www.energystar.gov/index.cfm?c=gas_tankless.pr_savings_benefits , March 10, 2009

[89] A study for Pacific Gas and Electric of a chain casual dining restaurant found peak water draws of up to 20 GPM. Wallace, C. and D. Fisher, Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants.April 2007

[90] http://www.tanklesswaterheaters.ca/waiwelaph28ci.html

[91] From correspondence with local distributor by Navigant Consulting.

[92] Rheem G91-200: $3,650

[93] Although the required minimum thermal efficiency to be in compliance with ASHRAE 90.1 is 78%, http://www.energycodes.gov/comcheck/pdfs/404text.pdf, only an very small percentage of commercial gas water heaters listed in the GAMA Consumer's Directory of Certified Efficiency Ratings had a thermal efficiency of less than 80%. http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf

[94] One of the input assumptions required for calculating resource savings for this measure is the stand-by heat loss of storage tank water heaters. Hourly stand-by losses are treated as constant using values drawn from GAMA's Consumer Directory (see citation below). This means that marginal percentage gas savings will fall as hot water use rises.

[95] Navigant draft report, pg B-237 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - February 6, 2009

[96] Chinnery, Glen. Policy Recommendations for the HERS Community to Consider regarding HERS point credit for Waste Water Heat Recovery Devices,EPA, Energy Star for homes, March 2004, pg 15 http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/Waste_Water_Heat_Recovery_Guidelines.pdf

[97] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4

[98] Consumer's Directory of Certified Efficiency Ratings http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf

[99] hot water heating - calculator - tankless comml - March 10 2009.xls

[100] "Introduction to Rinnai Water Heating Product – Course #101", page 7

[101] Canadian Building Energy End-Use Data and Analysis Centre - Domestic Water Heating and Water Heater Energy Consumption in Canada, C. Aguilar, D.J. White, and David L. Ryan, April 2005, http://www.ualberta.ca/~cbeedac/publications/documents/domwater_000.pdf

[102] Energy Star's High Efficiency Water Heaters brochure, http://www.energystar.gov/ia/new_homes/features/WaterHtrs_062906.pdf pg 2, March 10, 2009

[103] Energy Star website, http://www.energystar.gov/index.cfm?c=gas_tankless.pr_savings_benefits , March 10, 2009

[104] A study for Pacific Gas and Electric of a chain casual dining restaurant found peak water draws of up to 20 GPM. Wallace, C. and D. Fisher, Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants.April 2007

[105] http://www.tanklesswaterheaters.ca/waiwelaph28ci.html

[106] From correspondence with local distributor by Navigant Consulting.

[107] Rheem G91-200: $3,650

[108] Average number of cycles per day based on "Multi-Residential High efficiency clothes washer pilot project", City of Toronto, April 2001. Average cycles per day from all sites in report except Louvain & Tyndall, pre-conversion 4.73 cyc/day, post 4.24 cyc/day average 4.49 round to 4.5.

[109] Water consumption in US Gallons for base case clothes washer, from US DOE Federal Energy Management Program, Life-Cycle and Cost spreadsheet, tab Energy and water use. The consumption calculated 26.6 gallons for base case and 14.9 for CEE average washer, both values adjusted by 10% to account for commercial usage, see Enbridge discussion document

[110] Hot water consumption for both the base case and CEE case are adjusted for the total water consumption (ref 4) and the hot water is corrected based on original usage ratio then this value is increased by 10% to adjust for commercial clothes washer use, see Enbridge discussion document.

[111] Average all clothes washers listed in CEE to obtain average MEF and WF(MEF 2.2, WF 5.33), input into US DOE Life-Cycle and Cost and Payback Period spreadsheet. Increase water use and hot water consumption by 10%.
[112] See item Enbridge Discussion document item a. , Efficiency range for annual usage efficiency of water heaters estimated between 55% to 70%, 65% was selected as conservative estimate base on Enbridge experience. Further analysis is needed to quantify the efficiency of water heaters in commercial clothes washer facilities.
[113] Dryer energy usage is calculated using the US DOE Life-Cycle and Cost and Payback spreadsheet (0.9 kwh/cycle)
[114] 60% penetration for commercial clothes dryers "CEE Commercial, Family-Sized Washers:An Initiative Description of the Consortium for Energy Efficiency) 1998
[115] Bowser Technical, Inc., Comparison of EnerQuality EnergyStar Version 3.0 & EnergyStar Version 4.0 Vs Ontario Building Code 2009 Energy use, March 10 2009
[116] Jennifer Tausman, ESNH files coordinator, NRCAN OEE, July 21, 2008

[118] The upgrades are based on the EnerQuality Energy-Star for New Homes Technical Specifications Version 4.0 D, February '09 performance compliance method (section 5.1).
[119] The EnerQuality EnergyStar Version 4.0 Prescriptive options are not applicable to homes North of the Muskoka climate zone. Upgrades are based on the performance Compliance Method (section 5.1) as set out in the EnerQuality EnergyStar for New Homes Technical Specification Version 4.0, February '09..

Appendix A

Union Gas and Enbridge Gas Distribution: Review and Proposed Changes to Navigant's Report "Appendix B"
Draft Report: Measures and Assumptions for Demand Side Management (DSM) Planning,
Ontario Energy Board, February 6, 2009

Legend:
- cells with proposed changes are highlighted
- values from Navigant's Appendix B are shown in brackets next to the proposed change
- shaded rows show values as approved in EB 2008 0384 and 0385

	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.+	Free Ridership	Spillover	
	Residential Space Heating															
1	Residential	Existing	Air Sealing	Air infiltration reduction (6 ACH50)	Existing infiltration controls	(8 ACH50)	231	101	0	15	$1,000	8.3	Med			
2	Residential	Existing	Basement Wall	R-1 Insulation	R-12 Insulation		237	87	0	25	$2 / ft^2	13.4	High			
3	Residential	Existing	Ceiling	R-40 Insulation	R-10 Insulation		348	214	0	20	$0.7 / ft^2	3.2	Med			
4	Residential	Existing	Enhanced Furnace	ECM (continuous)	Mid-efficiency furnace	PSC motor	-183	1,387	0	15	$960	22*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
5	Residential	Existing	Enhanced Furnace	ECM (non continuous)	Mid-efficiency furnace	PSC motor	-26	324	0	15	$960	51*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
5a	Residential	Existing	Enhanced Furnace	ECM Only	Mid-efficiency furnace	PSC motor	-65	730	0	18	$550					
6	Residential	New	Enhanced Furnace	Furnace only (continuous)	Mid-efficiency furnace		-166	1,403	0	15	$960	18*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
7	Residential	New	Enhanced Furnace	Furnace only (non continuous)	Mid-efficiency furnace		-26	207	0	15	$960	137*	Low			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
8	Residential	Existing	Energy Star Windows	Low E, argon filled (R-3.8)	Standard windows	Double pane, standard glazing (R-2.0)	121	206	0	20	$150 / unit	28	High			
9	Residential	Existing	Reflector Panels		No reflector panels		143	0	0	18	($213) 238	3.1	Low	0%		Adjustments: Updated incremental cost based on cost of panels plus shipping ($238); FR of 0% as per EB 2008-0384 and 0385
9a	Residential	Existing	Reflector Panels		No reflector panels		143	0	0	18	$213					
10	Residential	Existing	High Efficiency Furnace	AFUE 90	Mid-efficiency furnace	AFUE 80	268	0	0	18	$667	4.8	Med			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
11	Residential	Existing	High Efficiency Furnace	AFUE 92	Mid-efficiency furnace	AFUE 80	317	0	0	18	$1,067	6.5	Med			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
12	Residential	Existing	High Efficiency Furnace	AFUE 96	Mid-efficiency furnace	AFUE 80	407	0	0	18	$2,433	11.5	Med			Recommendation: Base case used is mid efficiency unit, however new building code mandates 90% efficiency. This should be revised.
12a	Residential	Existing	High Efficiency Furnace		Mid-efficiency furnace		385	0	0	18	$650					

Appendix A

	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
13	Residential	Existing	Programmable Thermostat		Standard Thermostat		146	(182) 123	0	15	($25) 50	0.3	65%	43%	14%	Adjustments: Electricity savings adjusted to reflect market penetration of central air conditioning in Ontario (57% as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008); incremental cost increased to reflect full cost of unit; FR as per EB 2008-0384 and 0385, Spillover as per SB FR & Spillover Study - June 4, 2008
13a	Residential	Existing	Programmable Thermostat		Standard manual thermostat		152	26	0	15	$50					
14	Residential	Existing	Wall Insulation	R-8 Insulation	R-19 Insulation		405	194	0	30	$2.5 / ft^2	11.2	High			
	Residential Water Heating															
15	Residential	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	38	0	7,797	10	($2) 1	0.1	90%	UG 33%; EGD 31%	ESK 17% TAPS 7%	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385; Spillover as per SB FR & Spillover study June 4, 2008
15a	Residential	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	22	0	7,800	10	$2					
16	Residential	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	10	0	2,004	10	($2) 1	0.4	90%	UG 33%; EGD 31%	ESK 17% TAPS 7%	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385; Spillover as per SB FR & Spillover study June 4, 2008
16a	Residential	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,000	10	$2					
17	Residential	Existing	Low-flow showerhead	1.5 GPM (distributed, e.g., ESK)	Average existing stock	2.2 GPM	33	0	6,334	10	($6) 4	0.4	65%	10%	19% (distributed)	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385; Spillover as per SB FR & Spillover study June 4, 2008
17a	Residential	Existing	Low-flow showerhead	1.5 GPM, (Union ESK program)	Average existing stock	2.2 GPM (implicitly)	22	0	6,400	10	$4					
18	Residential	Existing	Low-flow showerhead	1.25 GPM (distributed, e.g., ESK)	Average existing stock	2.2 GPM	60	0	10,570	10	($13) $4	0.4	65%	10%	19% (distributed)	Adjustments: Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385. Spillover as per SB FR & Spillover study June 4, 2008
18a	Residential	Existing	Low-flow showerhead	1.25 GPM, distributed as part of Union ESK program	Average existing stock	2.2 GPM (implicitly)	40	0	10,700	10	$4					
19	~~Residential~~	~~Existing~~	~~Low-flow showerhead~~	~~1.25 GPM (installed)~~	~~Average existing stock~~	~~2.0 GPM~~	~~49~~	~~0~~	~~8,817~~	~~10~~	~~$13~~	0.5	65%			See below, line 20 and line 21
19a	Residential	Existing	Low-flow showerhead	1.25 GPM (TAPS program)	Average existing stock	2.0 GPM	33	0	8,900	10	$15					
20	Residential	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	2.25 GPM (2.0 to 2.5 GPM)	(62) 66	0	10,886	10	($13) $19	0.4	65%	10%	8% (installed)	Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385.
20a	Residential	Existing	Low-flow showerhead	1.25 GPM (TAPS program)	Average existing stock	2.25 GPM	47	0	12,400	10	$15					
21	Residential	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	3.0 GPM - 2.6 GPM and higher	(102) 116	0	17,168	10	($13) $19	0.3	65%	10%	8% (installed)	Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385.
21a	Residential	Existing	Low-flow showerhead	1.25 GPM (TAPS program)	Average existing stock	3.0 GPM	68	0	17,500	10	$15					

Appendix A

	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.+	Free Ridership	Spillover	
22	Residential	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes	R-1	25	0	0	10	($2) $1 / $4	0.2	47%	4%		Adjustments: Measure life as per EB2008-0384 and 0385. Incremental cost as per utility bulk purchase price, customer and contractor installed. Free ridership as per EB 2008-0384 and 0385
22a	Residential	Existing	Pipe insulation for DHW outlet pipe	1/2" polyethylene foam insulation	Uninsulated DHW outlet pipes		17	0	0	15	$1					
23	Residential	New/Existing	Solar Pool Heater	Solar Heating System	Conventional Gas-fired Heating System	50% seasonal efficiency	493	-57	0	20	$1,450	5.7	Med			
24	Residential	Existing	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.575	137	0	0	18	$750	10.5	Low			
24a	Residential	Existing	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.58	237	0	0	20	$694					
25	Residential	New	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.575	137	0	0	18	$750	10.5	Low			
25a	Residential	New	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.58	237	0	0	20	$694					
	Low Income Space Heating															
26	Low Income	Existing	Programmable Thermostat		Standard manual thermostat		146	(182) 123	0	15	($25) $69	0.3	65%	1%		Adjustments: Electricity savings adjusted to reflect market penetration of central air conditioning in Ontario (57% as per Summit Blue study, June 2008); incremental cost increased to reflect full cost of unit and installation; FR as per EB 2008-0384 and 0385
26a	Low Income	Existing	Programmable Thermostat		Standard manual thermostat		152	26	0	15	$50					
27	Low Income	Existing	Weatherization	full weatherization	No Weatherization		(1134) 1234	(165) 255	0	23	($2284) $2667	3.9	Med	0%		Adjustments: Gas savings and incremental costs adjusted to reflect results from first two years of program operation. FR as per EB 2008-0384 and 0385
27a	Low Income	Existing	Weatherization		Existing home sample		1,143	165		23	$2,600					
	Low Income Water Heating															
28	Low Income	Existing	Faucet Aerator	Kitchen, 1.5 GPM (distributed)	Average existing stock	2.5 GPM	38	0	7,797	10	($2) $1	0.1	90%	1%		Adjustments: Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385
28a	Low Income	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	22	0	7,800	10	$2					
29	Low Income	Existing	Faucet Aerator	Bathroom, 1.5 GPM (distributed)	Average existing stock	2.2 GPM	10	0	2,004	10	($2) $1	0.4	90%	1%		Adjustments: Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385
29a	Low Income	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,000	10	$2					
30	Low Income	Existing	Low-flow showerhead	1.5 GPM (distributed, e.g.,ESK)	Average existing stock	2.2 GPM	33	0	6,334	10	($6) $4	0.4	65%	Union 1%, EGD 5%		Adjustments: Incremental cost as per utility bulk purchase price. FR as per EB 2008-0384 and 0385
30a	Low Income	Existing	Low-flow showerhead	1.5 GPM, (Union ESK program)	Average existing stock	2.2 GPM (implicitly)	22	0	6,400	10	$4					
31	~~Low Income~~	~~Existing~~	~~Low-flow showerhead~~	~~1.25 GPM (installed)~~	~~Average existing stock~~	~~2.0 GPM~~	~~49~~	~~0~~	~~8,817~~	~~10~~	~~$13~~	0.5	65%			See below, line 32 and 33
31a	Low Income	Existing	Low-flow showerhead	1.25 GPM (TAPS program)	Average existing stock in 1 of 3 ranges.	2.0 GPM	33	0	8,900	10	$15					

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.[+]	Free Ridership	Spillover	
32	Low Income	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in 1 of 2 ranges.	2.25 GPM (2.0 to 2.5 GPM)	(62) 66	0	10,886	10	($13) $19	0.4	65%	Union - 1%; EGD - 5%		Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385.
32a	Low Income	Existing	Low-flow showerhead	1.25 GPM (TAPS program)	Average existing stock in 1 of 3 ranges.	2.25 GPM	47	0	12,400	10	$15					
33	Low Income	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in 1 of 2 ranges.	3.0 GPM (2.6 GPM and above)	(102) 116	0	17,168	10	($13) $19	0.3	65%	Union - 1%; EGD - 5%		Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per utility bulk purchase price; FR as per EB 2008-0384 and 0385.
33a	Low Income	Existing	Low-flow showerhead	1.25 GPM (TAPS program)	Average existing stock in 1 of 3 ranges.	3.0 GPM	68	0	17,500	10	$15					
34	Low Income	Existing	Low-flow showerhead	1.25 GPM (distributed)	Average existing stock	2.2 GPM	60	0	10,570	10	($13) $4	0.4	65%	Union 1%, EGD 5%		Adjustments: Incremental cost as per 2009 utility bulk purchase price. FR as per EB 2008-0384 and 0385
34a	Low Income	Existing	Low-flow showerhead	1.25 GPM, distributed as part of Union ESK program	Average existing stock	2.2 GPM (implicitly)	40	0	10,700	10	$4					
35	Low Income	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes (R-1)		25	0	0	10	($2) $4	0.2	47%	1%		Adjustments: Incremental cost as per utility bulk purchase price plus installation. Free ridership as per EB 2008-0384 and 0385
35a	Low Income	Existing	Pipe insulation for DHW outlet pipe	1/2" polyethylene foam insulation	Uninsulated DHW outlet pipes		17	0	0	15	$1					
	Commercial Cooking															
36	Commercial	New/Existing	Energy Star Fryer	50% cooking efficiency	Standard fryer	35% cooking efficiency	(1099) 916	-546	0	(12) 7	($3250) $1500	5.9	Med			Adjustments: Updatedsavings values, measure life and incremental cost based on best available information.
37	Commercial	New/Existing	High Efficiency Griddle	40% cooking efficiency	Standard griddle	32% cooking efficiency	503	0	0	12	$1,570	6.2	Med			
	Commercial Space Heating															
38	Commercial	Existing	Air Curtains	Single door	Non-air curtain doors		2,191	172	0	15	$1,650	1.5	Med	5%		Adjustments: FR as per EB 2008-0384 and 0385
38a	Commercial	Existing	Air Curtains	Single door			2,118	172	0	15	$1,650					
39	Commercial	Existing	Air Curtains	Double door	Non-air curtain doors		4,661	1,023	0	15	$2,500	1.1	Med	5%		Adjustments: FR as per EB 2008-0384 and 0385
39b	Commercial	Existing	Air Curtains	Double door			4,508	1,023	0	15	$2,500					
40	Commercial	New / Existing	Condensing Boilers	(88%) 90% estimated seasonal efficiency	Non-condensing boiler	76% estimated seasonal efficiency	(0.0104) .0119 / Btu/hr	0	0	25	$12 / kBtu/hr	2.3	High	5%		Adjustments: Details of Efficient Equipment and savings values updated. FR as per 2008-0384 and 0385
40a	Commercial	Existing	Condensing Boilers	88% seasonal efficiency (est.)	Non-condensing Boiler	76% estimated seasonal efficiency	0.0119/Btu/hr	0	0	25	15.4 / kBtu/hr					
41	Commercial	Existing	Demand Control Kitchen Ventilation	(5,000 CFM) 0 - 4,999 CFM	Kitchen ventilation without DCKV		(4801) 3972	(13521) 7231	0	(10) 15	($10000) $5000	4.2	Low	5%		Adjustments: Updated savings values, measure life and incremental cost. FR as per EB 2008-0384 and 0385
41a	Commercial	Existing	Demand Control Kitchen Ventilation	0 - 4,999 CFM	Ventilation without DCKV		3,660	7229 (7319 UG)	0	20	$5,000					
42	Commercial	Existing	Demand Control Kitchen Ventilation	(10,000 CFM) 5,000 - 9,999 CFM	Kitchen ventilation without DCKV		(11486) 10,347	(30901) 23,051	0	(10) 15	($15000) $10000	2.6	Low	5%		Adjustments: Updated savings values, measure life and incremental cost. FR as per EB 2008-0384 and 0385

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
42a	Commercial	Existing	Demand Control Kitchen Ventilation	5,000 - 9,999 CFM	Ventilation without DCKV		5960 (9535 UG)	2855 (23180 U	0	20	$10,000					
43	Commercial	Existing	Demand Control Kitchen Ventilation	(15,000 CFM) 10,000 - 15,000 CFM	Kitchen ventilation without DCKV		(18924) 18,941	(49102) 40,692	0	(10) 15	($20000) $15000	2.1	Low	5%		Adjustments: Updated savings values, measure life and incremental cost. FR as per EB 2008-0384 and 0385
43a	Commercial	Existing	Demand Control Kitchen Ventilation	10,000 - 15,000 CFM	Ventilation without DCKV		10910 (17,455 UG)	0334 (40929 U	0	20	$15,000					
43b	Commercial	New	Demand Control Kitchen Ventilation	0 - 4,999 CFM	Ventilation without DCKV		3,972	7,190	0	15	$5,000			5%		Adjustments: included item from EB2008-0384 and 0385. FR as per 2008-0384 and 0385.
43c	Commercial	New	Demand Control Kitchen Ventilation	5,000 - 9,999 CFM	Ventilation without DCKV		6,467	22,791	0	15	$10,000			5%		Adjustments: included item from EB2008-0384 and 0385. FR as per 2008-0384 and 0385.
43d	Commercial	New	Demand Control Kitchen Ventilation	10,000 - 15,000 CFM	Ventilation without DCKV		11,838	40,217	0	15	$15,000			5%		Adjustments: included item from EB2008-0384 and 0385. FR as per 2008-0384 and 0385.
44	Commercial	New / Existing	Destratification Fans		No destratification fans		(6129) 7,020	(-511) -123	0	15	$7,021	2.3	Low	10%		Adjustments: Updated savings based on Enbridge research, Prescriptive Destratification Fan Program, Agviro Inc., February, 2009 . Free ridership as per EB-2008-0384 & 0385.
44a	Commercial	New / Existing	Destratification Fans		No destratification fans		6,205	-511	0	15	$7,021					
45	Commercial	Existing	Energy Recovery Ventilator		Ventilation without ERV		3.95 / CFM	0	0	20	$3 / cfm	1.5	Low	5%		Adjustments: Free ridership based on EB-2008-0384 and 0385.
45a	Commercial	Existing	Energy Recovery Ventilator		Ventilation without ERV		3.14 / CFM	0	0	15	$2.5 / CFM					
46	Commercial	New	Energy Recovery Ventilator		Ventilation without ERV		3.75 / CFM	0	0	20	$3 / cfm	1.6	Low	5%		Adjustments: Free ridership based on EB-2008-0384 and 0385.
46a	Commercial	New	Energy Recovery Ventilator		Ventilation without ERV		3.14 / CFM	0	0	15	$2.5 / CFM					
47	Commercial	Existing	Enhanced Furnace	ECM (continuous)	Standard PSC Motor		(-)2.7 kBtu/hr	20.5/kBtu/hr	0	15	$960	14*	Low			
48	Commercial	Existing	Enhanced Furnace	ECM (non-continuous)	Standard PSC Motor		(-)0.4 / kBtu/hr	4.8 / kBtu/hr	0	15	$960	31*	Low			
48a	Commercial	Existing	Enhanced Furnace	Up to 299 MBtu/h, ECM only	Mid-efficiency furnace		(-)0.87 / kBtu/hr	9.7 / kBtu/hr	0	18	$550					
49	Commercial	New	Enhanced Furnace	ECM (continuous)	Standard PSC Motor		(-)2.5 kBtu/hr	20.8/kBtu/hr	0	15	$960	11*	Low			
50	Commercial	New	Enhanced Furnace	ECM (non-continuous)	Standard PSC Motor		(-)0.3 / kBtu/hr	3.1 / kBtu/hr	0	15	$960	55*	Low			
51	Commercial	Existing	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		3.77 / CFM	0	0	20	$3.40	1.8	Low	5%		Adjustments: FR as per EB 2008-0384 and 0385
51a	Commercial	Existing	Heat Recovery Ventilation		Ventilation without HRV		2.92 / CFM	0	0	15	$3.40					
52	Commercial	New	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		3.49 / CFM	0	0	20	$3.40	2.0	Low	5%		Adjustments: FR as per EB 2008-0384 and 0385
52a	Commercial	New	Heat Recovery Ventilation		Ventilation without HRV		2.92 / CFM	0	0	15	$3.40					
53	Commercial	Existing	High Efficiency Furnace	AFUE 90			3.6 / kBtu/hr	0	0	18	$6.7 / kBTu/h	3.7	Med			
54	Commercial	Existing	High Efficiency Furnace	AFUE 92			4.2 / kBtu/hr	0	0	18	$11 / kBTu/h	5.2	Med			
55	Commercial	Existing	High Efficiency Furnace	AFUE 96			5.4 / kBtu/hr	0	0	18	$22 / kBTu/h	8.1	Med			
55a	Commercial	Existing	High Efficiency Furnace		Mid-efficiency furnace		5.1 / kBtu/hr	0	0	18	$650					

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
56	Commercial	New / Existing	Infrared Heaters	0 - (75,000) 49,000 BTUH	Regular Unit Heater		(0.015) 0.0102/ Btu/hr	(245) 236	0	20	($0.0122 / Bth/hr) $0.009/$10^3$ Btu/hr	1.6	Med	33%		Adjustments: Updated savings values and incremental costs. Free ridership based on EB-2008-0384 and 2008-0385.
56a	Commercial	New / Existing	Infrared Heaters	0 - 49,999 BTUH	Unit heater		0.0102 Btu/hr	312	0	20	$15.4 kBTu/h					
57	Commercial	New / Existing	Infrared Heaters	(76,000 - 150,000 BTUH) 49,000 - 164,999 BTUH	Regular Unit Heater		(0.015) 0.0102/ Btu/hr	(559) 534	0	20	($0.0122 / Bth/hr) $0.009/$10^3$ Btu/hr	1.6	Med	33%		Adjustments: Updated savings values and incremental costs. Free ridership based on EB-2008-0384 and 2008-0385.
57a	Commercial	New / Existing	Infrared Heaters	49,999 - 164, 999 BTUH	Unit heater		0.0102 m^3/Btu/hr	624	0	20	$15.4 kBTu/h					
58	Commercial	New / Existing	Infrared Heaters	(151,000 - 300,000 BTUH) >165,000 BTUH	Regular Unit Heater		(0.015) 0.0102/ Btu/hr	(870) 833	0	20	($0.0122 / Bth/hr) $0.009/$10^3$ Btu/hr	1.6	Med	33%		Adjustments: Updated savings values and incremental costs. Free ridership based on EB-2008-0384 and 2008-0385.
58a	Commercial	New / Existing	Infrared Heaters	165,000 BTUH	Unit heater		0.0102 /Btu/hr	936	0	20	$15.4 kBTu/h					
59	Commercial	New / Existing	Rooftop Unit	Two-stage rooftop unit - up to and including 5 tons of cooling	Single stage rooftop unit	Single stage rooftop unit - 80% efficient	(255) 300	0	0	15	$375	2.9	Med	5%		Adjustments: Navigant gas savings were incorrectly calculated based on their own efficiency assumptions. The new substantiation document reflects this correction. FR as per EB 2008-0384 and 0385
59a	Commercial	New	Rooftop Unit	Two-stage rooftop unit	Rooftop unit	Single stage rooftop unit	1,275	0	0	20	$1,250					
60	~~Commercial~~	~~Existing~~	~~Programmable Thermostat~~		~~Standard thermostat~~		~~239~~	~~251~~	~~0~~	~~15~~	~~$110~~	0.9	Med			See below, line 60a and 60b
60a	Commercial	New / Existing	Programmable Thermostat (Warehouse, Recreation, Agriculture, Industrial)		Standard thermostat		674	524	0	15	$40			20%		Adjustments: New savings values developed on a sector basis. Incremental costs as per utility bulk purchase price. FR as per EB-2008-0384 and 0385.
60b	Commercial	New / Existing	Programmable Thermostat (Other, eg. Retail, Office)		Standard thermostat		191	246	0	15	$40			20%		Adjustments: New savings values developed on a sector basis. Incremental costs as per utility bulk purchase price. FR as per EB-2008-0384 and 0385.
60c	Commercial	Existing	Programmable Thermostat		Standard thermostat		519	921	0	15	$50					
61	Commercial	Existing	Prescriptive Boilers for Schools - Elementary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		10,830	0	0	25	($5646) $8646	1.0	Low	12% (EGD) 27% (Union)	10% (EGD & Union)	Adjustments: Incemental costs based on weighted average of boiler types as per EB 20080384 and 0385. FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study, October 2008
61a	Commercial	Existing	Prescriptive Schools - Elementary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		10,830	0	0	25	$8,646					
62	Commercial	Existing	Prescriptive Boilers for Schools - Secondary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		43,859	0	0	25	($8470) $14470	0.4	Low	12% (EGD) 27% (Union)	10% (EGD & Union)	Adjustments: Incemental costs based on weighted average of boiler types as per EB 20080384 and 0385. FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study, October 2008
62a	Commercial	Existing	Prescriptive Schools - Secondary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		43,859	0	0	25	$14,470					
	Commercial Water Heating															
63	~~Commercial~~	~~New / Existing~~	~~Condensing Gas Water Heater~~	~~95% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~338~~	~~0~~	~~0~~	~~13~~	~~$2,230~~	13	Low			See below, line 65a

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
64	~~Commercial~~	~~New / Existing~~	~~Condensing Gas Water Heater~~	~~95% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~905~~	~~0~~	~~0~~	~~13~~	~~$2,230~~	5.0	Low			See below, line 65a
65	~~Commercial~~	~~New / Existing~~	~~Condensing Gas Water Heater~~	~~95% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~1,614~~	~~0~~	~~0~~	~~13~~	~~$2,230~~	2.8	Low			See below, line 65a
65a	Commercial	New / Existing	Condensing Gas Water Heater	95% thermal efficiency	Conventional storage tank water heater	80% thermal efficiency	1,543	0	0	13	$2,230			5%		Adjustments; Savings updated. Measure life and incremental cost updated to reflect Navigant research, FR as per EB 2008-0384 and 0385
65b	Commercial	New / Existing	Condensing Gas Water Heater	EF=0.86	Conventional storage tank water heater	EF=0.59	1,412	0	0	15	$4,200					
66	Commercial	Existing	Pre-Rinse Spray Nozzle	1.6 GPM	Standard pre-rinse spray nozzle	3.0 GPM	387	0	116,086	5	$41	0.2	Med			See below
66a	Commercial	Existing	Pre-Rinse Spray Nozzle	1.6 GPM	Standard pre-rinse spray nozzle	3.0 GPM	2,434	0	432,800	5	$100					
67	~~Commercial~~	~~Existing~~	~~Pre-Rinse Spray Nozzle~~	~~1.24 GPM~~	~~Standard pre-rinse spray nozzle~~	~~3.0 GPM~~	~~486~~	~~0~~	~~145,937~~	~~5~~	~~$60~~	0.3	Low			See below, line 67a to 67f
67a	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Full Service)	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	931	0	182,000	5	$100			12.4%	3%	Adjustments: New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group); Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67b	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Limited)	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	278	0	55,000	5	$100			12.4%	3%	Adjustments: New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group); Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67c	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Other)	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	272	0	53,000	5	$100			12.4%	3%	Adjustments: New information based on Free Ridership and Spillover for Low Flow Pre Rinse Spray Nozzles (Nov. 26, 2008, PA Consulting Group); Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67d	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	1,286	0	252,000	5	$88			0.0%		Adjustments: Relatively new product; currently only aware of one manufacturer - propose 0% FR; Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67e	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	339	0	66,400	5	$88			0.0%		Adjustments: Relatively new product; currently only aware of one manufacturer - propose 0% FR; Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
67f	Commercial	New / Existing	Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	318	0	62,200	5	$88			0.0%		Adjustments: Relatively new product; currently only aware of one manufacturer - propose 0% FR; Savings based on Energy Profiles -Pre-rinse spray nozzle deemed savings study - January 30, 2009.
68	~~Commercial~~	~~New / Existing~~	~~Tankless Water Heater 100 gal/day~~	~~84% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~215~~	~~0~~	~~0~~	~~18~~	~~-$1,570~~	~~0.0~~	~~Low~~			See below, line 70a
69	~~Commercial~~	~~New / Existing~~	~~Tankless Water Heater (500 gal/day)~~	~~84% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~57~~	~~0~~	~~0~~	~~18~~	~~$510~~	~~18~~	~~Low~~			See below, line 70a
70	~~Commercial~~	~~New / Existing~~	~~Tankless Water Heater (1000 gal/day)~~	~~84% thermal efficiency~~	~~Conventional water heater~~	~~80% efficiency, 91 gal. tank.~~	~~-142~~	~~0~~	~~0~~	~~18~~	~~$2,590~~	~~N/A~~	~~Low~~			See below, line 70a

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
70a	Commercial	New / Existing	Tankless Water Heater 50-150 USG gal/day	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	221	0	0	20	-$1,570	0.0	Low	2%		Adjustments: Updated savings and measure life. FR as per EB2008-0384 and 0385.
70b	Commercial	New	Tankless Water Heater (950 gal/day)		Conventional storage tank water heater	140 gallon tank	825	0	0	20	$2,200					
	Multi-Family Water Heating															
71	Multi-Family	Existing	(Energy Star Clothes Washer) CEE qualified washers	(MEF=1.72, WF=8.0) MEF=2.20, WF=5.33	Conventional top-loading, vertical axis clothes washer	MEF=1.26, WF=9.5	(79) 222m3	(201) 296	(19814) 80,000	11	($150) $600	3.8	High	10%		Adjustments: Savings recalculated based on equipment in Enbridge program. FR as per EB 2008-0384 and 0385
71a	Multi-Residential	Existing	Energy Efficient Washer		Conventional top-loading, vertical axis clothes washer		342	306	90,790	10	$450					
72	Multi-Family	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	26	0	5,377	10	$2	0.2	90%	10%		Adjustments: FR as per EB 2008-0384 and 0385
72a	Multi-Family	Existing	Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	39	0	8,072	10	$2			10%		Adjustments: Savings calculation applied to a 1.0GPM aerator. FR as per EB 2008-0384 and 0385
72b	Multi-Residential	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	22	0	7,800	10	$2					
73	Multi-Family	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	7	0	1,382	10	$2	0.5	90%	10%		Adjustments: FR as per EB 2008-0384 and 0385
73a	Multi-Family	Existing	Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	11		2,371	10	($2) $1.50			10%		Adjustments: Savings calculation applied to a 1.0GPM aerator. Incremental costs to reflect utility bulk purchase price. FR as per EB 2008-0384 and 0385
73b	Multi-Residential	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,000	10	$2					
74	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (distributed, e.g., ESK)	Average existing stock	2.2 GPM	(23) 30	0	(4369) 5345	10	($6) $4	0.5	65%	10%		Adjustments: Savings adjusted to account for percentage of showers taken with efficient unit in Multi-residential setting (92%) compared to 76% in low rise residential as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008. Incremental costs as per utility bulk purchase price. FR as per EB 2008-0384 and 0385
74a	Multi-Residential	Existing	Low-flow showerhead	1.5 GPM, (Union ESK program)	Average existing stock	2.2 GPM (implicitly)	22	0	6,400	10	$4					
75	~~Multi-Family~~	~~Existing~~	~~Low-flow showerhead~~	~~1.25 GPM (installed)~~	~~Average existing stock~~	~~2.0 GPM~~	~~34~~	~~0~~	~~6,081~~	~~10~~	~~$13~~	0.7	65%			See below, line 76 to 77g
76	Multi-Family	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	2.25 GPM (2.0 to 2.5 GPM)	(43) 53	0	(7507) 9078	10	($13) $17	0.6	65%	10%		Adjustments: Savings adjusted to account for percentage of showers taken with efficient unit in Multi-residential setting (92%) compared to 76% in low rise residential as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008. Incremental cost as per utility bulk purchase plus installation cost. FR as per EB 2008-0384 and 0385
77	Multi-Family	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	3.0 GPM (2.6 GPM and above)	(70) 87	0	(11840) 14341	10	($13) $17	0.4	65%	10%		as above

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	Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
77a	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	2.25 GPM (2.0 to 2.5 GPM)	28	0	5,197	10	$17			10%		Adjustments: Navigant method used to calculate savings for 1.5 GPM showerhead with adjustment for percentage of showers influenced in Multi-residential application. Incremental cost as per utility bulk purchase plus installation cost. FR as per EB 2008-0384 and 0385
77b	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	2.75 GPM (2.6 to 3.0 GPM)	55	0	9,490	10	$17			10%		as above
77c	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	3.25 GPM (3.1 to 3.5 GPM)	79	0	13,250	10	$17			10%		as above
77d	Multi-Family	Existing	Low-flow showerhead	1.5 GPM (installed)	Average existing stock in one of four ranges.	3.6 GPM (3.6 GPM and above)	91	0	15,114	10	$17			10%		as above
77e	Multi-Family	Existing	Low-flow showerhead	2.0 GPM (installed)	Average existing stock in one of three ranges.	2.75 GPM (2.6 to 3.0 GPM)	4	0	1,727	10	$17			10%		Adjustments: Navigant method used to calculate savings for 2.0 GPM showerhead with adjustment for percentage of showers influenced in Multi-residential application. Incremental cost as per utility bulk purchase plus installation cost. FR as per EB 2008-0384 and 0385
77f	Multi-Family	Existing	Low-flow showerhead	2.0 GPM (installed)	Average existing stock in one of three ranges.	3.25 GPM (3.1 to 3.5 GPM)	28	0	5,487	10	$17			10%		as above
77g	Multi-Family	Existing	Low-flow showerhead	2.0 GPM (installed)	Average existing stock in one of three ranges.	3.6 GPM (3.6 GPM and above)	40	0	7,351	10	$17			10%		as above
77a	Multi-Residential	Existing	Low-flow showerhead		Average stock		115	0	30,966	10	$15					
78	Multi-Family	Existing	Low-flow showerhead (distributed, e.g., ESK)	1.25 GPM	Average existing stock	2.2 GPM	(42) 53.8	0	(7289) 8916	10	($6) $4	0.6	65%	10%		Adjustments: Savings adjusted to account for percentage of showers taken with efficient unit in Multi-residential setting (92%) compared to 76% in low rise residential as per Summit Blue, Resource Savings Values in Selected Residential DSM Prescriptive Programs, June 2008. FR as per EB 2008-0384 and 0385
78a	Multi-Residential	Existing	Low-flow showerhead	1.25 GPM (Union ESK program)	Average existing stock	2.2 GPM (implicitly)	40	0	10,700	10	$4					
	All	New / Existing	CFL	13W	60W incandescent		-	45	-	8	$0			24%		Adjustments: Measure as per EB 2008-0384 and 0385
	All	New / Existing	CFL	23W	75W incandescent		-	50	-	8	$0			24%		Adjustments: Measure as per EB 2008-0384 and 0385
	Residential	New	Energy Star New Homes	Energy Star for New Homes V4	New home built to OBC as of Jan 1, 2009		881	734		25	$4,275			5%		Adjustments: 2008 measure updated to reflect changes to Energy Star and Ontario Building Code and based on E Star V4

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Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	300 MBH 83-84% efficient	boiler with 80% combustion efficiency		1,075	0	0	25	$3,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	600 MBH 83-84% efficient	boiler with 80% combustion efficiency		1,777	0	0	25	$5,800			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1000 MBH 83-84% efficient	boiler with 80% combustion efficiency		3,136	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1500 MBH 83-84% efficient	boiler with 80% combustion efficiency		4,317	0	0	25	$5,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	300 MBH 85-88% efficient	boiler with 80% combustion efficiency		1,766	0	0	25	$4,500			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	600 MBH 85-88% efficient	boiler with 80% combustion efficiency		2,290	0	0	25	$6,000			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1000 MBH 85-88% efficient	boiler with 80% combustion efficiency		5,155	0	0	25	$10,300			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (DHW)	1500 MBH 85-88% efficient	boiler with 80% combustion efficiency		7,095	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.

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Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.*	Free Ridership	Spillover	
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	300 MBH 83-84% efficient	boiler with 80% combustion efficiency		2,105	0	0	25	$3,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	600 MBH 83-84% efficient	boiler with 80% combustion efficiency		3,994	0	0	25	$5,800			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1000 MBH 83-84% efficient	boiler with 80% combustion efficiency		7,310	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1500 MBH 83-84% efficient	boiler with 80% combustion efficiency		11,554	0	0	25	$5,900			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	2000 MBH 83-84% efficient	boiler with 80% combustion efficiency		16,452	0	0	25	$4,950			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	300 MBH 85-88% efficient	boiler with 80% combustion efficiency		3,125	0	0	25	$4,500			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	600 MBH 85-88% efficient	boiler with 80% combustion efficiency		5,930	0	0	25	$6,000			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1000 MBH 85-88% efficient	boiler with 80% combustion efficiency		10,856	0	0	25	$10,300			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.

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Target Market		Equipment Details				Annual Resource Savings			Other						NOTES
Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	Market Share/Pen.+	Free Ridership	Spillover	
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	1500 MBH 85-88% efficient	boiler with 80% combustion efficiency		17,157	0	0	25	$7,400			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Small Commercial / Large Commercial and Multi-residential	Existing	Higher Efficiency Boilers (Space Heating)	2000 MBH 85-88% efficient	boiler with 80% combustion efficiency		24,431	0	0	25	$7,050			Enbridge: 10/12/20% Union: 10/59/42%		Adjustments: New measure. EUL as per Measure life table from EB 2008-0384 and 0385. Free ridership by sector as per EB 2008-0384 at 10/12/20% for Enbridge and 10/59/42% for Union for small commercial, Commercial and Multi-residential applications.
Commercial	Existing	Custom Retrofit											EGD 12% Union 59%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2008
Commercial	Existing	Custom Multi-family											EGD 20% Union 42%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2009
Commercial	New	Custom New Build											EGD 26% Union 33%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2010
Agriculture	New/Existing	Custom Agriculture											EGD 40% Union 0%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2011
Industrial	New/Existing	Custom Industrial											EGD 50% Union 56%	EGD 21% Union 10%	FR as per EB 2008-0384 and 0385. Spillover as per Summit Blue, Custom Projects Attribution Study October 31,2012
See also: Custom Resource Acquisition Technologies - Measure Life Assumptions															

* Payback for measures with natural gas savings is based on natural gas savings only; payback for measures that increase natural gas consumption (ie, furnaces with ECMs) is based on net energy cost savings (ie, electricity savings less incremental natural gas costs)

+ When available, the current market penetration or market share percentage is provided, else, an estimated "low", "medium" or "high" scale is used, where "low" is below 5%, "medium" is between 5 and 50%, and "high" is greater than 50%.

THIRD PARTY REVIEW OF MEASURES AND ASSUMPTIONS FOR DSM PLANNING IN ONTARIO

Submitted to:

Enbridge Gas Distribution Inc.

March 12, 2009

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1 INTRODUCTION

The purpose of this third party review of DSM measure assumptions for Ontario gas distribution companies is to provide additional insights to all stakeholders on whether the *best available information* is being used to develop savings estimates for gas DSM program measures. The comments are provided to the Ontario Energy Board (OEB) in response to the recent invitation to comment on the OEB DRAFT DSM Technologies and Input Assumptions Report [File # EB-2008-0346]. This report provides comments in two sections, a policy level overview on estimating DSM measure savings, and a review of measure level assumptions. These sections follow a brief summary of relevant experience of the reviewers below.

1.1 Summit Blue Experience

The viewpoints expressed here are based on the professional judgment of Summit Blue Consulting staff. The staff that reviewed the measure assumptions and approaches used to develop savings estimates have many years of DSM program design and evaluation experience across North America. This includes significant experience in Ontario, in roles directly pertinent to this review.

- Dr. Dan Violette appeared as a qualified expert at the Generic Proceeding.
- Kevin Cooney directed an audit of Union Gas measure assumptions, and SSM/LRAM calculations in 2006. Mr. Cooney is also currently the director of an evaluation of the OPA Double Return Demand Response Initiative.
- Rachel Freeman conducted a detailed review of a number of specific DSM measure assumptions during the Union Gas Audit.

In addition to this direct experience with gas efficiency measures in Ontario, the authors and additional Summit Blue staff bring substantial credentials to the process of conducting independent reviews and evaluations of DSM program efforts across North America. Summit Blue has provided expert testimony and developed program designs and regulatory filings for natural gas and electric DSM efforts in many jurisdictions. These include the following roles:

- Conducted Ontario specific review of measure savings for selected Residential gas DSM measures and reviewed free ridership levels for custom programs in the Commercial and Industrial Sectors;
- Currently conducting evaluation of Ontario Power Authority (OPA) DSM and demand response programs, the Cross Cutting DSM Program and Double Return program;
- Independent evaluator for the portfolio of statewide Local Government Partnerships DSM programs for California Public Utility Commission (CPUC);
- Retrospective Evaluation of the Accomplishments of the NW Energy Efficiency Alliance (NEEA) for the Board of Directors;
- Served as Independent M&V Expert for the state of Texas PUC;
- Recently developed DSM measure savings for the state of Minnesota as part of a statewide potential study, and for Gas Networks in the Northeastern United States; and
- Currently conducting evaluations of DSM program portfolios for Arizona Public Service, Commonwealth Edison, and Tucson Electric, and a gas DSM programs for National Grid.

2 POLICY LEVEL OVERVIEW

Summit Blue reviewed the assumptions for all measures listed in the recently released Board report *Measures and Assumptions for Demand Side Management (DSM) Planning*.[1] This brief set of high level comments is intended to provide a general framework with which to view specific comments on measure assumptions in the following chapter. Some of those comments are based on the availability of new data that Navigant may not have had available at the time of their report. Notes on specific adjustments to measure assumptions are included in Section 3. The key question this overview seeks to answer is:

What is an appropriate process to be considered to select the best e values for DSM measure-level savings for natural gas distributors in Ontario?

There are some general points to consider in developing assumptions for DSM measure savings. Certainly, it is in the best interest of all parties to develop the best savings estimates for DSM measures that balance accuracy with cost considerations. Union Gas and Enbridge have provided DSM programs for over ten years, and there are historical trends and data from these programs that can inform current data collection and analysis priorities. Both utilities have a record of being forthcoming to regulators and stakeholders with data, and want to continue to work in a cooperative manner to develop the most appropriate and accurate savings estimates for gas DSM efforts in Ontario.

<u>Themes to consider when estimating measure and program savings:</u>

- ***Use pertinent local data*** helps to improve measure and program level savings estimates and helps to focus future program activities and resources.
  - Collecting data on statistically representative samples of program participants is generally the best way to determine the expected savings from a given DSM measure for program participants.
  - Energy simulation modeling that utilizes local data can help to estimate program savings for some measures that have interactive effects, or may be used in new applications.
  - Secondary data from other jurisdictions can supplement primary data collection activities, and when sufficient local data are not available, data from other jurisdictions may be the sole source of a savings estimate. Primary data is preferred when available.

- ***Focus on what matters*** – consider the 80/20 rule when analyzing where the savings are coming from, and where the program dollars are being spent.
  - Gas DSM program savings in Ontario come primarily from Custom Projects.
  - Which measures result in the largest share of program savings? Answering this can focus data collection and analysis efforts on those measures produces the greatest information value per dollar.
  - Other large jurisdictions (California in particular) have taken a High Impact Measures (HIM) approach to DSM program savings – gathering significant local data on the measures that account for large portions of savings across programs.
  - Focusing data collection on places where uncertainty can be reduced around measure characteristics that heavily influence savings, or those characteristics that have a high

[1] Measures and Assumptions for Demand Side Management (DSM) Planning, Navigant Consulting, February 6, 2009.

degree of uncertainty (like operating hours for some equipment) provides the best improvement in estimates, whether gathering primary or secondary data.

- ***Assure that data from other jurisdictions are appropriate*** to use for the gas DSM programs delivered in Ontario.
    - o It is imperative to ask if the assumptions used in a study for another state or region are pertinent to the way a measure is used in Ontario. Are the *geography, climate, and culture* of the customer base in the other jurisdiction a reasonable comparison group for the Ontario gas customers that participate in DSM programs? In addition, it is important to consider differences in codes and standards, the existence of tax credits, and other factors that affect baselines and customer behavior.
    - o While there are many current and reputable studies out there on DSM measure savings, asking upfront whether the customer base, data collection methods, or other measure assumptions will provide data that improves existing estimates is important. There is always another study out there that can be cited to refute numbers offered for a measure. Is it productive to continue chasing the next study from another state or region?

<u>Applying themes to current measures and Assumptions draft report:</u>

- Enbridge has ***significant local data*** on some DSM measures that were not considered by Navigant in developing the assumptions in the current report
    - o The local utilities have the best access to customer data and knowledge of local markets for energy efficiency products.
    - o Incremental cost data is being updated by the Utilities based on bulk purchase arrangements actually available to Enbridge Gas. For some measures, incremental costs and total cost for the measure is the same, as there is no base case measure.
    - o Enbridge has suggested changes to measure assumptions in instances when they have actual local data, but not in cases where no data are available. Examples of this include:
        - For some water heating measures, Enbridge has recent load research data on gas consumption of equipment, so is suggesting updated values for the annual natural gas savings. There is not comparable data on water consumption savings, so no adjustment is recommended for these assumption (conservatively in most cases).
    - o Navigant data assumed to be relevant for Enbridge customers, sometimes is not:
        - Building codes may vary in the cited jurisdictions. Code enforcement varies considerably as well, so baseline value comparisons may not be relevant either.
        - Program delivery methods and quality control may vary considerably from the program being cited and the program delivery methods employed by Enbridge.

- ***Free Ridership and Spillover*** numbers based on a specific program design should still apply to that same program design.
    - o While the Navigant report indicates the program designs for 2010 are not known at this time, and thus free rider estimates are unknown, Enbridge has indicated that they will use the same program design and delivery mechanisms as in the previous program cycle. Thus, for planning purposes, it is reasonable to assume that free-ridership and internal spillover will be comparable to the values estimated last year for these program designs.
    - o Free ridership and spillover rates for low income programs are typically lower than rates measured for other sectors. Suggested values, based on the most recent studies bear this out.

- The use of ***market share data*** for resource acquisition programs has limited relevance. There does not appear to be added value to including the subjective ratings of market penetration in Appendix B of the Navigant report.

3 MEASURE ASSUMPTIONS REVIEW

Enbridge Gas has been delivering DSM programs to residential, commercial, and industrial customers since the mid to late 90's in response to direction from the OEB. Commercial and industrial programs contribute a significant amount of gas savings and net TRC benefits to DSM efforts. Approximately 70 percent of gas savings are attributable to custom programs in the Commercial and Industrial sectors; in addition, significant electricity and water savings have been achieved through these programs. This experience in delivering programs, and collecting data on the DSM measures deployed in these programs, positions Enbridge to have the most current and pertinent data on these measures. Whenever possible, the reviewers considered these data in the following comments.

Union Gas and Enbridge Gas Distribution staff reviewed the deemed measure definitions given in Appendix B of Navigant's Draft Report for Measures and Assumptions for Demand Side Management (DSM) Planning, Feb 6, 2009, and recommended adjustments or review of some of the measures. Significant time was put into this review by Union Gas and Enbridge Gas Distribution staff, including some original research and detailed assumptions and methodology reviews for each measure.

Of the 176 unique measures defined in the report, 16 had no changes assigned to them, and 108 had some kind of change recommended for one or more of the following values: Natural Gas savings (m3), Electricity savings (kWh), Water savings (L), EUL, Incremental Measure Cost ($), Free Ridership, or Spillover. Summit Blue reviewed all of the measures with changes for applicability of the best available information, but no new research was conducted on specific measures. If questions regarding specific assumptions arose during the review, the team did a quick review of the cited sources for applicability.

Summit Blue initially recommended that the changes be accepted for 82 of the measures. For many of these measures, the change was simply an update of the Free Ridership or Spillover value, based on 2008 studies performed by Summit Blue Consulting for Union Gas, for residential, commercial, and custom measures.

For 26 of the changed measures, a brief review of the documentation, deemed savings methodology, and assumptions was done to resolve outstanding questions and issues. After this brief review, all but 5 of the unique measures were transferred to the list of measures for which Summit Blue recommends that the changes be accepted.

Exhibit 1 shows all of the measures for which Summit Blue recommends a different change to that provided by Union Gas and Enbridge Gas, and the results of the Summit Blue Consulting review.

Exhibit 1: Suggested Changes to Reviewed Measures

Line Number	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Changes Made	SBC Notes
20	Residential	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	2.25 GPM (2.0 to 2.5 GPM)	Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385.	Navigant: 24% water savings over base, 23% gas savings over base. USG gas savings: 24.4% over base. Recommend that water savings be incremented by 6% to align with gas savings.
21	Residential	Existing	Low-flow showerhead	1.25 GPM (installed)	Average existing stock in one of two ranges.	3.0 GPM - 2.6 GPM and higher	Adjustments: Gas savings updated from EGD load research study, Effects of Low Flow Showerheads on Consumption, SAS Institute (Canada) and Enbridge Gas Distribution, March 2009. Incremental cost as per 2009 utility bulk purchase price; FR as per EB 2008-0384 and 0385.	Navigant: 32% water savings over base, 35% gas savings. USG gas savings: 37% over base. Recommend that water savings be incremented by 6% to align with gas savings.
68	Commercial	Existing	Tankless Water Heater (100 gal/day)	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	Navigant did not include Tankless Water Heaters for Existing Commercial	This measure has negative incremental costs for the 100 gal/day case and negative savings for the 1000 gal/day case. The base case water heater (Rheem G91-200) is the same size for all three cases. It is likely that the 100 gallons/day case would have a smaller baseline storage water heater than the 1000 gallons/day). At 1000 gallons/day base case water heater size will almost definitely be higher than 91 gallons - hence negative savings. Also, at 100 gallons/day the number of tankless water heaters to replace the water heater would be less. We recommend that the base case water heater size be reviewed for each case. This would affect both savings and costs for all three cases.
69	Commercial	Existing	Tankless Water Heater (500 gal/day)	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	Navigant did not include Tankless Water Heaters for Existing Commercial	
70	Commercial	Existing	Tankless Water Heater (1000 gal/day)	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	Navigant did not include Tankless Water Heaters for Existing Commercial	

APPENDIX A: RESUMES OF SUMMIT BLUE REVIEWERS

Dan Violette

Kevin Cooney

Rachel Freeman

EMPLOYMENT HISTORY

- Principal and Founder, Summit Blue Consulting, Boulder, CO, 2000-present
- Sr. Vice President, Economics and Analytics, Hagler Bailly Consulting, Inc., Boulder, CO, 1996-2000
- Sr. Vice President,/EDS Management Consultants, Boulder, CO, 1994-1996
- Sr. Vice President, XENERGY Inc., Boulder, CO, 1992-1994
- Sr. Vice President, RCG/Hagler Bailly, Inc., Boulder, CO, 1987-1991
- Cofounder and Sr. Vice President, Energy and Resource Consultants, Inc., Boulder, CO, 1979-1987
- Economist, Energy and Environmental Analysis, Inc., Boulder, CO, 1977-1979

PROFESSIONAL EXPERIENCE

Dr. Violette is a leading authority on the application of quantitative methods to supply-side and demand-side resource planning for electric and gas utilities. He has authored guidebooks on the application of these methods, and he has presented testimony and participated in litigation support efforts addressing new generation, demand-side actions, and load management / demand response technologies. He has performed assignments for over 50 utilities and energy companies in North America and has testified before regulatory authorities in over a dozen states. His work has been documented in handbooks authored for the Electric Power Research Institute, International Energy Agency, OECD, and the American Gas Association.

In his 20 years of consulting experience, Dr. Violette has conducted assignments for clients across North America and internationally. This work includes over 500 evaluations of energy efficiency program portfolios, innovative pricing programs, and demand response initiatives. He has also worked on new energy services products focused on information and demand-side technologies for leading technology companies.

His consulting engagements have ranged from focused quick-hit white paper studies to managing multi-year, multi-million dollar assignments. For electric and gas utilities, he has conducted assignments in the areas of resource planning, DSM planning/operations and evaluation, risk assessment, rate design, new energy services analyses, and organizational studies. He has provided support to utilities in merger and acquisition analyses, rate cases, and regulatory hearings, as well as in securities and environmental litigation.

He has conducted on-site workshops at nearly a dozen client sites and numerous workshops on planning, DSM and evaluation for EPRI, as well as training courses for the Association of Energy Services Professionals and the Peak Load Management Alliance. He was selected to teach the workshop on Necessary Statistics and Data Analysis for the evaluation of energy programs (DSM and pricing) at the International Energy Program Evaluation Conference (IEPEC) for each of the three past meetings (2001, 2003 and 2005).

As a senior executive with Hagler Bailly Consulting, he co-managed the North American utility practice for this 500 person international consulting firm. He also helped establish Electronic Data Systems Management Consulting Services' (EDS-MCS) practice in the energy industry. Both at Summit Blue and in these previous positions, Dr. Violette has led teams of consultants and subcontractors in the performance of assignments for energy companies and related network industry trade allies, public utility commissioners, consumer groups, state collaboratives, and international agencies such as the World Bank, the International Energy Agency (IEA), and the Asian Pacific Economic Cooperation (APEC) organization. Dr. Violette has worked on assignments in Pakistan, Hungary, and the Philippines as well as leading key tasks for a 12-member consortium of countries on the IEA's Demand Side Programme.

Dr. Violette served three elected terms as the President of the Association of Energy Services Professionals (AESP) and two terms as Vice Chair of the Peak Load Management Alliance (PLMA). He currently is on the Board of Directors of both organizations. Dr. Violette has published over 40 papers in journals and books, made over 60 contributions to published conference proceedings, and contributed to reports to the U.S. Congress prepared by the Department of Energy, the National Acid Precipitation Assessment Panel (NAPAP), and the National Commission on Air Quality (NCAQ).

SELECTED ASSIGNMENTS

- Currently working on the design and evaluation of NSTAR's Smart Grid Pilot Program in response to the legislation passed by the Massachusetts State Legislature.
- Completing a review of BC Hydro's 2008 DSM Plan on behalf of the Electricity Conservation and Efficiency Advisory Committee in British Columbia.
- Served as expert staff to the California Public Utilities Commission on evaluation methods for demand response (DR) programs and approaches for assessing the cost-effectiveness of DR programs (2007-2008).
- Evaluated Hydro One's Double Returns Peak Load Reduction program (2008).
- Led a DSM technical potential study for Con Ed focused on peak reduction and dispatchable reduction technologies (2008).
- Currently working with three utilities on the development of evaluation plans for DSM programs and portfolio's including recent large-scale programs for all three IOUs in California.
- Leading the implementation of the evaluation of New York State Energy Research and Development Authority's (NYSERDA) utility-SBC funded DSM and DR programs as part of a five-year contract awarded as a follow-on to a prior four year effort on DSM evaluation of programs spanning all sectors, including the evaluation of the NYSERDA's new DSM technology development program. (2006- 2008)
- Dr. Violette is the lead workshop facilitator for Public Service Company of New Mexico Integrated Resource Planning collaborative process and consultant to the utility on integration of DSM programs into the IRP. (2006-2007)
- Dr. Violette is currently leading Summit Blue's work in support of the California Energy Commissions Working Group 2 (WG2) Monitoring and Evaluation Subcommittee which involves an impact evaluation all three California IOUs DSM and price-responsive load programs for program years 2004 and 2005. This is a multi-year effort assessing demand bidding programs and critical peak pricing programs for customers with over 200kW demand. (Jan 2005 - May 2006)
- Dr. Violette served as a consultant / facilitator to the IRP stakeholders collaborative supporting the development of Idaho Power's 2006 integrated resource plan. (Planned end July 2006)
- Leading the impact evaluation and overseeing the process and operational assessment of Public Service Electric &Gas (PSE&G) company's myPOWER innovative pricing pilot program spanning three years and addressing TOU, CPP and day-ahead RTP rate designs. (Year 1 report completed, 2006 work on-going)

- Project manager for a multi-year, multi-million dollar DSM evaluation, market characterization, market assessment and causality/attribution study covering the energy efficiency, demand response and market transformation programs offered by the New York State Energy Research Development Authority (NYSERDA). Over 50 demand-side programs spanning energy efficiency, peak load management, renewables, metering and combined-head and power programs were examined in this evaluation effort. (Separate awards for the 2003 to 2004 program years, and a contract extension for the 2005 program year, and a recent renewal for the 2006 program year).

- Dr. Violette just concluded a project for the California Energy Commission's PIER (Public Interest Energy Research) Program where he worked on the development of A Comprehensive framework for assessing the value of demand response programs including both load-reduction and price-response programs. (Completed March, 2006)

- Leading a comprehensive market assessment of energy efficiency programs implemented by the eight electric and gas utilities in New Jersey on behalf the Office of Clean Energy, New Jersey Board of Public Utilities. (2005 – 2006)

- Dr Violette is leading a Summit Blue assignment working with Hawaiian Electric Company to design Commercial/Industrial Voluntary Load Control (CIVLC) Programs Development. Summit Blue is designing a suite of demand response program offerings for HECO’s commercial and industrial customers as an alternative to the company’s current direct load control program. The Summit Blue team is reviewing customer data, conducting customer focus groups, and interviewing utility dispatchers and key account representatives to develop several program options that are appropriate for various customer types and sizes. The program will allow participants to choose the offering that is best suited to their operational needs and preferences regarding technology, flexibility, financial incentives, and other considerations. Summit Blue is also preparing a business case that includes an economic rationale for the program and that will form the basis of HECO’s application for PUC approval of the program. (on-going)

- Throughout 2004, Dr. Violette led the evaluation planning and implementation for the assessment of the New York State Energy Research and Development Authority’s SBC (System Benefit Charge) funded programs across residential, commercial, and industrial sectors including energy efficiency, load response, renewables and combined heat and power programs. This initial year effort led to two additional years being added to the contract. (2004)

- Working with the Sacramento Municipal Utility District to evaluate the impacts of a smart thermostat program among residential customers for Summer 2002 and to design and assess a combined Smart Thermostat program and TOU rates offer to encourage both energy efficiency and demand response (2002-2004)

- Working on a project for the Board of the Northwest Energy Efficiency Alliance examining the portfolio of programs being implemented by the NW Alliance to determine if the objectives of the Alliance have been achieved, whether benefits that were expected to occur from a regional implementation organization are being achieved, and whether the overall value of the Alliance can reasonably be assumed to be exceeding its costs (2003).

- Conducting an evaluation of a mass market program for small businesses for the Massachusetts DSM Collaborative. The program is being offered by NSTAR and involves audits, equipment installation and load control equipment. Impact, process and market evaluations are being conducted in this ongoing assessment (October 2002 to February 2003)

- Worked with the Energy research Centre of the Netherlands to develop the verification protocols for bids for Joint Implementation and Clean Development Mechanisms for cross country investments in carbon emission reduction strategies (January, 2002)

- Developed verification and evaluation protocols for energy efficiency projects designed to reduce emissions of greenhouse gases across a wide variety of programs for the International Energy Agency (IEA) and led a workshop in Denmark on this topic (May, 2001)

- Leading the implementation of process and impact evaluations using both engineering and econometric techniques to evaluate seven DSM programs for LG&E Energy and Kentucky Utilities. Data being used includes selected samples of end-use metered data, billing data, audit data, and survey data (Fall, 2001).Implementing evaluation efforts for seven programs at LG&E Energy and KU Utilities

- Worked with American Electric Power (AEP) Companies retail pricing group along with its subsidiary utilities Public Service Company of Oklahoma and Central and Southwest utilities to design innovative retail pricing strategies for the opening of the Texas market to retail choice.

- Designed peak load curtailment programs for Louisville Gas & Electric Company and developed evaluation plans for a portfolio of energy efficiency programs (2000).

Selected Project Activities 1990 to 2000:

- Led a number of projects for the Electric Power Research Institute, including developing and conducting training courses on performance measurement, data collection for decision making, authoring a handbook for assessing the performance of energy services programs.

- Led a three-year in-field metering and monitoring for a consortium of seven gas utilities in New England estimating the impacts of energy efficiency equipment in the residential and commercial sectors.

- Led an effort for a consortium of five New England utilities to examine the influence of utility actions on regional energy use and the markets for energy products (1.

- Coauthored a “White Paper” for the National Association of Regulatory Utility Commissioners on regulatory issues in the evaluation of energy services programs.

- Managed the analytic tasks of an EPRI tailored collaborative project examining the integration of information from short-term metering of technologies with longer term billing analyses of customers. The participating utilities were Northern States Power and Madison Gas and Electric Company.

- Performed a number of assignments for utilities assessing their customer information systems and how they can be used for performance measurement and market research. These efforts often included the development of strategies for the collection of customer data and market intelligence.

- Designed and conducted training programs and workshops on market and resource planning, as well as performance measurement for a number of utilities. These seminars and workshops have been conducted for professionals at San Diego Gas and Electric Company, Ontario Hydro, Bonneville Power Administration, Hydro Quebec, Public Service Electric & Gas, Arizona Public

Service Company, and other utilities. Dr. Violette has also produced and conducted six training seminars on behalf of the Electric Power Research Institute.

- Developed environment strategies, including environmental externality valuation and integration of externalities in utility plans, as well as a number of assignments related to Clean Air Act compliance, including emissions trading, conservation as a compliance strategy, and the evaluation of compliance plans.

SELECTED PUBLICATIONS — JOURNALS AND BOOKS

"AMI and Demand Response – Getting it right the first time!" with Ross Malme and Pete Scarpelli, Public Utilities Fortnightly, July 2006

"Metering: Calm at a Technology Crossroads" Energy Markets, Vol. 10, No. 3, April 2005

AESP/EPRI Pricing Conference: What's Working and What's Needed; White Paper, EPRI Value and Risk Program; Daniel Violette, Ahmad Faruqui and Brent Barkett: Prepared for: Victor Niemeyer Area Manager, Power Markets, published by EPRI, December 2004m #1008530

"Demand Response as a Driver of Innovation and New Technology" with Ross Malme, Electricity Today, Issue 8, Volume 16, 2004

"*Electricity Pricing -- Lessons from the Front"* White Paper Based on: The AESP/EPRI Pricing Conference: Innovation, Technology, Economics and Markets; Violette, Daniel and Ahmad Faruqui; Prepared for: Victor Niemeyer Area Manager, Power Markets, published by EPRI, October 2003, #1002223

"Implications of Retail Customer Choice for Generation Companies" in Customer Choice: Finding Value in Retail Electricity Markets, Faruqui, A. and J. R.Malko, Eds., Published by Public Utility Reports, ISBN#: 0-910325-73-1, 2003.

"Strategic Alliances: Partnering to Achieve Cooperative Objectives," published by the National Rural Electric Cooperative Association (NRECA), October 2003, #Project01-06

"Retrospective Assessment of the Northwest Energy Efficiency Alliance" Published by the Northwest Energy Efficiency Alliance, October 2003, #E03-120

"Rationalizing Prices in Retail Markets" Energy Markets, Hart's Publications, April Issue, 2003.

"Demand Response: Creating Customer and Market Value," with L. Barrett, White Paper Series, Published by the Peak Load Management Alliance, October, 2002.

"Making Demand Response a Reality", with Larry Barrett, Energy User News, Aug. 2002, Vol. 27, No. 8.

"*Price-Responsive Load among Mass-Market Customers*," in Electricity Pricing in Transition, A. Faruqui and K. Eakins, eds., Kluwar Academic Publishers, Norwell, MA, 2002

"Demand Response: Principles for Regulatory Guidance" with Larry Barrett, White Paper Published by the Peak Load Management Alliance, February 2002.

"An Initial View on Methodologies for Emission Baselines: Energy Efficiency Case Study," Published by OECD and IEA, June 2000

"*Conventional Pricing Wisdom Not Competitive: Riding Customer-Choice Wave with Innovation Creates Margin, Attracts Customers*," for Energy Marketing, February 1999, Volume 2 Issue 1.

"Conventional Pricing Wisdom Not Competitive: Riding Customer-Choice Wave with Innovation Creates Margin, Attracts Customers," for Energy Marketing; Forecasting the Future of the Energy Marketplace, February 1999/Volume 2.1.

"Chapter 16: Implications of Retail Customer Choice for Generation Companies." In Customer Choice: Finding Value in Retail Electricity Markets, published by Public Utility Reports (PUR) Press, January 1999.

"Evolving Business Processes for Gas Utilities: The Impacts of Retail Choice," published by the Gas Research Institute, Market Analysis and Information Technology Business Unit, May 1998.

"Retail Choice and Energy Convergence: Implications for Gas Utilities," Natural Gas, Pubs., John Wiley & Sons, Inc., August 1998.

"Evaluation, Verification, and Performance Measurement of Energy Efficiency Programmes." *International Energy Agency Publication*, Paris, France, Forth Draft, April 25, 1996.

Editor, Performance Impacts: Evaluation Methods for the Nonresidential Sector**,** Electric Power Research Institute Pubs., Palo Alto, CA, EPRI TR-105845, Research Project 3269, December 1995.

Editor, Inaugural Issue of the Energy Services Journal, Lawrence Erlbaum Associates Pubs., Vol. 1, Issue 1, October 1995.

"Chapter 6: Estimating Spillover and Market Transformation." In Performance Impacts: Evaluation Methods for the Nonresidential Sector, Electric Power Research Institute Pubs., Palo Alto, CA, EPRI TR-105845, Research Project 3269, December 1995.

Evaluation and Verification of Energy Efficiency Programmes: Issues and Methods, International Energy Agency Pubs., Paris, France, October 1995.

"A Convergence of Concepts: The Coming Wave of Change Management and Strategic Benchmarking." President's Column, STRATEGIES: A Publication of the Association of Energy Services Professionals, Spring 1995, p. 9.

"Demand-Side Management at the Crossroads," Natural Gas Journal, Pubs: John Wiley & Sons, Inc., December 1994, pp. 13-18.

"DSM in the Crystal Ball." President's Column, STRATEGIES: A Publication of the Association of Energy Services Professionals, Fall 1994, p. 7.

Regulating DSM Program Evaluation: Policy and Administrative Issues for Public Utility Commissions. National Association. of Regulatory Utility Commissions, (NARUC), Washington, DC, NTIS Pubs. #ORNL/Sub/95X-SH985C, April 1994.

“Comments on Applying Ratio Estimation Methods.” Evaluation Exchange. Synergic Resources Corporation and the International Energy Program Evaluation Conference Pubs., Bala Cynwyd, PA, September/October 1993, Vol. 3, No. 2, p. 3.

“Chapter 4: Value of a Statistical Life in Wrong Death Cases,” Hedonic Methods in Forensic Economics, J. Ward Ed., University of Missouri Press Pubs., 1992.

“Setting Evaluation Accuracy Standards: What Will and Will Not Work.” Evaluation Exchange. Synergic Resources Corporation and the International Energy Program Evaluation Conference Pubs., Bala Cynwyd, PA, November/December 1992, Vol. 2, No. 6, p. 9.

Approaches for Synthesizing DSM Program Evaluations: The Wisconsin DSM programs Evaluation Database and a Review of Meta-Analysis, Electric Power Research Institute Pubs., Palo Alto, CA, #EPRI, TR-100697s, Vols. 1-3, June 1992.

“Chapter 5: Data Analysis for DSM Program Evaluation,” in the Handbook to DSM Program Evaluation, Eric Hirst and John Reed, eds., NTIS Pubs., Washington, DC, # ORNL/CON -336, December 1991.

“Chapter 9: Integrated Resource Planning and the Clean Air Act:” Energy Efficiency and the Environment: Forging the Link, E. Vine, D. Crawley and P. Centolella, eds., ACEEE Series on Energy Conservation and Energy Policy, Pubs: American Council for an Energy-Efficient Economy Pubs., Washington, DC, 1991, pp. 177-188.

Impact Evaluation of Demand-Side Management Programs — Volume 2: Case Studies and Applications, Electric Power Research Institute Pubs., Palo Alto, CA, #EPRI CU-7179 V2, September 1991.

Impact Evaluation of Demand-Side Management Programs — Volume 1: A Guide to Current Practice, Electric Power Research Institute Pubs., Palo Alto, CA, #EPRI CU-7179, Vl, February 1991.

Integrated Planning, Evaluation and Cost Recovery Issues for Gas Distribution Utilities, Planning and Analysis Group, American Gas Association Pubs., May 1991.

SELECTED CONFERENCE PRESENTATIONS AND PAPERS

“Review of BC Hydro’s 2008 DSM Plan.” Prepared for: BC Hydro’s Electricity Conservation and Efficiency Advisory Committee, Summit Blue Consulting, January 22, 2009

“Energy Efficiency and Demand Response.” Peak Load Management Alliance (PLMA) Fall Conference, Austin, Texas, October 28-29, 2008.

“2008 Electric Cooperative Rate Conference: Demand-Side Management and Demand Response.” Kentucky International Convention Center, Louisville, Kentucky, October 28, 2008

“Demand Response and Energy Efficiency – Issues and Trends,” ECUI Conference on Demand Response and Energy Efficiency Canada, Toronto, Canada, October 9-10, 2008.

“Estimate It, Measure It, Verify It.” National Town Meeting on Demand Response, Demand Response Coordinating Committee (DRCC), Washington, D.C., June 2-3, 2008.

“Demand Response in Organized Electric Markets – Comments by Daniel M. Violette.” at Federal Energy Regulatory Commission (FERC) Technical Conference, May 21, 2008.

"Load-Impact Estimation and Cost-Effectiveness Rulemaking in California -- Working Towards Recommendations." Proceedings of National Energy Services Conference, Association of Energy Services Professionals, January 28-31, 2008

"*Integrating Demand Side Resource Evaluations in Resource Planning – An Industry Turning Point*" in Proceedings of the International Energy Program Evaluation Conference (IEPEC) Proceedings, August, 2007, and Presenter at Meetings August 14-16, 2007.

"*Developing Protocols to Estimate Load Impacts from Demand Response Programs and Cost-Effectiveness Methods -- Rulemaking Work in California*" in Proceedings of the International Energy Program Evaluation Conference (IEPEC) Proceedings, August, 2007, and Presenter at Meetings August 14-16, 2007.

"Select Issues in Attribution and Net-to-Gross – Practical Examples." Presented at: CALifornia Measurement Advisory Council (CALMAC) Meetings, July 18, 2007

"*Joint Regulatory Dialogue on: Energy Efficiency/Demand-Side Management,"* Presenter and Panel Member, Canadian Electric Association, Montreal, Canada, April 2007.

Speaker, "Demand-Side Management" at CAMPUT's 2006 Conference and Annual General Meeting, Fairmont Algonquin Hotel, St. Andrews, New Brunswick, September 10-13, 2006.

"Demand-Side Management Regulatory Issues" Presented at the Canadian Association of Members of Public Utility Tribunals (CAMPUT) Regulatory Key Topics Meeting, Ottawa, CA, March 2006

"Demand Response in Resource Planning." Panel discussion at the Peak Load Management Alliance Spring 2006 Conference: A Critical Update on Demand Response, Washington, D.C., March 2006

"Protocol Development for estimating load impacts of DR" California Public Utility Commission and the California Energy Commission Workshop on Benefit Cost Analyses of Demand Response Programs, San Francisco, CA, March 2006

"Framework for Non-Energy Benefits in the Next Generation of Evaluation and Program Design" Proceedings of the 16th National Energy Services Conference: Market Transformation, Research and Evaluation Track, San Diego, February 2006

"A Comprehensive/Integrated DR Value Framework" presented at the Demand Response Research Center TAG Technical Advisory Group Meeting, San Francisco, CA, January 2006

"Valuing Demand Response – An Integrated Resource Planning Approach," presented at the U.S. Demand Response Coordinating Committee's National Town Meeting on Demand Response II, Washington, D.C., January 2006

"Valuing Demand Response – An Integrated Resource Planning Approach," prepared for DistribuTECH 2006, Tampa, Florida February 2006

"Valuing Demand Response in Resource Planning," Technology Symposium: What's New in Demand Response and Energy Efficiency, Proceedings of the Association of Energy Professionals Irwindale, CA, November 2005

"Incorporating Climate Change into Resource Planning," Presented at "Identifying Research to Help Electric Companies Adapt to Climate Change" Sponsored by EPRI , Arlington, VA, October 2005

"Valuing Demand Response Resources in Resource Planning," Proceedings of the International Demand Response Seminar, CEC PIER Demand Response Research Center and the IEA Demand-Side Management Programme, February 4, 2005.

"IEA Task XIII: Demand Response Resources Assessment" Peak Load Management Alliance (PLMA) Spring Meeting, San Diego, CA; March 2004

"NW Energy Efficiency Alliance: Retrospective Evaluation," Eighth National Symposium on Market Transformation, Washington, D.C. -- March 2004

"Portfolio Analysis of Demand-Side Resources (DSR) – Role in Planning," presented at the Eighth Annual National Symposium On Market Transformation, Washington DC, March 1st-2nd, 2004

"Making Electricity Markets Work for Everyone," presented at the 2004 Center for Neighborhood Technology and The Community Energy Cooperative Forum, Chicago, IL, February 27, 2004.

"The Natural Gas Crisis - Implications for EE & DR Cost-Effectiveness Analysis," presented at the 14th National Energy Services Conference and Exposition for the Association of Energy Professionals, New Orleans, December 10-12, 2003

"State Regulatory Activity On Time-Differentiated Electricity Pricing Programs," Proceedings of the AESP National Energy Services Conference, New Orleans, December 2003.

"Assessment Of Demand Response Options – A Distribution Company View." Proceedings of the AESP National Energy Services Conference, New Orleans, December 2003.

"Mass-Market DR Offerings: Evaluation Methods Assessment and Results" *Proceedings of the International Energy Program Evaluation Conference*, Seattle, WA, August 2003.

"Pricing in Retail Markets — Innovation and Resource Allocation," presented at the 2003 Pricing in Electricity Markets Conference for the Association of Energy Professionals, in conjunction with EPRI, Chicago, IL, May 14-15, 2003.

"DR Strategic Assessment: A DISCO Perspective" *Peak Load Management Alliance Spring Meetings,* Arlington VA, March 2003.

"Demand Response: Infrastructure and Design Principles*" in Enhancing Demand Response in Liberalised Electricity Market,* Paris, France, February, 2003

"Cost Effective Evaluation of Mass Market Load Management Programs" In P*roceedings of the 2001 International Energy Program Evaluation Conference*, Salt Lake City, UT, NTIS Pubs., Washington, DC, July 2001.

"Opportunities for Load Management in Mass Markets," EEI Retail Energy Services Conference**,** Chicago, Ill., March 29, 2001

"Innovative Sales and Pricing Structures — Riding the Waves!", presented at EMACS '98: The 1998 Energy Marketing and Customer Service Conference, The Westin Horton Plaza, San Diego, California, October 15, 1998.

"Convergence of Markets Opportunities and Risks," presented at the American Gas Association's (AGA) Workshop on Unbundling and Affiliate Transactions, Ritz-Carlton Hotel, Arlington, VA, July 9, 1998.

"Convergence - reality or hype?," presented at the Electric Utility Consultants conference on Electric Utility Business Environment, Westin Hotel, Denver, CO, June 24, 1998.

"Stranded Cost Recovery — Understanding the Legislation Affecting New Jersey and States Around the Country," presented at the IBC's Fourth Annual Industry Forum on Developing and Negotiating Strategic Mechanisms for Stranded Cost Recovery, Renaissance Washington DC Hotel, Washington, DC, June 23, 1998.

"Electricity Price Forecasts and the Forward Price Curve for Electricity," presented at the EPRI 1998 Innovative Approaches to Electricity Pricing Conference, Washington, DC, June 18, 1998.

"The Business Process Challenges of Retail Competition: Organizational Structures Will Change," Pacific Cost Gas Association's (PCGA) Deregulation Conference, Portland, OR, May 13, 1998.

"Changing Times: Business Opportunities and Risks in the Gas and Electric Industries." Presented at the American Gas Association's (AGA) Marketing and Communications Conference: Betting On Our Customers, Las Vegas, NV, April 27, 1998.

"The Ten Year Perspective: What Actions Need to be Taken Today for Your Firm to be Successful 10 Years From Now?" Presented at *The Fourth Annual Power Industry Forum, Panel Four: Marketing — Heart of the New Power Company*, Infocast, Carlsbad, CA, March 7, 1997.

"North American Energy Measurement & Verification Protocols (NEMVP)." Presented at the AEE Chapter, Budapest, Hungary, November 26, 1996.

"Evaluation of Energy Efficiency Activities: The Keys to Success." Conference materials presented at the *2nd International DSM & Energy Efficiency Strategies Conference*, Copenhagen, Denmark. November 20-21, 1996.

"An Introduction to the Principles and Applications of Market Research for Electric Power Companies." In *Infocast Conference Proceedings — Market Intelligence for Utilities: Obtaining and Analyzing Critical Customer and Competitor Data.*" Denver, CO, July 29, 1996.

"Customer Decision Making." Presentation for *Infocast Conference — The Marketing Institute for the Electric Power Industry*, Atlanta, GA, March 5, 1996.

"Creating Market Opportunities through Energy Services." Opening Plenary Session, *Proceedings of the 1995 Association of Energy Services Professionals Annual Member Meeting*, Association of Energy Services Professionals Pubs., Boca Raton, FL, December 4-6, 1995.

"Customers' Speak — What Customers Need from Energy Suppliers." In *Proceedings of the 1995 Association of Energy Services Professionals Annual Member Meeting*, Association of Energy Services Professionals Pubs., Boca Raton, FL, December 4-6, 1995.

"Assessing Marginal Costs for Competitive Pricing." In *Proceedings of Conference on Competitive Analysis & Benchmarking for Electric Power Companies*, Center for Business Intelligence Pubs., Burlington, MA, November 1995.

"Performance Measurement Concepts and Framework." In *The 1995 Performance Measurement Workshop: Measuring the Performance of Utility Products and Services in an Era of Increasing Competitiveness*, Denver, CO, Electric Power Research Institute Pubs., Palo Alto, CA, November 1995.

"Setting a Research Agenda for Assessing Market Transformation and Spillover," In *Proceedings of the 1995 International Energy Program Evaluation Conference*, Chicago, IL, NTIS Pubs., Washington, DC, #CONF-950817, August 1995, p. 9.

"Evaluation in the Age of Anxiety." In P*roceedings of the 1995 International Energy Program Evaluation Conference*, Chicago, IL, NTIS Pubs., Washington, DC, #CONF-950817, August 1995, p. 859.

"Data Collection and Information Systems: What We've Learned from the DSM Experience." In *Proceedings: Delivering Customer Value — 7th National Demand-Side Management Conference*; Electric Power Research Institute Pubs., Palo Alto, CA, #EPRI TR-105196, June 1995, p. 25.

"Energy Efficiency Evaluation." In *Proceedings — IEA Experts Panel Meeting on Evaluation*, Sponsor: International Energy Agency/Organization for Economic Co-operation and Development, Washington, DC, November 1994.

"Evaluation: Issues, Methods, and Direction." In *Proceedings of Asian Pacific Economic Community (APEC) Inter-Utility Demand Side Management Liaison Group*, Julia Shaver, ed., Oak Ridge National Laboratory, Oak Ridge, TN, October 1994.

"Addressing Uncertainty and the Value of Flexibility in the Second Generation of IRP." Published in the *Proceedings of American Council for an Energy Efficient Economy — 1994 Summer Workshop***,** ACEEE vol. 6, p. 231, August 1994.

"The Treatment of Outliers and Influential Observations in Regression-Based Impact Evaluation." Published in the *Proceedings of American Council for an Energy Efficient Economy — 1994 Summer Workshop***,** ACEEE vol. 8, p. 172, August 1994.

"Addressing Uncertainty and the Value of Flexibility in Utility Planning." In *Proceedings of the 1994 Integrated Resource Planning Conference*, Electric Utility Consultants, Inc. Pubs., Denver, CO, April 1994, p. 1.

"Discrete Choice Models for Planning and Evaluation of Electric Utility Demand-Side Management Programs," *Proceedings TIMS/ORSA Joint National Meeting*, Chicago, IL, May 1993.

"Data Quality in Program Tracking Systems: The Impact on Evaluation." *Proceedings of the 6th National Demand-Side Management Conference*; Electric Power Research Institute Pubs., Palo Alto, CA, #EPRI TR-102021, March 1993.

"Impact Evaluation and Program Tracking Systems." *Proceedings — 6th National Demand-Side Management Conference: Making a Difference.* Sponsors: Electric Power Research Institute, Edison Electric Institute, and U.S. DOE, Electric Power Research Institute Pubs., Palo Alto, CA, #EPRI TR-102021, March 1993, p. 41.

"Uncertainty in an IRP Process." *Proceedings of the Integrated Resource Planning Conference*, Sponsor: Electric Utility Consultants, Inc., Denver, CO, March 18-19, 1993, p. 289.

"Estimating the Impacts of DSM Programs for Use in IRPs." *Conference Proceedings — Long Range Forecasting for Gas Utilities*, New Orleans, LA. Sponsor: American Gas Association, Washington, DC, March 11-13, 1992.

“A Framework for Evaluating Environmental Externalities in Resource Planning — A State Regulatory Perspective.” In *Proceedings of the NARUC National Conference on Environmental Externalities* in Jackson Hole, WY. National Association of Regulatory Utility Commissioners, Washington, DC, October 1990.

“Five Steps through the Clean Air Act — Developing an Acid Rain Compliance Strategy.” In *Proceedings of the 1990 Energy and the Environment Conference*. Sponsor: Electric Utility Consultants, Inc., Denver, CO, September 1990.

“Using Billing Data to Estimate Energy Savings: Specifications of Energy Savings Models, Self-Selection and Free-Riders.” Published in the *Proceedings of American Council for an Energy Efficient Economy (ACEEE) — 1990 Summer Workshop,* ACEEE, Washington, DC, August 1990, Vol. 6, p. 131.

“Evaluation of a New Home Construction Program: Combining Load Research, Billing Data, and Engineering Estimates in a Consolidated Framework.” Published in the *Proceedings of American Council for an Energy Efficient Economy (ACEEE) — 1990 Summer Workshop,* ACEEE, Washington, DC, August 1990, Vol. 6, p. 167.

“Use of End-Use Load Research Data in Statistical/Econometric Evaluations of DSM Programs.” *Proceedings — Conference on End-Use Load Information and its Role in DSM* in Irvine, CA. Sponsor: The Fleming Group, July 1990.

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“Energizing Virginia: Efficiency First” with American Council for an Energy-Efficient Economy, Summit Blue Consulting, ICF International, and Synapse Energy Economics, prepared for ACEEE, Report Number E085, September 2008.

“Impact and Process Evaluation of the Double Return Program” prepared for Hydro One Networks Inc., June 2008.

“Con Edison Callable Load Study” prepared for Con Edison, May 2008.

“Sampling Methodology for Engineering Reviews of Custom Projects” prepared for Enbridge Gas Distribution Inc. and Union Gas Ltd – A Spectra Energy Co., April 2008.

“Final Report for the myPower Pricing Segments Evaluation,” Prepared for Public Service Electric and Gas Company, December 2007.

“A Commitment to Serve: A Cooperative Board Member’s Guide to G&T Resource Planning” with Jane Pater, prepared for Western Resource Advocates, November 2007.

“Energy Efficiency: the First Fuel for a Clean Energy Future – Resources for Meeting Maryland’s Electricity Needs” prepared for ACEEE, Report Number E082, February 2008.

10. “New Jersey Central Air Conditioner Cycling Program Assessment – Final Report” with Jeff Erickson and Mary Klos prepared for Atlantic City Electric, Jersey Central Power & Light, and Public Service Electric & Gas, June 2007.

“New Jersey Central Air Conditioner Cycling Program Assessment” prepared for Atlantic City Electric, Jersey Central Power & Light, and Public Service Electric & Gas, June 2007.

“Avoided Cost Analysis for Energy Efficiency Programs” with Rachel Freeman, prepared for Kansas City Power and Light, Highly Confidential, March 2007.

“Evaluation of 2005 Statewide Large Nonresidential Day-Ahead and Reliability Demand Response Programs – Final Report” with Quantum Consulting, Inc. and Summit Blue Consulting, LLC prepared for Working Group 2 Measurement and Evaluation Committee, P2037, April 2006

“Evaluation of the 2005 Energy-Smart Pricing Plan^{SM}” prepared for the Community Energy Cooperative, April 2006

“Protocols for Estimating the Load Impacts From DR Program” with Quantum Consulting Inc, prepared for Working Group 2 Measurement and Evaluation Committee, April 2006

“Development of A Comprehensive/Integrated DR Value Framework” prepared for the Demand Response Research Center, California Energy Commission, Public Interest Energy Research (PIER) Program, March 2006.

“Interim Report for the First Season of the myPower Link Utility Activated Load Management Pilot Program” with Jeff Erickson and Michael Ozog, prepared for Public Service Electric and Gas Company, February 2006.

“Demand-Side Management: Determining Appropriate Spending Levels and Cost-Effectiveness Testing” co authored with the Regulatory Assistance Program, prepared for Canadian Association of Members of Public Utility Tribunals, January 2006.

"DRR Valuation and Market Analysis; Volume I: Overview" with Rachel Freeman and Chris Neil, prepared for International Energy Agency Demand-Side Programme, Task XIII: Demand Response Resources Task Status Report, January 2006.

"DRR Valuation and Market Analysis; Volume II: Assessing the DRR Benefits and Costs" with Rachel Freeman and Chris Neil, prepared for International Energy Agency Demand-Side Programme, Task XIII: Demand Response Resources Task Status Report, January 2006.

“Quick-Hit DR Programs: A Case Study of California’s 20-20 Program” prepared for Ontario Power Authority, October 2005.

“Program Design for Commercial and Industrial Voluntary Load Control Programs” with Stuart Schare, prepared for Hawaiian Electric Company Inc, September 2005.

“Estimating Demand Response Market Potential” with Randy Gunn prepared for the International Energy Agency Demand Side Management Programme, Task XIII: Demand Response Resources, July 2005.

“Commercial/Industrial Performance Program (CIPP); Market Characterization, Market Assessment and Causality Evaluation” prepared for The New York State Energy Research and Development Authority (NYSERDA), March 2005.

“New Construction Program (NCP); Market Characterization, Market Assessment and Causality Evaluation” prepared for The New York State Energy Research and Development Authority (NYSERDA), March 2005.

"Working Group 2 Demand Response Program Evaluation – Program Year 2004" with Quantum Consulting Inc, prepared for California Energy Commission Working Group 2 Measurement and Evaluation Committee, December 2004, P1996.

"Evaluation of the 2004 Energy-Smart Pricing Plan^sm" prepared for the Community Energy Cooperative, March 2005.

"Impact Evaluation of the Power Choice Program" prepared for Sacramento Municipal Utility District, California Energy Commission PIER program, January 2004.

"Phase 1 Market Characterization Market Assessment and Causality: New Construction Program" prepared for New York State Energy Research and Development Authority, May 2004.

"Findings and Report: Retrospective Assessment of the Northwest Energy Efficiency Alliance" with Kevin Cooney and Michael Ozog, prepared for Northwest Energy Efficiency Alliance, December 2003.

TESTIMONY / LITIGATION

- "Staff Guidance for Straw Proposals on: Load Impact Estimation From DR and Cost-Effectiveness Methods for DR," Prepared for: Energy Division, CPUC Demand Analysis Office. May 24, 2007
- Direct Testimony on behalf of Piedmont Environmental Council before the State Corporation Commission of Virginia; Case Nos. PUE-2007-00031 and PUE-2007-00033 addressing "Summit Blue Expert Paper: Demand-Side Management for the Commonwealth of Virginia, December 4, 2007.
- Prepared Testimony with Testimony scheduled July 2006, *Appropriate DSM Incentives and Alignment with Policy Objectives*, written rate case testimony submitted to the Hawaii Public Utilities Commission on behalf of Hawaiian Electric Company, HECO T-12, Docket No. 04-0113.
- Assisting in the development of load management rates that are expected to be filed as part of Hawaiian Electric Company's current rated case before the Hawaiian Public Utilities Commission, Docket No. 04-0113.
- Expert Report prepared for Constellation NewEnergy, Inc. United States District Court Eastern District of Pennsylvania, Civil Action No. 02-CV-2733, May 2004 related to demand response / load management programs and technologies.
- Prepared testimony and testified before the New Jersey Board of Public Utilities concerning GPU's Restructuring Petition, Docket No. EO97060396, March 20, 1998. Corresponding report is entitled "Review of GPU's Restructuring Petition, GPU Energy Docket No. EA97060396, February 24, 1998.
- Prepared testimony and testified before the New Jersey Board of Public Utilities concerning GPU Energy Unbundled Rates Petition, Docket No. EO97070458," January 12, 1998. Corresponding Report is entitled "Review of GPU's Unbundled Rates Petition," GPU Energy Docket No. EA97060396, December 15, 1997.
- Prepared testimony in the Joint Application of Central Power and Light Company, West Texas Utilities Company and Southwestern Electric Power Company for Approval of Preliminary Integrated Resource Plans and for Related Good Cause Exceptions, before the Public Utility Commission of Texas, Docket No. 16995, January 1997.

- Participated in rate case testimony and support for Central Light and Power Company for the rate case, Docket No. 14965, before the Texas PUC, March 1996.
- Prepared testimony for three utilities in Iowa on DSM evaluation, incentives and IRP.
- Authored testimony on behalf of El Paso Electric Company examining the efficacy of its supply planning process as part of an ongoing rate case concerning in part, the cost recovery of the Palo Verde 3 Nuclear Power Plant.
- Prepared testimony for Peoples Natural Gas concerning the impact evaluation of five energy efficiency programs, November 1993.
- Provided litigation support for the Municipal Electric Association of Canada, in hearings in Ontario concerning Ontario Hydro's commitments to nuclear facilities, utility planning methods, and load forecasting. This multiyear assignment involved the most thorough review of Ontario Hydro's planning process, the future of nuclear power in Canada, and the role of independent power producers. The hearings were presided over by an Ontario Province supreme court justice. (1991-1992)
- Rebuttal testimony on behalf of Arizona Public Service Company involving utility planning and rate increase procedures, before the Arizona Corporation Commission, January 1991, Docket Nos. U-1345-900007 and U-1345-89-162.
- Prepared testimony on behalf of El Paso Electric pertaining to its planning and resource acquisition process, filed in October 1990 before the Texas Commission.
- Testimony on cost of service, innovative rates, and rate design before the Connecticut Department of Public Utility Control RE: United Illuminating Company, Docket No. 89-08-11 and 12.
- Surrebuttal testimony for the staff of the Delaware Public Service Commission, "Concerning the Power Plant Performance Program of Delmarva Power & Light Company," Docket No. 88-16, March 1989.
- Testimony for the staff of the Delaware Public Service Commission, "Review of the Delmarva Power & Light Company Power Plant Performance Program," Docket No. 88-16, November 1988.
- Testimony on Arizona Public Service Company, Cost of Service and Rate Design, for the staff of the Arizona Corporation Commission, Docket No. U-1345-85-150, January 1987.

Between 1983 and 1987, testified in eleven regulatory proceedings covering a-range of topics.

EDUCATION

- University of Colorado, PhD, Economics, 1980
  (Honors: Fields of Industrial Organization and Econometrics)
- University of Colorado, MS, Economics, 1974
- Arizona State University, BS, Economics, 1973
  (Summa Cum Laude)

PROFESSIONAL AFFILIATIONS AND HONORS

- Served three elected terms (1994, 1995, and 1996) as the President of the Association of Energy Professionals (AESP).
- Elected to the AESP Board of Directors in 2004 and re-elected in 2006, and currently serving on the AESP Executive Committee as Vice President.

- Elected to two terms as the Vice Chair of the Peak Load Management Alliance (2002-2004 and 2006 to 2008)
- Editor of the inaugural issue of the *Energy Services Journal*, Lawrence Erlbaum publishers, 1995
- Member of the National Commission on Air Quality Benefits Estimation Panel
- Member of the editorial board of *Evaluation Exchange*
- Awarded *Highest Distinction* on both PhD Comprehensive Field Exams, University of Colorado
- Recipient of University of Colorado Regents Fellowship
- Graduated *summa cum laude*, Arizona State University, 1973
- Male Scholar of the Year, Arizona State University, 1973
- Athlete/Scholar Award, Western Athletic Conference (WAC), 1972

KEVIN P. COONEY, MS, PE

EMPLOYMENT HISTORY

- Principal/CEO, Summit Blue Consulting, LLC, Boulder, CO, 2004-present
- Principal, Stratus Consulting Inc., Boulder, CO, 2003-2004
- Vice President of Research, E Source, Boulder, CO, 1999-2003
- Independent Consultant, Boulder, CO, 1995-1999
- Manager, Hagler Bailly Consulting, Boulder, CO, 1993-1995
- Senior Research Scientist/Engineer, Johnson Controls, Milwaukee, WI, 1988-1993
- Design Engineer, Sturm & Ballard, Lakewood, CO, 1984-1985

EDUCATION

- University of Colorado, MSCE, Building Energy Engineering, 1988
- University of Colorado, BS, Civil Engineering, 1984
- Stanford University Executive Education, Advanced Management College, 2002

PROFESSIONAL EXPERIENCE

Mr. Cooney has conducted leading edge analysis of energy technologies and their markets for public and private sector clients for over 20 years. He is adept at managing diverse teams in multicultural settings to develop and achieve ambitious clean energy objectives. His extensive experience includes new product and service development, energy efficiency program design and evaluation, and market assessment. Mr. Cooney combines his engineering training, marketing instinct, and leadership background to assist clients as diverse as the U.S. EPA, a large Japanese investor, a Tribal Council, a state utility commission, or an investor owned utility. His 20+ years of work has focused on helping organizations of all type make informed decisions about investments in energy technology and services. Mr. Cooney is a regular contributor to professional organizations, including reviewing papers, moderating conference sessions, and serving on standing or special committees.

Mr. Cooney was previously the Vice President of Research for E Source, an internationally recognized company in the areas of energy end-use technology and market assessment. Mr. Cooney was responsible for managing business strategy, financial performance, operations, research direction and QC, and staffing. He coordinated activities between technical staff, marketing staff, and clients - and developed partnerships with firms in Europe and the Far East.

In previous positions, Mr. Cooney helped develop, implement, and evaluate programs for the optimal use of energy resources in a variety of cultures. He has worked as a technical advisor in the Mideast, the Soviet Republics, and the Caribbean. Mr. Cooney's experience focused on the delivery of new products and services through team use of strategic information. His management background included budgeting, profitability analysis, staffing, consultant selection, and business development. Mr. Cooney has performed these activities for utilities, international development agencies, building service providers, and consumer goods manufacturers.

At Hagler Bailly, Mr. Cooney managed a team of economists and engineers that provided analysis and planning services to the utility industry. This included demand side management (DSM) program design and evaluation, energy use monitoring, market research and training program development. In addition to developing program assessment strategies and managing the workflow of multiyear efforts for clients, he was responsible for engineering analysis, expert testimony coordination, end-use metering, data tracking systems, and reporting to utility boards.

While working in R&D at Johnson Controls, Mr. Cooney developed and tested knowledge-based decision support systems, re-engineered business processes, and designed training programs and documentation for the organization's branch field staff. During his tenure there, Mr. Cooney also spearheaded an evaluation of the business opportunities arising from CFC regulations, and led the development of diagnostic expert systems for buildings.

SELECTED PROJECTS

Currently, Mr. Cooney is directing the evaluation of the **Ontario Power Authority's Double Return Demand Reduction** program.

Audit of 2005 DSM Evaluation Report (Union Gas) Mr. Cooney directed this review of Union Gas's internally-produced DSM Evaluation report. This review assessed the assumptions regarding measure savings, assured that appropriate procedures were used to verify savings by program, and reviewed cost effectiveness reporting calculation methodology.

Currently assisting **Bonneville Power Administration (BPA)** develop their strategy and presentation materials for an upcoming 6-month public process to define BPA's role in energy efficiency for the Northwest region after 2011, when public power pricing is scheduled to change.

Develop a chapter on estimating energy savings for the Multiple Benefits Guide, U.S. Environmental Protection Agency. Mr. Cooney worked with the client to develop a chapter on energy savings estimation methods for the Multiple Benefits Guide being produced by the agency. The chapter is intended to set the stage for determining and quantifying the benefits of clean energy measures by providing information on methods and tools for calculating the energy (kWh) savings and avoided energy.

Potential Study for Combined Heat and Power in Texas, for the Public Utility Commission of Texas, Summit Blue recently completed a study of combined heat and power potential across commercial and industrial sectors. This study included a characterization of existing CHP installations, an assessment of the potential for additional CHP capacity, and policy recommendations to encourage new investment in CHP. The report was presented before the Commissioners and delivered to the state legislature which requested the study in order to inform development of new energy policy bills during the 2009 legislative session.

Develop a Business Plan for Bonneville Power Administration's Accelerated Conservation Efforts (2007). Mr. Cooney led this research and strategic consulting assignment to assist Bonneville Power Administration (BPA) in developing a business plan that laid out strategies, costs, and energy savings potential for a ramped-up effort to achieve higher energy efficiency targets over the next 3 years. Research included focus groups and interviews with conservation leaders in the region, analysis of existing conservation efforts conducted by regional utilities, review of BPA rules, and analysis of market and industry risks and opportunities. The business plan outlined an approach for bridging gaps in the region's energy efficiency efforts in a cost effective manner with tools and funds that could be deployed by BPA.

Develop a Strategic Marketing Plan (Bonneville Power Administration) Mr. Cooney led this effort to develop a strategic market plan for the conservation efforts being conducted by BPA. BPA has aggressive energy conservation targets that must be met by working through local utilities to acquire efficiency resources, and these targets must be met with reduced staffing and budgets. Summit Blue reviewed internal capabilities to market programs, regional needs and positioning, and best practices across North America to develop an effective marketing strategy.

New Jersey Renewable Energy Market Assessment (Board of Public Utilities) Mr. Cooney directed this project to perform an evaluation of New Jersey's marketplace for the delivery of renewable energy technologies. The project: assessed the renewable energy markets for each technology and renewable resource; update baseline studies and estimates used as performance indicators; assessed the costs of and barriers to the development of renewable energy in the state; and provided recommendations regarding the future direction of existing programs in order to optimize the portfolio of programs going forward. A supplemental study of the ratepayer impacts of various proposed incentive mechanisms was completed as well. This study evaluated the risk-adjusted prospective costs of meeting the Solar RPS requirements of feed-in tariffs, solar renewable energy credit (SREC), rebates, and other incentive mechanisms to assist the BPU in designing a cost-effective incentive program for the future.

Long Term Project Monitoring & Tracking (Northwest Energy Efficiency Alliance). Mr. Cooney is currently managing a project to analyze the ongoing energy impacts of market transformation initiatives that are in their post-funding period. This project is focused on identifying the critical parameters to measure, and the frequency of data collection required to adequately assess long-term impacts. Summit Blue is entering the third year of this effort for the Alliance, and continues to work with the client to streamline the reporting of program impact estimates while increasing confidence in data accuracy. Ten projects were assessed during the first two years of this effort, and the Alliance used Summit Blue recommendations to make adjustments to ex-ante estimates of post-funding impacts for these programs.

Retrospective Evaluation of Market Transformation efforts (NW Energy Efficiency Alliance - 2003). Mr. Cooney recently completed an independent evaluation of the market transformation accomplishments of a multi-state organization that has been funded for the past six years to catalyze the regional marketplace for energy efficiency products and services. This evaluation of the Alliance's value to the region was conducted for their board, in order to provide an independent review to the organization's funding stakeholders. The analysis covers a portfolio of 30 programs, with about $100M in funding to date. Key activities included: analyzing the overall benefits associated with the portfolio of programs the Alliance has funded over the past six years (in terms of benefits vs. costs of electricity reduction impacts); whether the right progress indicators were selected to analyze market transformation progress; analyzing the quality of the data collected, and bounding the Alliance estimates of electricity savings; and exploring alternative hypotheses regarding attribution of market effects to the Alliance or other market factors.

Evaluation, Measurement and Verification of the Statewide Local Government Partnerships Program for the California Public Utilities Commission (CPUC). Mr. Cooney is the director of this multi-year, multi-program evaluation of partnerships between California's investor owned utilities and 56 distinct local government entities. The evaluation includes monitoring and verification of reported direct impacts associated with a subset of the energy efficiency partnership programs, along with assessment of indirect impacts associated with marketing, outreach and education program components being delivered by the partnerships. The program efforts include direct install efforts, retro-commissioning, incentive programs, codes and standards promulgation, and design assistance among other elements, comprising 256 program elements across the partnerships. Summit Blue is managing a 6 firm team that is responsible for all data analysis, sampling, field measurements, engineering analyses, surveys, a process evaluation, and reporting of kW and kWh savings attributable to the programs to the CPUC.

Evaluation of the Statewide Emerging Technologies Program for the California Public Utilities Commission (CPUC). Mr. Cooney led the evaluation planning to analyze the accomplishments of the 2006-2008 statewide emerging technology programs, as implemented by the California IOUs. This multi-firm effort involves analysis of program design, an assessment of program implementation effectiveness, and an impact evaluation of program achievements. The emerging technology program is designed to accelerate the introduction of new energy efficient technologies into the marketplace by reducing the technology performance risk as well as the market acceptance risk associated with new technologies.

Independent Measurement and Verification Expert to the Public Utility Commission of Texas (PUCT). Mr. Cooney managed the team that performed an M&V audit of the utility-reported energy and peak demand reductions for calendar years 2003 and 2004. The objective of the review was to provide an independent assessment of the progress made toward energy efficiency goals established for the State. The team verified the savings estimates developed by the six IOUs and their contractors for a portfolio of programs, reviewed deemed savings assumptions used statewide, and conducted a process evaluation of program delivery effectiveness. Mr. Cooney was responsible for all reporting and presentation of findings to the Texas Commission.

California Statewide Self-Generation Program Evaluation (PG&E managing for the Public Utility Commission). Mr. Cooney directed a series of studies that analyzed the statewide Self Generation Incentive Program (SGIP) in California. This program was the source of incentive funding for behind-the-meter renewable and other distributed energy for systems over 30kW from 2001 to 2006. The studies included a process evaluation, a market assessment, a comparison of program administrator practices and effectiveness, and a technology retention study.

Impact Evaluation of the Innovative Designs for Energy Efficiency Activities (IDEEA) for Southern California Edison. Mr. Cooney is currently advising the analysis team responsible for conducting research and field data collection to analyze the impacts from eight innovative programs being conducted by third party contractors for SCE. The programs range from oil production facilities and agricultural ventilation to advanced lighting and controls technologies. The evaluation team is conducting on-site metering and verification as required to supplement available data, then calculate adjustments to energy and demand savings estimates.

Measurement and Evaluation of San Francisco Peak Energy Program (PG&E). Mr. Cooney recently managed an impact and process evaluation of a unique partnership between the City of San Francisco and PG&E established to reduce summer and winter peak electricity demand in the city. The evaluation assessed the overall effectiveness of the partnership, developing reliable estimates of energy and demand savings achieved, and analyzing the effectiveness of implementation activities of five major program elements. The program includes single family, multi-family, and business elements that utilize direct install, rebate, performance contracting, and audit mechanisms to achieve program goals. The impact and process evaluations are employing on-site measurement and verification of efficiency measure installations, participant surveys, and in-depth interviews with market actors in the effort.

Assessment of U.S. Solar Market (Mitsubishi Corporation). Mr. Cooney is directing this characterization of the solar market in the United States with a focus on mid-size PV installations financed through power purchase agreements. The goal of this project is to help the client better understand the key market and regulatory trends driving current and future growth in the PV market. Summit Blue developed a framework for analyzing the players in the supply chain and identifying their priorities for doing business with both upstream and downstream actors. The results of this work will be used to inform a cohesive marketing and communications strategy for the client in the U.S. solar PV market. The analysis identified factors that will influence the future of green power markets in the United States and strategic opportunities for addressing those risks.

Renewable Energy Feasibility Study for Imperial Irrigation District. Mr. Cooney developed the initial scope and approach for this study to conduct a renewable energy feasibility study that produced a high-level strategic plan for developing appropriate renewable resources, in a cost-effective manner, in Imperial County, California. The action plan produced from this study provides IID with steps required to develop their large renewable energy potential, including a technical potential study, an economic potential study, and possible economic development strategies. The economic potential study compared renewable energy production costs with California's Market Price Referent, adjusted with appropriate Time of Delivery factors.

Strategic Energy Plan for the Pawnee Nation. Mr. Cooney led this effort to work with tribal staff of the Pawnee Nation of Oklahoma to develop strategies for meeting the Nations's evolving supply and demand-side energy needs. Project activities included: 1) energy demand forecasts and characterization; 2)characterization of supply opportunities and demand-side management potential; 3)a legal analysis of potential liabilities, deal structure options and land use policies; and 4) a review of both environmental impacts and financial risks associated with each supply and demand-side option considered.

Resource Planning Guide for Western Resource Advocates. Mr. Cooney initiated the research and provided managerial oversight for this effort, that developed a primer on the integrated resource planning process targeted at board members and general managers at electric cooperatives. It focused on the risks facing utility planners today and the resource options for addressing them. The report discussed uncertainty in capital costs, the cost of greenhouse gas regulation, fossil fuel availability and costs, and technology risk. In the context of these risks, Summit Blue examined strategies for incorporating a range of resource options – including coal, natural gas, renewables, and demand-side resources – in the integrated resource planning process.

Review of the Northwest Alliance's Contribution to BPA's Energy Conservation Targets Mr. Cooney managed this review that focused on whether there was sufficient basis for the savings claimed by the currently reported NW Energy Efficiency Alliance programs for BPA to claim those savings on the same basis of its other program investments. This involved several steps: Converting Alliance calendar year gross savings reported in 2004 and 2005 to estimate quarterly savings that match the fiscal year used by BPA; adjusting utility incentive numbers to reflect final data collected by BPA and NEEA; and adjusting the NEEA 'net' savings to account for the difference between their assumed baseline condition, and the NW Power and Conservation Council assumed baseline.

Impact Evaluation of Residential Direct Load Control Pilot (Progress Energy) Mr. Cooney was the Principal-in-Charge of this evaluation of the kW load reductions achieved of a variety of load management strategies to control residential air conditioning. The pilot utilized samples for each type of control strategy selected, including a range of thermostat setpoint and compressor switch strategies. The results of this analysis were used to design a full-scale program.

Review of Progress Energy Carolinas' (PEC) preliminary Demand Side Management plans. Mr. Cooney assisted the Demand Side Management and Renewables Sub-team at PEC by reviewing the preliminary DSM portfolio plans recently developed by their team. This review involved consideration of avoided cost modeling, providing feedback on proposed programs, and providing recommendations for additional EE measures and program options to consider. This initial set of recommendations will assist PEC as they prepare their proposed portfolio for utility management consideration.

Consultant/Facilitator to the IRP Advisory Council for Idaho Power. Mr. Cooney is providing technical and policy expertise, while serving as a facilitator of discussion sessions during ongoing stakeholder meetings in the integrated resource planning process.

Process Evaluation of California Statewide Education, Awareness, and Outreach Programs *(SDG&E)* Mr. Cooney oversaw the process evaluation of statewide and IOU-specific education and outreach initiatives to increase awareness and participation in Demand Response (DR) programs. The study identified key indicators of program effectiveness, and evaluated program communications and delivery efforts to provide recommendations on how future efforts should be shaped. The evaluation looked at 6 programs that spanned efforts including; Community Partnerships, children's education, and hands-on audit and demonstration programs.

Assistance in preparing the *Clean Energy Guide to Action* (U.S. EPA). Mr. Cooney assisted US EPA by drafting the background and executive summary for their *Clean Energy-Environment Guide to Action*, designed to help states evaluate clean energy options and identify programs and policies that could be applied in their state. The Guide compiles the latest information, analyses, evaluation reports and other studies prepared for States, and describes emerging issues and how States are responding.

Assessing the Risks and Benefits of Drinking Water Utility Energy Management Practices (American Water Works Association Research Foundation) Mr. Cooney led the team that provided the energy sector expertise on this cross-functional research to analyze the risks associated with various options for meeting the energy reliability and economic needs of water utilities. The core research objective was to develop, demonstrate, and convey a practical and readily implementable risk-benefit decision framework to enable water utilities to: identify and assess a broad array of energy management options, including both energy demand and energy supply alternatives, and then apply practical risk management tools that to help them select, explain, and implement suitable energy management practices.

Commercial Sector Market Research (Daikin Industries, Ltd). Mr. Cooney is leading this effort to conduct market research designed to assist Daikin in better understanding the needs and buying preferences of key customers in specific market verticals in Singapore. This market research will assist both the Daikin corporate Marketing Group, and the local Singapore office staff in developing effective marketing strategies to serve these markets. The research uncovered and described key trends in major vertical market sectors in Singapore – specifically the Office Building and Education sectors.

Update to Measure Cost Data for the California DEER Database (PG&E): Mr. Cooney advised the Summit Blue team to develop the research methods and planning required to update the costs for all EE measures included in the updated DEER database used by utilities in the state of California to estimate costs and benefits when developing DSM programs.

Tribal Renewable Energy Program (Council of Energy Resource Tribes – 2003).
Mr. Cooney worked closely with CERT (a non-profit organization that represents 55 federally recognized Tribes) on the Tribal Renewable Energy Program, supported by the Department of Energy (DOE). This project focused at identifying challenges and barriers to the development of renewable energy and energy efficiency on Tribal lands, and identifying ways to overcome these challenges. A series of regional workshops was coordinated through the Intertribal Energy Network to provide background information and training on; strategic energy planning, utility formation, transmission access, financial analysis, and human resources concerns to hundreds of Tribal leaders. He has personally developed and presented the material on integrated resource planning and the development of appropriate criteria for demand and supply planning in a Tribal environment. Mr. Cooney supervises several subcontractors that are developing other materials for these workshops. He also helps coordinate the efforts of CERT, the National Renewable Energy Lab (NREL), and stakeholders on this project, and will manage the development of a guidebook that documents the challenges and lessons learned during the course of the project.

Development of Business Case and Financial Analysis Tool for AMI Implementation (Delta-Montrose Electric Association). Mr. Cooney assisted a Colorado electric coop in developing a business case analysis and financial model that evaluates the potential operational cost savings and demand response options associated with a prospective investment in automated meter reading (AMR) technology. The analysis compares the capital cost estimates of a system-wide deployment of smart meters with the operational cost savings likely to be achieved by Customer Service, Meter Operations, Engineering, and Financial departments at the utility. The cost savings are based on a series of in-depth interviews with department heads at DMEA, combined with knowledge of savings achieved at other utilities. A second phase of the project will develop estimates of potential revenue enhancements enabled by the AMR technology. Summit Blue is also assisting DMEA with the roll-out of a pilot AMR program that will test a number of operational assumptions in the business case. For the pilot, we are assisting with program design, developing marketing materials, and other customer communications.

Impact Evaluation of Irrigation Peak Clipping Program, Idaho Power. Mr. Cooney supervised an assessment of the electric demand reductions achieved by a pilot program designed to shave summer peak demand through the use of electronic timer switches on irrigation pumps. The analysis included development of an econometric model that considered weather, day-of-week, pump horsepower, and previous billing patterns for the irrigation customers who opted to participate in the program. Model results indicated demand reductions were achieved with little change in overall energy consumption.

Financing for energy projects with pollution reduction potential (EPA – 2003). Mr. Cooney managed a project for the International Capacity Building Branch at EPA to assist developing countries in cost-effectively achieving the control of both greenhouse gases and conventional air pollutants. This goal is being approached through a variety of mechanisms, particularly the development of policies, measures, programs, and projects for expanding the use of more efficient energy technologies. This assignment focused on methods to overcome financing barriers for efficiency projects, by; outlining the information required to secure funding from sources including multilateral development banks and private investors; developing a plan for gathering this information, using Mexico as a case study; and developing a plan for raising funds to implement specific projects. Presentation materials were developed and presented at multiple international conferences on pollution reduction efforts.

Analysis of the effects of electric reliability investments on air quality (EPA – 2003).
Mr. Cooney led a team that researched options for investments to shore up electric system reliability that also address the environmental impacts of potential solutions. The research examined the interactions between demand, supply, and transmission components of the electric system by reviewing the economics and externalities associated with all potential solutions designed to enhance reliability. A white paper was developed that reviews approaches being considered, and their potential impacts on air quality.

Energy resource projects (E Source 1999-2003)

Served as executive-in-charge for a number of consulting assignments, providing review and oversight on projects, including:

- **Analysis of Electrotechnologies for Industrial Sectors, ENBW, Stuttgart, Germany.** Provided an assessment of current state-of-the-art technologies for a number of industrial sectors, including food production and metal fabrication. The analyses reviewed competing technologies, advantages and down-sides of each, energy requirements, and market barriers to adoption.
- **Assessment of Commercial Market Sector Trends, Trane Company.** Managed a team that conducted a series of market research projects to analyze the energy service needs of vertical markets in the U.S. and in several key international markets. This multi-year effort included design and supervision of field data collection, reporting, and presentation of findings to client global marketing teams. The team analyzed country statistics, specific market conditions, equipment and service needs and conducted interviews with key industry decision makers in each market vertical on their decision making processes and purchasing preferences for several commercial and manufacturing sectors in Asia, the Middle East, and Latin America, as well as the U.S.
- **Analysis of U.S. Utility Responses to Deregulation, Hitachi Research Institute, Japan.** Managed the analysis team and client relationship for the development of case studies that looked at the organizational and strategy changes of specific operational functions within U.S. investor owned utilities that occurred in response to regulatory changes in their respective markets. The analysis

looked at staffing concerns, information systems, and supply chains to support utility marketing activities.

- **Participated in Energy Efficiency Collaborative Process (Northern States Power/XCEL)** Supervised the development of a literature review on effective energy efficiency programs in the U.S., and at NSPs request, participated in collaborative meetings to provide an independent perspective on the options to significantly increase the DSM goals in their Resource Plan.
- Authored, co-authored, or provided senior review for numerous E Source research reports and multi-client studies (including a number of commercial sectors - food processing, hotels, retail, restaurants, and healthcare) published for member organizations.
- Ideation and oversight for a data tool that analyzes prospective markets for energy services. This product integrated and leveraged the expertise of two recently merged businesses. The project involved market researchers, energy analysts, SW programmers, GIS staff, and an econometrician. It combined firmographic data with end-use load shapes, and correlated the data to national surveys on propensity to buy specific products and services.
- Developed the business plan, staffing requirements, and initial product suite for European based information services. Hired and supervised the managing director, who oversaw a team of researchers that conducted and marketed the services in Europe.
- Led a team that developed and launched several new information products during tenure, including three research services focusing on the needs of small business, large commercial, and industrial customers, as well as a service on E-business strategies.
- Co-developed a partnership with a Japanese company to represent E Source in Japan, developed a similar business relationship with a German firm, and conducted business development activities with utilities and manufacturers in those countries, as well as in Europe and Australia.
- Served on the judging panel for the *Financial Times Global Energy Awards*.

Development of outdoor footwear product line (FILA - 1997-1998). Mr. Cooney coordinated the efforts of U.S. designers and laboratory personnel with development teams in Italy and Taiwan, and managed the team responsible for market research, product briefing, design reviews, prototype testing, materials sourcing, production specifications, pricing negotiations, product quality control, and marketing strategies.

Technical advisor to DSM unit of Jamaica Public Service (1995-1997). Mr. Cooney provided ongoing organizational development and technical assistance on a wide range of program design, implementation, and management issues to the DSM unit of the national utility in Jamaica. The project involved implementing five DSM programs, assessing market potential for a variety of energy conservation technologies, and strengthening standards and code enforcement organizations to develop a sustainable energy conservation industry in Jamaica. He assisted the DSM unit in program planning, tracking, and marketing strategies; staff development; and preparation of RFPs and bid documents, engineering specifications, and progress reports for international lending agencies. One program created a revolving loan fund to bring small-scale rooftop solar-PV electricity to a remote village.

End-use metering study for Energy Ministry in Ukraine (USAID - 1995). After reviewing facility energy data for industrial sites throughout Ukraine, Mr. Cooney selected a site visit sample. He coordinated training activities for local utility engineering staff on using metering equipment, software, and monitoring and evaluation protocols, and then conducted facility audits and specified a data collection program. Data were collected by local utility engineers and the analysis was performed by engineers in the United States. Results were utilized to identify economically viable industrial energy conservation opportunities in Ukraine.

Impact and process evaluation of DSM program Portfolio (Montana Power - 1993-1995). Mr. Cooney managed the efforts of Hagler Bailly staff and outside consultants to conduct process and impact evaluations of *nine* DSM programs (residential, commercial, and industrial) over a three-year cycle for Montana Power Company. Programs included low-income weatherization, new construction, and commercial and industrial lighting and motor programs. Mr. Cooney was responsible for all aspects of budgets, analysis, and technical content for the evaluations. The work involved metering, customer surveys, statistical and engineering analyses, DSM potential analyses, rate case testimony support, recommendations for program modifications, and presentation of evaluation results to utility board and PSC advisory groups.

Energy information system development for industrial sites in Egypt (USAID - 1994). Working with a multinational team, Mr. Cooney conducted energy audits of 10 industrial facilities in Egypt, and then outlined energy conservation opportunities and management reporting needs in audit reports. Spreadsheet models were developed to track energy consumption for various industrial processes at three pilot sites, and relevant metrics that related energy to economic and environmental parameters were created.

Evaluation of a pilot systems-oriented industrial DSM program (1994-1995). Mr. Cooney coordinated the impact and process evaluations of an innovative energy conservation program aimed at changing the approach consulting engineers and utility representatives use to promote and conduct industrial energy conservation in Wisconsin. An analysis of the training component of this program was completed, and an evaluation of industrial and utility decision analysis processes conducted.

Preparation of policy and procedures manual for DSM programs (1994). Mr. Cooney assisted in organizing materials for 10 DSM programs into a systematic manual for utility staff use at PG&E. The procedures manual is used by division staff throughout the organization, and as a reference source for general office program staff.

Development of instruction manuals for engineers in Egypt (1993). Mr. Cooney developed two training manuals for engineers involved in the Energy Conservation and Efficiency Program (ECEP), a USAID project in Egypt. These manuals, one on development of engineering specifications, and the other on start-up of cogeneration facilities, were used in a series of training seminars for engineers in Egypt.

Automated Building Response to Real Time Pricing (ASHRAE Research RP-833, 1993). Mr. Cooney wrote the SOW for and managed the consulting firm who conducted the research for this ground-breaking research project funded by ASHRAE. This project was part of Mr. Cooney’s service on Technical Committee 1.5, Computer Applications, and the project developed control concepts in use today for automated demand response.

Advanced knowledge systems deployment (Johnson Controls, 1991-1993). Mr. Cooney managed this team effort to streamline work tasks in a distributed branch environment by directing the development of prototype information systems for field personnel. He coordinated activities with the corporate IT department to interface with existing computing systems and outline the criteria for a new corporate IT architecture. Mr. Cooney also directed the analysts and consultants required for SW/HW design and development. He guided the design of user documentation and developed a training program for electronic technicians, office staff, and union employees. Effective utilization of information technology in a distributed service environment was achieved by maintaining an end-user focus. The project delivered prototype HW/SW systems, and outlined economic and deployment issues Johnson needed to consider when extrapolating to their 160 branch offices.

Analysis of CFC issues relating to building service industry (Johnson Controls - 1989). Mr. Cooney coordinated a study that reviewed the science and technology related to reducing CFC leakage in the air-conditioning and refrigeration service industry. This study provided direction for service offerings and identified potential product developments that would play a significant role in the future, at a time when options for replacement refrigerants were limited. Leak monitoring equipment was specified, and new air-conditioning control strategies were developed.

Development of expert systems for HVAC building services (Johnson Controls 1988-1991). Mr. Cooney encoded the knowledge of in-house experts into diagnostic software tools to assist technical staff in resolving diagnostic problems associated with HVAC controls. A review of the issues associated with integrating these tools into the existing company IS infrastructure led to the technology deployment project described above. Parallel to this work, he helped define the framework for a knowledge library to be used by corporate Technical Support Services.

Modeling and testing of high temperature solar applications (IEA - 1988). Mr. Cooney performed parametric computer analyses to refine a heat transfer model that predicted energy output from a high temperature solar central receiver. This work involved on-site data collection and testing of the optimal design at an International Energy Agency test facility (Plataforma Solar, Almeria, Spain), and report preparation for Sandia Labs (DOE).

Design and supervise construction of school playground in Guatemala (1988). For a short-term volunteer project for the Peace Corps, Mr. Cooney traveled to Central America to design, select materials, and construct (with local villagers) a playground facility for school children.

Energy conservation analysis of campus facilities (1986-1988). As a graduate student, Mr. Cooney conducted audits and monitored end-use energy consumption in three large institutional facilities. Consumption prediction profiles were created through regression analysis of these data and other parameters. The team then recommended energy conservation measures, and later performed monitoring and verification on program savings.

SELECTED PUBLICATIONS

Cooney, K., Meadows, K., Pater, J. Leading the Way: BPA's Efforts to Accelerate Energy Efficiency in the Northwest, ACEEE Summer Study on Energy Efficiency, August, 2008.

Cooney, K., LeBlanc, B,. Johnson, K., Why no one signed up after you sent the brochure: Insights into marketing practices to increase EE program participation, *AESP 18th national Energy Services Conference*, January, 2008.

Cooney, K., Winka, M., Freeman, R., Wobus, N., Kallock, B., The Cost of New Jersey's Solar PV Transition: An Analysis of Ratepayer Impacts Associated with Alternative Models for Transitioning a Statewide Solar PV Program from Rebates to Market-Based Incentives, *AESP 18th national Energy Services Conference*, January, 2008.

Cooney, K., Thompson, P., Cromwell, J., Raucher, B., Addressing the Reliability, Financial, and Environmental Risks of Energy Management Strategies at Water Utilities, *ACEEE Summer Study on Energy Efficiency in Industry*, July, 2007.

Cooney,K., Keneipp, F., Adams, D., Tyler, C. Energy and Demand Impacts Associated with a Partnership-Based Efficiency Program: Evaluation of the San Francisco Peak Energy Program (SFPEP), *ACEEE Summer Study on Energy Efficiency, August 2006.*

Adams, D. Cooney, K., Thornsjo, M. Tyler, C., Effectiveness of a Community-Wide Outreach Program in Achieving Energy and Demand Reduction Goals: Evaluation of the San Francisco Peak Energy Partnership (SFPEP), *ACEEE Summer Study on Energy Efficiency, August 2006.*

Cooney, K., Degens, P., Knickelbein, A., Schare, S., Ozog, M., *Tracking Impacts of Market Transformation Initiatives in their Post-funding Period*, Proceedings of the AESP Annual Conference, February 2006.

Cooney, K. Gobris, M.K., Thornsjo, M., Kelly, A., *San Francisco Peak Energy Program Partnership Evaluation*, IEPEC International Energy Program Evaluation Conference 2005.

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Cooney, K, Ries, H., Options for Improving Reliability: How Do They Impact Air Quality, *Electricity Journal*, June 2004.

Cooney, K. 2001. Build it and they will consume — or will they? *Public Utilities Fortnightly*.

Cooney, K. 2000. An End User perspective on National Energy Plan Priorities. *RDI Power Outlook.*

Cooney, K. 1999. Innovative Channels for Reaching the Small Business Sector. *Proceedings of the AESP*.

Cooney, K., with several co-authors. 1995. Guidebook to Developing DSM/Marketing Information Systems. *AESP Guidebook*.

Cooney, K., with several co-authors. 1993. Preparation of Operating and Maintenance Documentation for Building Systems. *ASHRAE Guideline*.

Brothers, P. and K. Cooney. 1989. A knowledge-based system for comfort diagnostics. *ASHRAE Journal*, September.

Haberl, J., L. Smith, K. Cooney, and F. Stern. 1988. An expert system for building energy consumption analysis: Applications at a university campus. *ASHRAE Transactions*, v. 94, pt. 1.

Cooney, K., Stern, F., and Haberl, J., 1987. An Action-Oriented Team Approach to Building Energy Conservation, *Proceedings of the ASME.*

SELECTED CONFERENCE PRESENTATIONS

The Great Incentive Debate: Analyzing Costs and Risk Allocation, *Solar Power 2008,* presentation and panel discussion, San Diego, October 2008.

Solar Incentive Policy Options: Recent Analysis for New Jersey, *Florida Solar Policy Meeting,* Orlando, Florida, June 2008.

BPA Strategic Marketing Plan, *Bonneville Power Utility Conference*, Portland Oregon, May 2007.

Solar in State RPS Policies: Recent Developments in New Jersey, *National Conference of State Legislatures*, Washington, D.C., October, 2007.

Water Utilities can help Achieve Energy & Demand Response Goals, *Colorado Utility Exchange*, Aspen CO, October, 2007.

Innovative Commercial and Industrial Sector Programs, *20th Annual E Source Forum*, Boulder, CO, September, 2007.

Energy's Role in Drinking Water Delivery: Risks & Benefits of Energy Management Strategies, *Energy and Water: Vital Connections, International Solar Energy Society, Annual Conference*, Denver, CO, July 12, 2006

Mitigating Risks Associated with Energy Management Strategies at Water Utilities, *Water Quality/Regulatory Conference*, Ontario, California, October 11, 2006

Tracking the Long-Term Impacts of Market Transformation Programs, National Symposium on Market Transformation ACEEE, Washington DC, March 20, 2006

Delivering CDM Services: To Outsource or Not to Outsource? *2005 OEA Energy Conservation and Demand Management Forum*, Toronto, June 9, 2005.

Energy Efficiency Program Implementation Planning, *2005 Energy Conservation Forum and Workshop,* Canadian Energy Efficiency Alliance, Toronto, January 2005.

Dynamic Pricing and Demand Response, *New Initiatives and Innovation in Customer Communications, DSM-EE, Demand Response and Pricing Workshop*, Toronto, June 2004.

Marketing Strategies, Did It Really Work? *Western Energy Institute Spring Energy Symposium*, Phoenix, March 2004.

Influence of Retail Market Structure on Financial Impacts of Multi-pollutant Bills at the Company Level. *Electric Utilities Environmental Conference*, Tucson, January 2004.

Integrated Resource Planning for Tribes. *Tribal Sustainable Energy Conference*, Albuquerque, April 2003.

The National Energy Plan - or Not?. Keynote address at *AEE Business Energy Solutions Conference*, Orlando, Fl, November 2002.

Demand Response Tools. Presented at the *Peak Load Management Alliance Fall Conference*, Annapolis MD, October, 2002.

Coordinated Autonomy – The Distribution Network of the Future. Presented at *Electric Power* 2002, St. Louis, MO, March 2002.

Current Status of the US Distributed Energy Market. Presented at *Emerging Energy Business Seminar*, Tokyo, Japan, June 2001.

US Retail Energy Markets. Presented to *Electricitie de France Strategic Planning Group*, Washington, DC, April 2001.

Moderator for Panel Discussion with Utility CEOs: New Ideas — New Strategies, at *EEI International Financial Conference,* London, February 2001.

Remote Monitoring and Control Services plenary address, *Jones Lang LaSalle Engineering Operations Conference,* August 2000.

Utility Industry Restructuring: How's it Working? *Globalcon*, Dallas, TX, April 2000.

Deregulation, How Is It Working? Presented at *ASHRAE Winter Meeting*, February 2000.

Innovative Marketing Channels for Reaching the Small Business Sector. Presented at 10th *National Energy Services Conference,* AESP, December 1999.

Numerous presentations and panel moderator roles at *E Source conferences* and events.

Developing Strategic Responses to Energy Trends. Presented at *Food Plant Strategies Conference,* September 1999.

REGULATORY PROCEEDINGS

- Prepared and delivered briefings for Texas Public Utility Commissioners on results of filed report on statewide potential study for Combined Heat and Power (CHP) resources in Texas (2008).
- Expert report and financial models prepared for the New Jersey Board of Public Utilities on renewable energy resources, markets and programs. These analyses included assessment of ratepayer impacts of meeting RPS requirements in the state. Provided briefings for individual Commissioners and the Governor's office (2007-2008).
- Served as Independent Measurement and Verification Expert to the Public Utility Commission of Texas (PUCT) in review of Energy Efficiency program savings, presenting findings at an Open Meeting of the Commission (2006).
- Expert Advisor and Facilitator for IRP Collaborative in Idaho, group included industry, environmental groups, consumer counsel, and others.
- Served as technical expert to DSM collaborative for the state of Minnesota.
- Facilitated discussions at various California PUC collaborative and Working Group discussions on M&V methods and results, and DR impacts.

PROFESSIONAL AFFILIATIONS & HONORS

- Association of Energy Service Professionals (AESP)
- American Solar Energy Society (ASES)
- American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). Served on Technical Committee 1.5 Computer Applications, for several years. Co-authored ASHRAE Handbook chapter updates, and chaired research monitoring committee ASHRAE sponsored research.
- Association of Energy Engineers (AEE)
- Registered Professional Engineer (Colorado license)
- John McCabe Memorial Scholarship (ASHRAE) 2006.

- Board of Directors of a non-profit organization; *The Mountain Fund*, and the *Anatoli Boukreev Memorial Fund.*
- A diverse athletic & professional background, having appeared on the cover of publications ranging from *Climbing* Magazine to the *ASHRAE Journal*

AREAS OF QUALIFICATIONS

- Energy efficiency program evaluation
- Energy savings analysis and modeling
- Valuation and analysis of demand response resources
- Avoided cost studies

EMPLOYMENT HISTORY

Consultant, Summit Blue Consulting, LLC, Boulder, CO, November 2004 - present
Software Engineer, Rutherford Appleton Laboratory, CCLRC, Oxfordshire, UK, June 2003 - October 2004
Flight Software Engineer, Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, November 1998 - August 2001
Software/Firmware Engineer, Exabyte Corporation, October 1995 - October 1998

EDUCATION

University of Reading, UK, M.S. in Renewable Energy and the Environment, 2002
Bedford College, University of London, UK, B.S. in Mathematics, 1984

PROFESSIONAL EXPERIENCE

Rachel Freeman has extensive experience in energy efficiency program evaluation and demand response programs. Ms Freeman has worked on projects related to energy efficiency program impact analysis, the integration of demand response within resource planning, and the financial analysis of renewable energy technologies.

Ms Freeman has a strong analytical and mathematical background, with a B.S. in Mathematics from the University of London and an M.S. in Renewable Energy and the Environment from the University of Reading, UK. For her dissertation, she designed and engineered a low-cost solar pump for drip irrigation. Her main areas of interest are renewable energy potential studies, energy efficiency technologies, and demand response program design.

Ms Freeman's recent professional experience includes the following areas:

- **Impact Analysis Protocol Reviews**
  - An audit of Union Gas's 2005 and 2006 DSM Evaluation Reports. This included verifying that calculations have been done correctly, reviewing assumptions underlying the estimation of savings, assessing the evaluation methodology and procedures, and making recommendations for changes and any further research required.
  - A review of engineering protocols used to determine energy and demand savings due to efficiency improvements, for the New Jersey Board of Public Utilities.
- **Sampling**
  - A statewide M&V evaluation of energy efficiency programs in Texas for the Public Utility Commission of Texas. Tasks included selecting sample projects (with random stratified approach) for detailed IMPMVP evaluation, a review of the deemed savings database, and a quality review of supporting documentation for energy efficiency installations.

- Data collection and analysis for a measure cost study for PG&E, to be used in the California Energy Commission's Database for Energy Efficiency Resources (2005 update). Included a market analysis of pricing and availability for a variety of energy efficient equipment; and statistical analysis of collected data, including regression analysis, to produce reliable estimates of typical market prices.

- **Analysis of Energy Efficiency Program Impacts**
  - Data analysis of participant and non-participant survey data for NYSERDA's New York Energy $mart[SM] portfolio of programs, including calculations of inside and outside spillover, non-energy impacts, and free-ridership.
  - A detailed impact evaluation of Xcel Energy's portfolio of DSM programs in Colorado. These programs include a Residential AC Rebate program, a Commercial Custom Efficiency program, and a Design Assistance Program. Tasks included: modeling savings from residential AC upgrades, selection of project samples for detailed review using a stratified approach; analysis of program databases; characterization of savings by six different day types; and verification of project savings.
- **Demand Response**
  - Extensive research into demand response resources in many different countries for the IEA's Demand Respond Resources (Task XIII) project. Tasks done in the project include:
    - Research into DR modeling methodologies in the USA and Scandinavia.
    - Building a risk analysis model to estimate the market potential of DR.
    - Working with New Energy Associate's Strategist® utility planning model to develop a methodology to value DR as part of a resource plan.
  - A study of potential benefits due to demand response programs for Sacrametno Municipal Utility District. Tasks included development of prototype DR programs and associated energy, demand, and avoided cost savings for both commercial and residential customers.
- **DSM Potential Studies:**
  - A DSM potential study for Nova Scotia Power, including modeling of commercial buildings with EQuest and calculation of TRC for a suite of energy efficiency measures.
  - A DSM potential study focused on reducing winter peak for Jacksonville Electric Authority.
  - A screening of both residential and commercial DSM measures with the DSMore model (from Integral Analytics) for KCP&L.
- **Market Effects Evaluation**
  - An estimation of the non-energy impacts of NYSERDA's energy efficiency programs. This study used conjoint analysis for the first time to measure these impacts. Tasks included: design of the conjoint questions, data management, and analysis of the results with Probit to determine Willingness to Pay for various non-energy impacts.
  - Modeling of potential ratepayer impacts for several market models that would enable the state of New Jersey to transition from a rebates-based incentive for solar PV to one based on Solar Renewable Energy Credits.

Prior to obtaining her M.S. in Renewable Energy and the Environment, Ms Freeman worked for both commercial and scientific organizations, including: writing an experiment user interface for scientists at the ISIS neutron scattering facility at the Rutherford Appleton Laboratory in the UK; writing microprocessor software for a NASA science satellite (including real-time PID control of a spectrometer grating drive) at the Laboratory for Atmospheric and Space Physics, University of Colorado; and writing software and firmware for tape drives at Exabyte Corporation, Colorado.

Ms Freeman has managed numerous technical and research projects for a diverse group of clients. She also has excellent language skills, and serves part-time as the editor of a bimonthly lifestyle magazine.

RECENT PUBLICATIONS AND PRESENTATIONS

Reducing Peak Load and Managing Risk with Demand Response and Demand Side Management, RE Focus Magazine, September 2005.

DRR Valuation and Market Analysis, Volumes I and II (Daniel M. Violette, Rachel Freeman, Chris Neil), prepared for the International Energy Agency Demand-Side Programme, Task XIII: Demand Response Resources

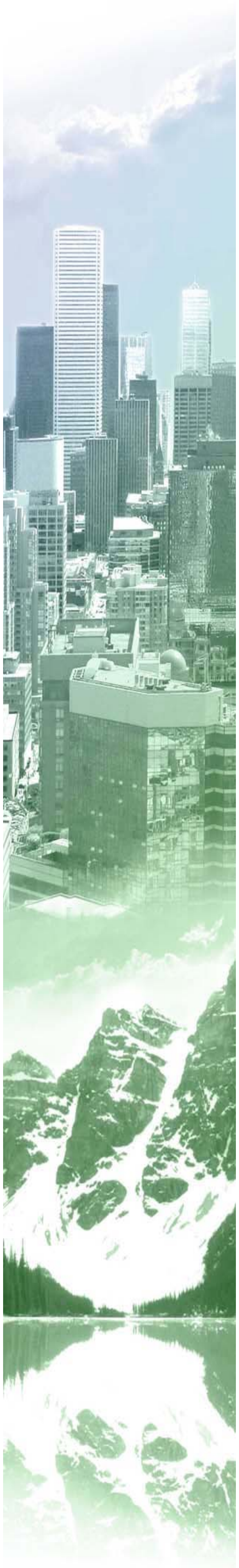
Valuing Demand Response Programs - Modeling Tools and Approaches, presented at DistribuTECH, San Diego, California, February 2007

Savings Uncertainties in Residential Air Conditioning Rebate Programs, IEPEC conference, August 2007

Integrating Demand Side Resource Evaluations in Resource Planning – An Industry Turning Point, (Dr. Daniel M. Violette, Rachel Freeman), IEPEC conference, August 2007

The Cost of New Jersey's Solar PV Transition: An Analysis of Ratepayer Impacts Associated with Alternative Models for Transitioning a Statewide Solar PV Program from Rebates to Market-Based Incentives, (Kevin Cooney, Mike Winka, Rachel Freeman, Nicole Wobus, Bill Kallock), AESP conference, January 2008.

Ms Freeman serves as a reviewer for The Energy and Resources Institute in New Delhi, India.



Measures and assumptions for DSM planning

IndEco

Review of the Draft Measures for DSM Planning for Natural Gas Distributors (EB-2008-0364)

IndEco

This document was prepared for Enbridge Gas Distribution by IndEco Strategic Consulting Inc.

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IndEco report A9505

4 March 2009

Contents

1 Introduction

At the request of Enbridge Gas Distribution (Enbridge), IndEco Strategic Consulting Inc. reviewed the treatment of spillover and free ridership in the draft report prepared by Navigant Consulting Inc. for the Ontario Energy Board entitled*, Measures and Assumptions for Demand Side Management (DSM) Planning* (February 6, 2009) (Input Assumptions report). Navigant Consulting was retained by the Ontario Energy Board to review and update input assumptions regarding the energy efficient measures, expected resource savings, costs, equipment life and other parameters for potential use in the development of the upcoming multi-year gas DSM plans for delivery in the 2010 rate year and beyond. The results of this work are documented in the Input Assumptions report.

IndEco conducted its review of the Input Assumptions report at the DSM policy level, As a result, determination of specific free ridership and spillover rates for particular measures, programs and at the portfolio level was outside the scope of this review. IndEco carried out the review taking into account the following policy objectives:

- Maximize the gas savings/TRC achieved from the implementation of DSM by the natural gas distributors
- Recognize the maturity of the natural gas distributors in delivering DSM and the maturity of the DSM market in Ontario
- Harmonize guidelines for natural gas DSM and electricity CDM where appropriate
- Set clear and transparent rules for DSM that allow the gas distributors the flexibility to deliver successful DSM
- Strike the right balance of regulatory oversight for natural gas DSM in Ontario to achieve the above objectives

1.1 About IndEco

IndEco Strategic Consulting was established in 1994. IndEco is an Ontario-based and Ontario-owned boutique energy firm, focusing on management consulting in conservation (DSM/CDM), energy efficiency, demand response, renewable energy, sustainable development and climate change. IndEco offers services in policy and framework design, strategic planning, program planning, development and delivery, stakeholder consultation, monitoring, evaluation and reporting, marketing and promotion, and awareness and training.

IndEco is a recognized expert in demand side management in Ontario, with extensive experience in both gas demand side management (DSM) and electricity conservation and demand management (CDM). Regarding DSM, IndEco has worked with both Enbridge Gas Distribution and Union Gas. We have provided advice on DSM frameworks, expert testimony at Ontario Energy Board hearings, program and policy design and program review and evaluation. Regarding CDM, IndEco has experience in program design and delivery, CDM framework development, providing expert testimony on CDM plans before the OEB, program development, program delivery, program evaluation and reporting. IndEco has also worked with over 30 distributors on CDM plans, regulatory reporting on CDM, and program delivery.

The principal authors of this report are David Heeney and Judy Simon. Appendix A contains the Curriculum Vitae for each author.

2 Issues with the treatment of free riders and spillover

This chapter provides a description of the issues that IndEco has identified with the treatment of free ridership and spillover input assumptions in the Input Assumptions report.

IndEco has identified the following issues:

- Locking in all input assumptions for the test year is essential to good DSM planning and effective program delivery by the gas distributors

- Input assumptions should include assumptions regarding free rider rates and spillover rates

2.1 Locking in input assumptions

Since Enbridge's 2003 rates case, the Ontario Energy Board (Board) has considered locking in input assumptions for the TRC and the SSM to be essential to good planning and program implementation. Any adjustments to these input assumptions for planning purposes have been made prospectively in the subsequent year.

The Board reviewed and confirmed the need for locking in assumptions for gas DSM in 2006 in the Generic Decision on Natural Gas Demand Side Management (EB-2006-0021) (Generic Decision). Most recently, the Board approved Enbridge's 2008 input assumptions, which were locked in for the year. For electric LDCs, the Board reviewed and approved the need to lock-in input assumptions in the TRC Guide (2005), and reaffirmed this need in the Guidelines for Electricity Distributor Conservation and Demand Management (EB-2008-0037) (Electricity Guidelines).

Historically, the locking in of input assumptions has been done as part of the Board's approval process for DSM plans. The gas distributors prepare DSM plans in consultation with stakeholders through the Consultative and based on the findings from previous audits and Evaluation Reports. The gas distributors screen programs based on TRC calculations which they prepare using the input assumptions approved by the Board, or in cases where the programs proposed are significantly different from those used to derive the input assumptions, the gas utilities seek Board approval of assumptions better suited to the new programs.

During the formal proceeding to approve the DSM plan, the gas distributor and intervenors bring to the table the best information they have to assist the Board in making an informed decision on the approval. Input assumptions for the TRC, programs and their budgets, and the overall portfolio and its TRC are reviewed and based on this scrutiny, the DSM plan, if found to be in the public interest, is approved by the Board. A significant amount of effort and resources are expended to carry out this process and to approve the DSM plan in the public interest. This process creates an expectation on the part of the gas distributors and ratepayers that the plan and the assumptions behind it are reasonable and therefore, should be the basis for program implementation.

If at the end of the year, the Board finds that the assumptions made at the beginning of the year can be improved, then the improvements should be made on a going forward basis to be used for the subsequent year. Since input assumptions such as free rider rates and spillover are not measured, but estimated, and ultimately approved in a regulatory proceeding, it is not practical and likely impossible for the gas distributor to make a determination during program delivery that the Board will decide to alter the free rider or spillover rates at the end of the year. Since anticipating such a change is not a reasonable expectation for gas distributors to meet, it is not reasonable to expect the gas distributor to make planning decisions during delivery in anticipation of such a future decision by the Board. Locking in input assumptions for the TRC and SSM avoids this situation and provides certainty to the Board and ratepayers that if the gas distributor delivers its DSM programs effectively based on the Board approval of the DSM plan, both the ratepayers and the gas distributor will be rewarded.

If the gas distributors and ratepayers cannot rely on the Board's approval of the DSM plan and its assumptions to guide program implementation, then this raises serious question around the role and usefulness of the approval.

While it is true that input assumptions for the TRC can be more accurately determined on an ex post basis, for planning and program delivery purposes this is far too late. Utilities allocate management time and resources based on Board approved assumptions. There is no going back and redoing program decisions based on information gained after program delivery is complete. If the gas distributors are expected to make decisions on programming based on assumptions to be determined at the end of their delivery, this will force the distributors to engage in programs that have minimal risk, rather than encouraging creativity. The effectiveness of the SSM as a driver of DSM will diminish as the gas distributors face increased uncertainty about what steps to take to maximize TRC as they deliver their programs. Over time such a fluid approach to input assumptions may lead the gas distributors to seek reduced DSM budgets in favour of focussing their efforts on a smaller set of less risky investments. This is contrary to the provincial government's desire to achieve a culture of conservation and to increase the energy efficiency of Ontario households and businesses, in part by the government taking steps to achieve greater market certainty for conservation.

The unlocking of these assumptions for calculating the TRC and the SSM incentive represents a major departure from gas DSM practice. This practice has been developed over years in multiple Board decisions. A change at this time is not warranted.

Recommendation #1	**The Board should indicate that the input assumptions are to be locked in for purposes of determining TRC and SSM**

2.2 Estimates for free ridership and spillover

Free ridership and spillover are two components of the net to gross ratio, required for the calculation of the TRC and SSM. Spillover is the opposite of the free rider effect; free-riders deducts energy savings that would have been achieved without the efficiency program, while spillover increases savings for any effects that occur as an indirect[1] result of the program.

The Input Assumptions report does not contain assumptions for either free ridership or spillover. While there is no mention of spillover effects, Navigant explains that it 'is not able to provide estimates of the free-ridership for any of the technologies and measures for DSM programs to be implemented in 2010 because the design of the DSM program and the specific customer segments targeted by Union and Enbridge can influence free-ridership.' (p. 7. Input Assumptions report)

We agree that the design of the DSM program and the specific customer segments can influence free ridership. However, this is not a sufficient reason for excluding free ridership or spillover input assumptions in the Input Assumptions report.

The input assumptions in the Input Assumptions report are already divided by customer segments and the measures listed do take into

[1] 'Indirect results' are results that occur because the program exists, but that are not realized directly through program delivery. For example, if someone hears about a measure being offered by the gas distributor through the gas distributor's program advertising campaign and then decides to install the measure, without becoming a participant in the gas distributor's program, this would be an 'indirect' result because the gas distributor was not directly involved, but the gas distributor's advertising related to the program led the customer to take action.

account the program experience of the gas distributors. The Enbridge programs have been designed from the technology list, and differences in program design have already been addressed in the assumption list (e.g. showerhead for contractor delivery of the TAPs program versus the ESK program showerhead drop-off),

Since 2005 the Board has determined that the appropriate free ridership rate for all electric LDC CDM programs is 30% and has included that rate in the TRC Guidelines for electric LDCs and most recently in the Electricity Guidelines. With regard to the previous gas distributor multi-year plans, the Board approved locked in input assumptions as part of the Settlement Agreement in EB-2006-0021, and these included free ridership rates for each of the measures.[2] Navigant appears to have considered the approach used for developing the input assumptions in 2006 appropriate for use in developing the assumptions for the second generation multi-year plans to be implemented in 2010 and beyond. However, free ridership rates and spillover are not included in the Navigant draft report.

In adopting the input assumptions for the first generation of multi-year plans, parties to the Settlement Agreement in EB-2006-0021, adopted a reasonable approach for taking into account the design of the DSM program and specific customer segments in determining free rider rates for particular measures.[3] This approach included determining input assumptions to be used by the gas distributors in the context of existing DSM programs, setting assumptions by market segment and measure, and assessing for reasonableness the proposed input assumptions for programs which are significantly different from those relied on to determine the original set of input assumptions. The parties stated:

> "The parties anticipate that these values [input assumptions] will be applicable to the multi-year plans to be filed by the Utilities for the multi-year period beginning in 2007. In the event that either Utility proposes programs which are sufficiently different from those which were used in the development of input assumptions that any of these assumptions are no longer appropriate, then consistent with issue 3.1 of the Board's decision in Phase I of this proceeding, the applicable input assumptions should be assessed for reasonableness prior to approval of the multi-year plan." (Filed 2006-10-05. EB-2006-0021 Phase II. Ex. K13.1, p. 4 of 4)

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[2] For example, under the market segment of residential new construction, the free ridership rate for a tankless water heater was 2%.

[3] Based on this approach Enbridge updated some of the 2006 approved input assumptions for use in 2008 (EB-2008-0384). The approved 2008 input assumptions (November 2008) were organized by market segment and the measures to be adopted within it.

The approach to determining locked in input assumptions for the first generation of multi-year plans should continue for the determination of locked-in input assumptions for the next generation of multi-year plans. As in 2006, input assumptions should include free rider rates for measures organized by market segment.

In addition to free rider rates, input assumptions for measures should also include spillover rates. As with all other input assumptions, the spillover rates should take into account the existing program spillover rates and be adjusted for any new programs proposed that are significantly different from existing ones. Navigant asserts that Union and Enbridge are in the best position to provide free rider estimates (Input Assumptions report, p.7), and this will also be true for spillover rates because of the studies on spillover and free riders that both gas distributors have completed as part of their evaluations and the independent audits of results.

The Board could request that Navigant amend its Input Assumptions report to include estimates from the gas utilities, methodologies for estimation or both for free-riders and spillover effects, drawing on values for these in other programs, in evaluations of programs already delivered, and in approved plans. Alternatively, the Board could approve an amended list of input assumptions based on the Navigant report which includes free rider and spillover rates, based on submissions of the gas utilities as part of the approvals process for their multi-year plans. If the Board chooses the latter approach, then it will be helpful to the gas utilities to obtain guidance from the Board now regarding the values to use for free ridership and spillover for program screening purposes. This latter approach, including the determination of input assumptions in advance of the submission of the DSM plans, is consistent with the Board's approach to approving input assumptions in every gas DSM related proceeding since E.B.0. 169-III up to and including the previous round of multi-year gas DSM plans.

Recommendation #2	**The Board should approve input assumptions for measures that include assumptions for free riders and spillover.**

Recommendation #3	**Free ridership and spillover assumptions should be approved at the same time as the Board approves the other input assumptions.**

Recommendation #4	**The input assumptions should be determined taking into account existing DSM programs. Where a gas distributor**

	proposes a new DSM program that is significantly different from the existing set of programs used in determining the input assumptions, then the input assumptions for the new program should be assessed for reasonableness before the new program's input assumptions are approved by the Board.

3 Recommendations

This chapter presents recommendations to the Board regarding the treatment of input assumptions in the Input Assumptions report based on the issues identified in the previous chapter. These recommendations are being made to meet the following objectives:

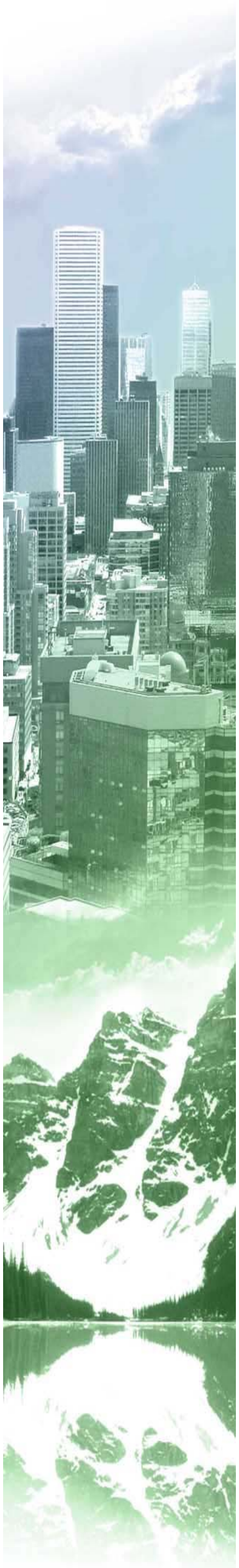
- Maximize the gas savings/TRC achieved from the implementation of DSM by the natural gas distributors
- Recognize the maturity of the natural gas distributors in delivering DSM and the maturity of the DSM market in Ontario
- Harmonize guidelines for natural gas DSM and electricity CDM where appropriate
- Set clear and transparent rules for DSM that allow the gas distributors the flexibility to deliver successful DSM
- Strike the right balance of regulatory oversight for natural gas DSM in Ontario to achieve the above objectives.

The recommendations are presented below:

- The Board should indicate that the input assumptions are to be locked in for purposes of determining TRC and SSM
- The Board should approve input assumptions for measures that include assumptions for free riders and spillover
- Free ridership and spillover assumptions should be approved at the same time as the Board approves the other input assumptions
- The input assumptions should be determined taking into account existing DSM programs. Where a gas distributor proposes a new DSM program that is significantly different from the existing set of programs used in determining the input assumptions, then the input assumptions for the new program should be assessed for reasonableness before the new program's input assumptions are approved by the Board

Curriculum Vitae

- David Heeney
- Judy Simon



JUDY SIMON

Vice President

Judy Simon, Vice President, is an environmental scientist and strategic planner with over 25 years experience in energy and environmental issues, focusing on energy regulation, energy efficiency and conservation, renewables, and climate change. Judy has extensive experience in both the public and private sector and has been a management consultant in the energy field for 20 years.

Judy was a part-time Board member of the Ontario Energy Board between 1992 and 2002, giving her extensive knowledge and experience in the development and implementation of natural gas and electricity regulatory frameworks in Ontario. Judy was appointed as the Board's leading expert on DSM, and on environmental matters related to energy regulation, and served in that capacity for ten years.

EXPERTISE

- Strategic planning
- DSM/CDM, distributed energy, and renewable energy policy analysis, program development and implementation
- Program monitoring, evaluation and reporting
- Energy adjudication
- Electricity and natural gas markets and energy regulation in Ontario
- Stakeholder, engagement, social marketing and training

EMPLOYMENT HISTORY

- Vice President, IndEco (1994 - present)
- President, Judy Simon + Associates (1989 – present)
- Part-time Board Member, Ontario Energy Board (1992- 2002)
- Manager, Technology Policy, Ontario Ministry of Industry, Trade and Technology (1987-1989)
- Manager, Environmental Assessment Branch, Ontario Ministry of Environment (MOE) (1982-1987)
- Environmental Planner, Environmental Assessment Branch, MOE (1981-1982)
- Energy Planner, Conservation and Renewable Energy Group, Ontario Ministry of Energy (1980-1981)
- Energy Researcher, Algas Resources, Trans Canada Pipelines (1978)

PROFESSIONAL QUALIFICATIONS

Master of Environmental Design (Environmental Science), University of Calgary (1980)

Bachelor of Science, University Scholar, Great Distinction, McGill University (1977)

APPEARANCES

1985	Joint Board, Ontario Hydro Southwestern Ontario Transmission System Expansion Program. On behalf of the Ontario Ministry of the Environment regarding Ministry environmental policy and approvals
2003	Ontario Energy Board, on behalf of Enbridge Gas Distribution Inc. regarding their DSM framework and incentive mechanisms
2004	Ontario Energy Board, on behalf of Brantford Power regarding the approval of its 2005 CDM Plan
2004	Ontario Energy Board, on behalf of Milton Hydro regarding the approval of its 2005 CDM Plan
2005	Ontario Energy Board, on behalf of Low-Income Energy Network regarding CDM policies and programs, regulated price plan and other matters
2008	Ontario Energy Board, on behalf of GLOBE regarding the OEB low income policy proceeding

ADVISORY COMMITTEES AND BOARDS

April 2008 to present	Member, Toronto Atmospheric Fund Grants and Special Projects Committee
Jan. 2006 to present	Member, Board of Directors, Clean Air Partnership
Jan. 2005 to July 2006	Member, City of Toronto's Environment Roundtable
Oct. 2002 to March 2006	Member, Grants and Loans Committee, Toronto Atmospheric Fund
Apr. 1999 to 2002	Vice President, Environment, Provincial Council of Women
Dec.1996 to Mar. 2008	President of the Board of Directors, Canadian Environmental Law Association (CELA)
Apr. 1994 to Mar. 2008	Member of the Board of Directors, CELA

May 1992 to May 2002	Part-time Board member of the Ontario Energy Board
Sept. 1990 – Dec. 2001	Member, Environmental Advisory Panel to the President, Ontario Hydro

AWARDS

1981	Commendation from Mayor, City of Toronto, for work on Toronto Recycling Action Committee
1997-1980	Natural Sciences and Engineering Post-graduate Scholarship
1972-1977	McGill University Scholarship
1972 -1977	Steinberg Canada Scholarship

SELECTED PROJECTS

Strategic/business planning

- Windstream Inc.. Provision of advice and preparation of a submission to the Ontario Energy Board (OEB) on behalf of Windstream, dealing with issues facing electricity transmitters and wind generators. Project manager.

- Northwatch. Provision of advice and preparation of brief for OEB proceeding on generation connections taking into account special needs/situation of northern Ontarians including aboriginals and off-grid residents. Project manager.

- Conservation Bureau. Provision of business planning and strategic advice. This included guidance on the creation and implementation of internal policy and administrative structures, and the identification of staffing and budgeting requirements for the planning, coordination and reporting function. It also included completion of the LDC, government and other market player scorecard components of the Chief Energy Conservation Officer's 2006 Annual Report. Wrote sections dealing with the natural gas utilities and non-Ontario Power Authority conservation and demand management by the electric utilities for the 2007 and 2008 Annual Reports. Project manager.

- Ontario Power Authority. Assisting the OPA to design and launch the $400M program for LDC CDM including establishing the rules for funding, the application process and the contract elements, and development of program templates and detailed program designs for the OPA's Standard LDC programs (Programs in a Box). Work is ongoing and being completed in partnership with Navigant. Project manager.

- Guelph Hydro. Development of a CDM business plan using IndEco's strategic planning process to develop priorities for the plan, and strategies to realize the priorities. Project manager.

- Energy Efficiency Office, City of Toronto. Development of the Report on the Development of the Energy Plan for Toronto. Senior advisor.

- Low-income Energy Network. Preparation of submissions on Regulated Price Plan and low-income consumers to the OEB and prepared with FRC Canada. Project manager.

- Canadian Energy Efficiency Alliance. Preparation of strategy papers on CDM which were submitted to the OEB and to the Minister of Energy. Project manager. Served as DSM expert to Alliance's DSM policy committee.

- Toronto Hydro and Milton Hydro. Development of business case that helped both utilities to decide to go forward to develop a DSM plan for 2003. Project manager.

- Energy Efficiency Office, City of Toronto. Senior policy advisor on the identification and evaluation of opportunities for strengthening partnerships with Toronto Hydro through joint work on DSM.

- Energy Efficiency Office, City of Toronto. Senior policy advisor on the development of a Sustainable Energy Business Plan for the Energy Efficiency Office for 2002.

- City of Toronto. Development of the City of Toronto's Implementation Plan for the Environmental Plan. Project manager.

- Brewers of Ontario. Development and implementation of a business strategy for enhancement and recognition of environmental performance in packaging. Project manager.

- Brewers of Ontario. Development of environmental strategy including opportunities to reduce energy use and emissions in new facilities and vehicles. Project manager.

DSM/CDM planning, program development, implementation, monitoring and evaluation

- Hydro One. Delivery of 2008 Power Savings Blitz. Work is ongoing. Account executive.

- Barrie Hydro. Delivery of 2007 and 2008 ERIP. Delivery of marketing and promotion related to 2008 GRRR, peakSaver, Summer Savings. Delivery of 2008 Power Savings Blitz. Work is ongoing. Account executive.

- OPA. Evaluation of Veridian and PowerStream Neighbourhood **peaksaver** custom programs. Work is ongoing. Senior advisor.

- Peterborough Distribution Inc. Delivery of 2007 ERIP and project management for Summer Savings, peakSaver, and GRRR.

- UHN. Design and delivery of 3-year (2007-09) comprehensive energy management program including social marketing, employee engagement, operator training, audit and retrofits. Work is ongoing. Senior advisor.

- NEPA Group. Delivery of 2007 ERIP. Project manager.

- Guidance on the preparation of workplans and budgets for applications to the OPA LDC CDM fund. Project manager.

- Oakville Hydro. Provide guidance on the preparation of workplans and budgets for applications to the OPA LDC CDM fund. Project manager.

- Kitchener-Wilmot Hydro, Waterloo North Hydro and Cambridge North Dumfries Hydro. Assist in the preparation of application to the OPA for funding for the delivery of LDC standard programs. Project manager.

- Oakville Hydro. Preparation of OEB application to exceed 20% rule for CDM spending. Project manager.

- Enbridge Gas Distribution. Advice on DSM policies, regulatory treatment of DSM, low-income programs and other matters in the 2006 generic gas DSM hearing and on Enbridge's 3-year DSM plan. Project manager.

- Toronto Atmospheric Fund. Development of a municipal lighting program design for Toronto Atmospheric Fund. Work involved review of energy forecasts and needs in the GTA, survey of existing municipal and LDC lighting programs in the GTA, evaluation of measures (including TRC calculations), and preparation of written descriptions. Project manager.

- Burlington Hydro. Management of key aspects of the implementation of the 2005-2007 CDM plan including development of detailed program designs, implementation plans marketing and advertising programs, as well as monitoring and evaluation systems for the utility's lighting retrofit programs for its general service customers, municipal customers, and for its residential new construction program. Project manager.

- Milton Hydro. Policy advisor on Milton Hydro CDM portfolio for 2005 and for 2006.

- Senior regulatory advisor on the development of post-third tranche 2006 CDM plans for Burlington Hydro and Milton Hydro.

- Enbridge Gas Distribution. Advice on improvements to its DSM regulatory framework including budget and target setting, its incentive, stakeholder input, monitoring, evaluation and reporting with Navigant. Project manager.

- Toronto Hydro. Investigation of options for Toronto Hydro to reduce customer bills including an illustrative approach for 2003 to DSM with Fraser & Company. Project manager.

- Canadian Energy Efficiency Alliance. Co-author of paper, "The Consumer Benefits of Interval Metering, with Marion Fraser, Fraser & Company. Project manager.

- Ontario Energy Board. As Board member, a principal author of natural gas regulatory framework for DSM (E.B.O. 169-III); adjudicator in over 100 cases.

Hard to reach consumers DSM/CDM

- GLOBE. Provision of strategic advice on programs and policies for social housing to be tabled at OEB low income proceeding. Work is ongoing. Project manager.

- Northwatch. Provision of strategic advice on CDM and renewables component of IPSP taking into account special needs of northern Ontarians, including aboriginals and off-grid residents. Project manager.

- Enbridge Gas Distribution. Benchmarking of customer care programs, including those for seniors and hardship customers compared with other Canadian and US utilities and jurisdictions. Made recommendations on improvements to programs and linkages to DSM programs. Project manager.

- Ontario Power Authority. Development of conservation program concepts for social housing, low-income tenants in private buildings, and low-income homeowners. Project manager.

- Low-Income Energy Network. Represented LIEN on the Union Gas DSM Consultative. Project manager.

- Brantford Power. Development of Conserving Homes program, the award winning Canadian low-income CDM program. Project manager.

- Low-Income Energy Network. Prepared evidence and argument that included the recommended design for Union Gas' low-income program, which was approved by the OEB in Union Gas' 2006 DSM proceeding (EB-2005-0507). Project manager.

- Low-Income Energy Network. Prepared evidence and argument that involved policies and program designs for low-income CDM in EB-2005-0523. Project manager.

- Low-Income Energy Network. Fundraising through a Trillium proposal to secure funds and then to use the funds to create the LIEN website and to hold the first annual conference on low-income energy matters with LIEN members and other interested NGO's, government and other participants. Project manager.

- Low-Income Energy Network. Development of a low-income energy efficiency program template for electric LDC's to adopt for low-income homeowners and tenants who pay their electricity bills directly. Work was funded by Ministry of Energy and Toronto Atmospheric Fund. Project manager.

- Toronto Environmental Alliance. Development of low-income energy conservation and assistance strategy for Ontario. Funded by Toronto Environmental Alliance and Ministry of Energy. Project manager.

- Canadian Environmental Law Association. Preparation of a CDM policy paper on the appropriate framework for CDM in Ontario to best meet the needs of low-income consumers which was submitted to the OEB as part of the consultation related to the Minister's Directive to the OEB on CDM. Project manager.

DSM/CDM best practices

- Canadian Gas Association. Identification of DSM best practices for monitoring and evaluation in Canadian gas utilities. Related paper presented at AESP, January 2009. Project manager.

- EDA. Presentation on comparison of CDM in US jurisdictions and in Ontario and Ontario at EnerCom 2007. Project manager.

- Association of Energy Service Professionals. Publication of paper and delivery of presentation on DSM Best Practices in the Canadian Natural Industry, winter 2007 and at AESP, January 2007.

- Electricity Distributors Association. Preparation and delivery presentation on CDM best practices in gas and electric LDCs to EDIST Conference with Enbridge Gas Distribution, winter 2006. Project manager.

- Canadian Gas Association. Preparation of policy paper on declining average across gas utilities in Canada and recommendations on treatment in rates. Project manager.

- Conference Board of Canada. Author of discussion paper on successful natural gas regulatory DSM frameworks in Canada, published in November 2005.

- Canadian Energy Efficiency Alliance. Senior advisor on Webinar on best practices with Enbridge Gas Distribution.

- Canadian Gas Association. Identification of natural gas DSM best practices among natural gas utilities across Canada with Bruce Vernon & Associates. Senior policy advisor.

- Enbridge Gas Distribution. Identification of best practices regarding incentive mechanisms in North American Gas utilities with Navigant. Project manager.

- Enbridge Gas Distribution. Survey of natural gas DSM in North American jurisdictions with Navigant. Project manager.

Training

- Conservation and demand management training for Ontario's local distribution utilities. The development and delivery of IndEco's training program for new electric utility staff and a refresher for more experienced staff on conservation and demand management. The course includes training in program design, delivery, management, monitoring and evaluation, regulatory approvals and reporting. Federal and provincial programs and US program examples are presented. Account executive and trainer.

- Canadian Electricity Association. Facilitator for joint CEA-Natural Resources Canada workshop on monitoring and evaluation of conservation and demand management programs. Work included providing a workshop report, summarizing workshop content - issues, lessons learned. Project manager and facilitator.

- Canadian Gas Association. Design and delivery of a workshop on monitoring and evaluation of energy efficiency and conservation programs. Work also included the preparation of a report on issues and lessons learned from this workshop and 3 previous ones. Project manager and facilitator.

- Clean Air Partnership. Conservation and demand management training for municipal officials. On behalf of the Clean Air Partnership, IndEco designed and delivered a training program for municipal staff targeted at southern Ontario municipalities (members of GTA-Clean Air Council) on conservation, energy efficiency and demand response. Account executive and trainer.

- Milton Hydro. Design and implementation of a breakfast seminar series with the utility's GS customers on DR. Senior advisor.

- Burlington Hydro. Design of training workshops for the ICI sector and local Burlington builders on energy efficiency and the DSM programs available to them. Senior advisor.

- City of Ottawa and Canadian Gas Association. Design and delivery of workshop to local builders, architects, engineers, utilities, energy managers and consultants on conservation and renewable energy opportunities in Ottawa to improve air quality and reduce GHGs. Project manager.

- City of Mississauga and Canadian Gas Association. Design and delivery of workshop to builders, architects, engineers, utilities, energy managers and consultants on conservation and renewable energy opportunities in Mississauga to improve air quality and reduce GHGs. Project manager.

- Canada Mortgage and Housing Corporation. Development and implementation of design charette for multi-residential and commercial buildings, which became a key basis for CMHC to offer these charettes with Sustainable Buildings Canada across the country. Project manager.

- Association of Canadian Distillers. Design and delivery of a training and awareness program on energy efficiency opportunities in whiskey manufacturing plants to manufacturer members.

Stakeholder engagement and social marketing

- York Region. Delivery of water conservation programs for York Region (2009-2011) including a rain barrel program, rebates for water saving toilets and washing machines, and a pre-rinse spray valve program in cooperation with Enbridge Gas Distribution and ICI water audits. With Finn Projects. Senior advisor.

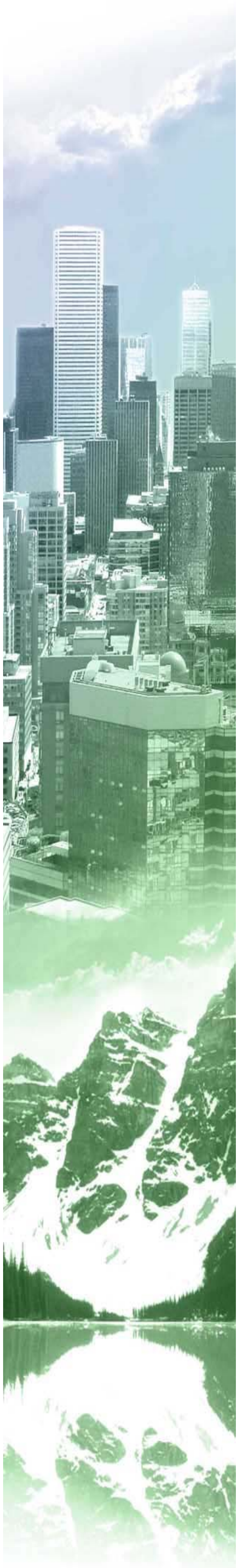
- University Health Network. Design and delivery of a social marketing and employee engagement program for energy efficiency and energy conservation in Toronto Western and Toronto General Hospitals (2008-2010). Senior advisor.

- Ontario Power Authority. Design and delivery of the stakeholder consultation process for the $400M CDM program including the design and delivery of the Program Design Advisory Group and Program Operations Design Group activities. With Navigant Consulting. Project Manager.

- Toronto Catholic District School Board. Design and implementation of the Energy Drill demand response one year pilot program in three boards and eight schools across the GTA. Program funded by the Ontario Power Authority and in partnership with the City of Toronto, Toronto Hydro, Milton Hydro, Toronto Catholic District School Board, Halton District School Board and the Halton Catholic District School Board. This program is based on a social marketing campaign and the implementation of specific energy drill protocols. Senior program advisor.

- Burlington Hydro. Design of a partnership with Canada Centre for Inland Waters and BHI to promote awareness related to opportunities for commercial building retrofits and distributed generation (gas and solar) for BHI's largest customers. Project manager.

- Association of Canadian Distillers. Design of a pilot social marketing and employee engagement program for a member manufacturing company. Project manager.



DAVID HEENEY

President

David Heeney has done management consulting in energy and environment strategy and policy, management systems, technology assessment and training since 1978 both in Canada, US and abroad. One of his distinctive capabilities is to quickly see through a morass and identify the central kernel.

David's consulting projects have covered a wide range of energy and environment issues, including conservation and demand side management (DSM/CDM), climate change, emissions reductions, and environmental management and information systems. He has done extensive work for both public, private and third sector clients in energy efficiency programs – both design and program evaluation, life-cycle assessment, performance indicators (in particular sustainability indicators), full-cost accounting, and the development and use of economic instruments to achieve goals such as the virtual elimination of toxics. He has developed innovative strategic planning, computer modeling and communications and workflow management tools to assist decision-makers to deal with the energy, environment and business challenges they confront.

EXPERTISE

- Electricity and natural gas markets and energy regulation in Ontario
- DSM/CDM and renewable energy policy analysis, program development, implementation and training
- Monitoring and evaluation of CDM programs
- Strategic planning
- Municipal energy and environmental management

EMPLOYMENT HISTORY

- President, IndEco Strategic Consulting Inc. (1994 – present)
- Partner, Hickling (1992 – 1994)
- President, VHB·Hickling (1991-1992)
- Partner, VHB Research & Consulting Inc. (1988-1991)
- President, Heeney Associates (1987)
- Senior Analyst, Ontario Waste Management Corporation (1982-1986)
- Consultant, Middleton Associates (1980-1982)
- Project Analyst, Grande Prairie School District Energy Conservation Program (1979-1980)

PROFESSIONAL QUALIFICATIONS

Master of Environmental Design (Environmental Science), University of Calgary (1980)

Bachelor of Science, University Scholar, McGill University (1977)

APPEARANCES

1992	Joint Board, North Simcoe Waste Management landfill EA, on behalf of the North Simcoe Waste Management Association regarding evaluation methods in environmental assessment
2003	Ontario Energy Board, on behalf of Enbridge Gas Distribution Inc. regarding their DSM framework and incentive mechanisms
2005	Ontario Energy Board, on behalf of the Canadian Energy Efficiency Alliance on DSM/CDM and the 2006 Electricity Distributors Rate Case
2005	Ontario Energy Board, on behalf of Low-Income Energy Network on the TRC Guide in EB-2005-0523

SELECTED PROJECTS

Strategic/business planning

- BC Hydro. Development of a comprehensive framework for the management of low-income customers including DSM and customer care. Project manager.
- Ontario Power Authority. Development of an input-output model which calculated green employment in the Ontario economy as a result of particular energy efficiency, energy conservation and demand management programs and policies. With Dr. Atif Kibursi. Project manager.
- Energy Efficiency Office, City of Toronto. Development of the Report on the Development of the Energy Plan for Toronto. Project manager.
- Social Housing Services Corporation. Development of strategies for CDM program options with various partners including CMHC, OPA, NRCan and other natural gas and electric utilities.
- Conservation Bureau. Conducted a residential fuel choice study involving a review of existing models and forecasts and the development of scenarios for residential fuel-substitution from electricity to natural gas in Ontario. Project manager.

- Conservation Bureau. Provision of guidance on business planning and strategy related to the planning, coordination and reporting functions of the Bureau. Senior technical advisor.

- Energy Efficiency Office, City of Toronto. Development of a Sustainable Energy Business Plan for the Energy Efficiency Office for 2002. Project manager.

- City of Toronto. Development of the City of Toronto's Implementation Plan for the Environmental Plan. Senior advisor.

- CN Rail. Development of a business strategy for the implementation of an environmental management system for facilities across North America in partnership with Retech. Project manager.

- Brewers of Ontario. Development and implementation of a business strategy for enhancement and recognition of environmental performance in packaging. Senior advisor.

- Brewers of Ontario. Senior policy advisor on the development of an environmental strategy including opportunities for reducing energy use and emissions in new facilities and vehicles.

DSM/CDM planning, program development and implementation

- Toronto Catholic District School Board. Design and implementation of the Energy Drill demand response pilot program in three boards and eight schools across the GTA. Program funded by the Ontario Power Authority and in partnership with the City of Toronto, Toronto Hydro, Milton Hydro, Toronto Catholic District School Board, Halton District School Board and the Halton Catholic District School Board. Senior technical advisor.

- Milton Hydro. Design and implementation of Milton Hydro's Energy Drill pilot demand response program. Project manager.

- Conservation Bureau. Development of low-income program options. Senior technical advisor.

- Development of 2006 CDM plans (post third tranche) for Milton Hydro and Burlington Hydro. Project manager.

- Development of 2005 CDM Plans (third tranche) for Milton Hydro, Brantford Power, Brant County Power, Burlington Hydro and Kitchener-Wilmot Hydro. Project manager.

- Milton Hydro. Senior technical advisor in the preparation of Milton Hydro's 2004 DSM Plan (with Fraser & Company).

- Toronto Hydro. Senior technical advisor in the investigation of options for Toronto Hydro to reduce customers' bills including an illustrative approach for 2003 to CDM (with Fraser & Company).

- Toronto Hydro and Milton Hydro. Senior technical advisor in the identification and evaluation of opportunities for DSM for local distribution companies (with Fraser & Company).

- Energy Efficiency Office, City of Toronto. Identification and evaluation of opportunities for strengthening partnerships with Toronto Hydro through joint work in DSM. Project manager.

- Canadian Gas Association and City of Toronto. Senior advisor in the development of a concept and successful proposal to the Climate Change Action Fund for a series of energy efficiency workshops across Canada.

- Ontario Hydro. Comparison of gas-fired and electric commercial chillers. Project manager.

- Ontario Ministries of Energy, Environment and Transportation. Reducing energy use and emissions in Ontario's transportation sector. Project manager.

- Ontario Ministry of Energy. Compressed natural gas market potential in Southwestern Ontario. Project manager.

- Canada Mortgage and Housing Corporation. Implications of energy retrofit on municipal by-laws. Project manager.

- Ontario Hydro. Advisor on the impact of alternative energy areas on the bulk electricity system.

- Ontario Ministry of Housing. Senior advisor on the energy impact of urban development standards.

Program/portfolio evaluation, measurement and verification in DSM/CDM

- Ontario Power Authority. Evaluation of the Powerstream and Veridian peaksaver Neighbour Referral Program. Work is on-going and involves developing an Evaluation Plan for conducting process and impact evaluations and implementing the evaluation activities. Process and impacts evaluations being conducted include: a survey of program participants, non-participants and those referred and interviews with LDC program staff to evaluate the design of the program and why customers did or did not participate; analysis of the tracking sheets, and other process documents, to evaluate the processes employed by the LDCs; and calculating the cost per referral to the program including and excluding incentives. Project manager.

- Burlington Hydro. Prepared the CDM portfolio evaluation for Burlington Hydro's 2005 CDM portfolio and the regulatory approvals application to obtain post-third tranche 2006 CDM funding for new program initiatives. OEB application was successful. Worked on the evaluation of the 2006 and 2007 CDM portfolios. Work involved cost effectiveness testing (comparing actuals to forecast), an assessment of the process for program delivery and recommendations for the future, as part of OEB annual CDM filings. Project manager.

- Milton Hydro. Prepared the CDM portfolio evaluation for Milton Hydro's 2005 CDM portfolio and the regulatory approvals application to obtain post-third tranche 2006 CDM funding. Prepared the filing for the OEB on program evaluation for the 2007 portfolio, which involves cost effectiveness testing (comparing actuals to forecast) for the programs approved under the supplemental funding application, an assessment of the process for program delivery and recommendations for the future. Project manager.

- Kilowatt Corporation. Preparation of financial evaluations of optional program designs for various CDM programs for the Ontario commercial sector. Work is ongoing. Project manager.

- Burlington Hydro. Developed a monitoring and reporting tool for Burlington Hydro for each of their 2005-2008 CDM programs. This tool was developed to assist Burlington Hydro to track resources and savings from each of their programs and to assist in the preparation of quarterly and annual CDM reports to the OEB. Project manager.

- Social Housing Services Corporation. Work involved the development of a computer-based financial tool to optimize and track the financial contributions of participating funders. Project Manager.

- Ontario Power Authority. Assisted the OPA to design and launch the $400M program for LDC CDM by developing a tool for use by LDCs and the OPA to track and report on savings and other performance metrics of CDM programs. Senior advisor.

- Canadian Gas Association. Work involved the preparation of a program evaluation prepared for CGA on the success of the workshop programs conducted by various natural gas LDCs across Canada to increase awareness regarding conservation and renewables among building owners and managers, engineers and architects, and municipalities. The evaluation was based on questionnaires and personal interviews. Senior advisor.

- Milton Hydro. Design of pre-and post seminar questionnaires to evaluate the success of the CDM awareness program for general service customers. Work involved the design and delivery of questionnaires to participants to evaluate awareness effectiveness and interest in participation in Milton Hydro's DR programs. Project manager.

- Enbridge Gas Distribution. With Navigant consulting, provided advice on improvements to Enbridge's DSM framework that included its evaluation and audit protocols. Senior Advisor.

- Expert CDM evaluation witness on behalf of Low-Income Energy Network at the OEB on the appropriate evaluation framework for CDM including how to calculate the TRC (free-riders, measure life, attribution, etc), the nature of any audit required and the treatment of input assumptions approvals by the OEB.

- Expert DSM evaluation witness on behalf of Enbridge Gas Distribution at the OEB on the appropriate DSM framework, including the evaluation framework. T his included how to calculate the TRC (free riders, attribution, overall treatment of input assumptions etc), SSM, the role of the Audit Subcommittee and Consultative, the audit and audit protocol.

DSM/CDM best practices

- Low-Income Energy Network. Preparation of written evidence, oral testimony and input to argument for best practices for TRC calculations for low-income programs. Project manager.

- Enbridge Gas Distribution. Senior policy advisor in survey on regulated incentive mechanisms and the survey on best practices in regulated DSM in North America with Navigant.

- Canadian Energy Efficiency Alliance. Provision of written evidence, oral testimony and input to argument in OEB's 2006 EDR proceeding on best practices for electric utilities on CDM. Project manager.

- Enbridge Gas Distribution. Senior advisor in the development of the DSM regulatory framework and incentive mechanism with Navigant.

Training

- Design Science Laboratory and UN International School in New York City. Facilitated a diverse group of participants in the Design Science Laboratory held at the United Nations and the United Nations International School in New York City. The ten day program provided the participants with classroom interactive instruction on planning methodologies, the millenium development goals (MDGs), and facilitated the group in developing strategies for meeting the goals. Strategies developed were presented to United Nations representatives, and published in a book. Senior trainer.

- Milton Hydro. Design and delivery of a seminar series to the utility's business customers on the electricity market, smart meters and demand response and opportunities for the facilities to save energy. Project manager and senior trainer.

- Burlington Hydro. Design and delivery of customized one on one staff training on calculating the Total Resource Cost Test for the utility's conservation and demand management portfolio and to meet regulatory reporting requirements. Project manager and senior trainer.

- CIDA. Building capacity for climate change in Cuba. With the University of Toronto development and delivery of training modules for senior management in the Ministry of Basic Industry on strategic planning and business development for implementing programs such as energy conservation and renewable programs to address climate change. Project manager.

- BAIF and IDRC. Member of a three member training team for a week-long course delivered to BAIF in Pune, India on monitoring and evaluation of development projects on behalf of the International Development and Research Centre. Senior trainer.

- Beijing Environmental Monitoring Centre. Member of a three member team of trainers that delivered a course to the Beijing Environmental Monitoring Centre in Beijing China on developing inventories of greenhouse gas emissions and the development of strategies for reducing emissions. The project consisted of two training sessions of approximately one week each. In the first, concepts and methodologies were provided to staff of the BEMC in order to allow them to develop a preliminary inventory and strategies. A second session, four months later, involved working with the staff to elaborate upon and refine their work on an emissions inventory for the Province of Beijing. Mr. Heeney assisted the members of the Chinese team focusing primarily on transportation energy use and emissions, and he presented results of the work at a conference of Chinese government representatives in Beijing.

specializing in industrial ecology and strategic management
providing environmental and energy consulting to private, public and non-governmental organizations

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