uniongas
A Spectra Energy Company

March 30, 2009

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

Re: 2009 Demand Side Management Input Assumptions - Chapter 5 - EB-2006-0021

Dear Ms. Walli:

Please find attached the 2009 Demand Side Management ("DSM") input assumptions for Union Gas ("Union") as per Chapter 5 of EB-2006-0021. The input assumptions were jointly prepared by Enbridge Gas Distribution ("Enbridge") and Union. The schedule provides the input assumptions for the various equipment and technologies that apply for each utility. Also attached is the supporting documentation including:

Appendix A - Custom Resource Acquisition Technologies - Measure life assumptions
Appendix B - Substantiation documents

Union's proposed 2009 input assumptions follow the comments Union submitted on the draft report titled, "Measures and Assumptions for Demand Side Management Planning", which was prepared by Navigant Consulting Inc. (EB-2008-0346).

Similar to 2008, Union has not included spillover values for 2009. However, as noted in Union's comments on the Navigant Report, spillover is a valuable measure and it should be discussed prior to the next DSM framework.

Union's Evaluation and Audit Consultation ("EAC") has not reviewed the proposed 2009 input assumptions. While Union had intended to send a draft of the 2009 assumptions to the EAC prior to this submission, given the time spent reviewing and commenting on the Navigant Report on February 6, 2009, Union only recently completed the 2009 input assumptions.

Further, in 2008 Union and the EAC agreed to provide the 2009 input assumptions to the Board by the end of March 2009. There was insufficient time to discuss the assumptions with the EAC prior to filing the assumptions with the Board.

While the EAC has not reviewed the input assumptions, Union believes it is important to maintain our commitment to file the 2009 input assumptions by March 31. In addition, Union has started the 2009 DSM programs and it is imperative that we finalize the 2009 input assumptions as soon as possible.

Yours truly,

[original signed by]

Chris Ripley
Manager, Regulatory Applications

cc: Julie Girvan, CCC
Vince DeRose, CME
Kai Millyard, GEC

Appendix A
2009 DSM Input Assumptions
March 26, 2009

2009 DSM Input Assumptions - March 26, 2009

Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Resource Savings Assumptions Natural Gas	 Electricity	 Water	Equipment Life	Incremental Cost		Free Ridership	Reference
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	RESIDENTIAL NEW CONSTRUCTION										
1	Tankless Water Heater	Storage Tank Water	base	237	-	-	20	-	$694	2%	As approved in EB 2008-0384 and 0385.
2a	Energy Star Home (version 3)	Home built to OBC 2006	weather	1,018	1,450	-	25	-	$4,701	5%	As approved in EB 2008-0384 and 0385.
2b	Energy Star Home (version 4)	Home built to OBC 2006 as of Jan 1, 2009	weather	881	734	-	25	-	$4,275	5%	As submitted with 2010 Assumptions.
	RESIDENTIAL EXISTING HOMES										
3a	Enhanced Furnace (ECM only)	Mid-Efficiency Furnace	weather	-65	730	-	18	-	$550	15%	As per EB-2008-0384 and 0385
3b	Enhanced Furnace (Furnace only) & High Efficiency Furnace	Mid-Efficiency Furnace	weather	385	-	-	18	-	$650	90%	As per EB 2008-0384 and 0385. Updated to reflect audit recommendation from Summit Blue Study (2007-65%, 2008 - 82%, 2009 - 90%)
4	Faucet Aerator (kitchen, distributed, 1.5 GPM)	Average existing stock, 2.5 GPM	base	38	-	7,797	10	$1	-	Union 33% EGD 31%	As submitted with 2010 Assumptions. Navigant savings values and updated incremental cost based on EGD purchase costs. Measure life and FR as per EB 2008-0384 and 0385.
5	Faucet Aerator (bathroom, distributed, 1.5 GPM)	Average existing stock, 2.2 GPM	base	10	-	2,004	10	$1	-	Union 33% EGD 31%	As submitted with 2010 Assumptions. Navigant savings values. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
6	Low-Flow Showerhead (Per unit, distributed, 1.5 GPM)	Average existing stock, 2.2 GPM	base	33	-	6,334	10	$4	-	10%	As submitted with 2010 Assumptions. Navigant savings values. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
7	Low-Flow Showerhead (Per unit, distributed, 1.25 GPM)	Average existing stock, 2.2 GPM	base	60	-	10,570	10	$4	-	10%	as above
	~~Low-Flow Showerhead (Per household, installed, 1.25 GPM replacing 2.0 GPM)~~	~~2.0 GPM showerhead~~	~~base~~	~~33~~	~~-~~	~~8,900~~	~~10~~	~~-~~	~~$19~~	~~10%~~	no longer applicable
8a	Low-Flow Showerhead (Per household, installed, 1.25 GPM replacing 2.0-2.5 GPM)	2.0 -2.5 GPM showerhead (2.25 GPM)	base	66	-	10,886	10	-	$19	10%	As submitted with 2010 Assumptions. Updated gas savings based on EGD load research and water savings as per Navigant. Incremental cost based on EGD purchase and installation. Measure life and FR as per EB 2008-0384 and 0385
8b	Low-Flow Showerhead (Per household, installed, 1.25 GPM replacing 2.6 + GPM)	2.6 + GPM showerhead (3.0 GPM)	base	116	-	17,168	10	-	$19	10%	as above
9	Pipe Insulation	Water Heater w/o pipe insulation	base	25	-	-	10	$1	$4	4%	As submitted with 2010 Assumptions. Savings and measure life updated as per Navigant. Incremental costs and FR as per EB 2008-0384 and 0385
10	Programmable Thermostat	Standard Thermostat	weather	146	123	-	15	$50		43%	As submitted with 2010 Assumptions. Updated using Navigant 2010 gas savings values. Navigant electricity savings adjusted to reflect market penetration of central air conditioning. Incremental cost, measure life and FR as per EB 2008-0384 and 0385.
11	Tankless Water Heater	Storage Tank Water Heater	base	237	-	-	20	-	$694	2%	As approved in EB 2008-0384 and 0385
12	Reflector Panels	Radiant heat w/o reflector panels	weather	143	-	-	18	-	$238	0%	As submitted with 2010 Assumptions. Updated incremental costs represent cost of panels + shipping. Savings, measure life and free ridership as per EB 2008-0384 and 0385.

				Resource Savings Assumptions							
Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Natural Gas	Electricity	Water	Equipment Life	Incremental Cost		Free Ridership	Reference
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%	
	LOW INCOME										
13	Faucet Aerator (kitchen, distributed, 1.5 GPM)	Average existing stock, 2.5 GPM	base	38	-	7,797	10	$1	-	1%	As submitted with 2010 Assumptions. Navigant savings values and updated incremental cost based on EGD purchase costs. Measure life and FR as per EB 2008-0384 and 0385.
14	Faucet Aerator (bathroom, distributed, 1.5 GPM)	Average existing stock, 2.2 GPM	base	10	-	2,004	10	$1	-	1%	As submitted with 2010 Assumptions. Navigant savings values. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
15	Low-Flow Showerhead (Per unit, distributed, 1.5 GPM)	Average existing stock, 2.2 GPM	base	33	-	6,334	10	$4	-	Union: 1% EGD: 5%	As submitted with 2010 Assumptions. Navigant savings values. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
16	Low-Flow Showerhead (Per unit, distributed, 1.25 GPM)	Average existing stock, 2.2 GPM	base	60	-	10,570	10	$4	-	Union: 1% EGD: 5%	as above
	~~Low-Flow Showerhead (Per household, Installed, 1.25 GPM)~~	~~2.0 GPM showerhead~~	~~base~~	~~33~~	-	~~8,900~~	~~10~~	-	~~$15~~	~~1% / 5%~~	no longer applicable
17a	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.0 -2.5 GPM showerhead	base	66	-	10,886	10	-	$19	Union: 1% EGD: 5%	As submitted with 2010 Assumptions. Updated gas savings based on EGD load research and water savings as per Navigant. Incremental cost based on EGD purchase and installation. Measure life and FR as per EB 2008-0384 and 0385
17b	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.6 + GPM showerhead	base	116	-	17,168	10	-	$19	Union: 1% EGD: 5%	as above
18	Pipe Insulation	Water Heater w/o pipe insulation	base	25	-	-	10	-	$4	1%	As submitted with 2010 Assumptions. Savings and measure life updated as per Navigant. Incremental costs and FR as per EB 2008-0384 and 0385
19	Programmable Thermostat	Standard Thermostat	weather	146	123	-	15	-	$69	1%	As submitted with 2010 Assumptions. Updated using Navigant 2010 gas savings values. Navigant electricity savings adjusted to reflect market penetration of central air conditioning. Incremental cost updated to reflect utility purchase cost plus installation. Measure life and FR as per EB 2008-0384 and 0385.
20	Weatherization	Existing home sample	weather	1,234	255	-	23	-	$2,667	0%	As submitted with 2010 Assumptions. Savings and incremental costs updated based on 2 years of program data. Measure life and FR as per EB 2008-0384 and 0385
	COMMERCIAL NEW BUILDING CONSTRUCTION										
21	Condensing Gas Water Heater	Storage Tank Water Heater	base	1,543	-	-	13	-	$2,230	5%	As submitted with 2010 Assumptions. Savings, measure life and incremental cost as per Navigant. FR as per EB 2008-0384 and 0385.
22	Rooftop Unit	Standard Rooftop Unit	weather	300	-	-	15	-	$375	5%	As submitted with 2010 Assumptions. Updated savings. Measure life and incremental cost as per Navigant. FR as per EB 2008-0384 and 0385.
23	Tankless Water Heater 50 - 150 USG/day, 84% thermal efficiency	Storage Tank Water Heater 91 gal tank, 80% efficiency	base	221	-	-	20	-	-$1,570	2%	As submitted with 2010 Assumptions. Savings updated. Incremental cost as per Navigant. Measure life and FR as per EB-2008-0384 and 0385

Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Resource Savings Assumptions Natural Gas	 Electricity	 Water	Equipment Life	Incremental Cost		Free Ridership	Reference
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%	
24a	Infrared Heaters (0 - 49,999 BTUH)	Unit Heater	weather	0.0102 m3/BTUH	236	-	20	-	\$0.009/10^{3} BTUH/hr	33%	As submitted with 2010 Assumptions. Electricity savings and incremental costs updated. Gas savings, measure life and FR as per EB-2008-0384 and 0385
24b	Infrared Heaters (49,9099 - 164,999 BTUH)	Unit Heater	weather	0.0102 m3/BTUH	534	-	20	-	\$0.009/10^{3} BTUH/hr	33%	as above
24c	Infrared Heaters (>165,000 BTUH)	Unit Heater	weather	0.0102 m3/BTUH	833	-	20	-	\$0.009/10^{3} BTUH/hr	33%	as above
25a	Demand Control Kitchen Ventilation (0 - 4999 CFM)	Ventilation without DCKV	weather	3,972	7,190	-	15	-	$5,000	5%	As submitted with 2010 Assumptions. Savings updated. Measure life as per Navigant. Incremental cost and FR as per E 2008-0384 and 0385.
25b	Demand Control Kitchen Ventilation (5000 - 9999 CFM)	Ventilation without DCKV	weather	6,467	22,791	-	15	-	$10,000	5%	as above
25c	Demand Control Kitchen Ventilation (10000 - 15000 CFM)	Ventilation without DCKV	weather	11,838	40,217	-	15	-	$15,000	5%	as above
26	Energy Recovery Ventilators (ERV)	Ventilation without ERV	weather	3.75 m3/CFM	-	-	20	-	$3.00/CFM	5%	As submitted with 2010 Assumptions. Savings, measure life and incremental costs as per Navigant. FR as per EB 2008-384 and 0385
27	Heat Recovery Ventilator (HRV)	Ventilation without HRV	weather	3.49 / CFM	-	-	20	-	$3.40/CFM	5%	As submitted with 2010 Assumptions. Savings and measure life as per Navigant. Incremental costs and FR as per EB 2008-0384 and 0385
28	Condensing Boilers (90% estimated seasonal efficiency)	Non-condensing Boiler (76% estimated seasonal efficiency)	base	0.0119 m3/BTUH	-	-	25	-	\$12.00/10^{3} BTUH	5%	As submitted with 2010 Assumptions. Incremental cost updated as per Navigant. Savings, measure life and FR as per EB 2008-0384 and 0385
29	Destratification Fans	No destratification fans	weather	7,020	-123	-	15	-	$7,021	10%	As submitted with 2010 Assumptions. Savings updated based on EGD research. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
30a	Programmable Thermostats (Warehouse, Recreation, Agriculture, Industrial)	Standard thermostat	weather	674	524	-	15	$40	-	20%	As submitted with 2010 Assumptions. Savings updated based on 2 sub sectors. Incremental costs as per utility purchase price. Measure life and FR as per EB 2008-038 nd 0385.
30b	Programmable Thermostats (Other, e.g., Retail, Office)	Standard thermostat	weather	191	246	-	15	$40	-	20%	as above
31	Energy Efficient Fryers	Standard fryer	base	916	-546	-	7	$1,500	-		As submitted with 2010 Assumptions.
	COMMERCIAL EXISTING BUILDINGS										
31	Condensing Gas Water Heater	Storage Tank Water Heater	base	1,543	-	-	13	-	$2,230	5%	As submitted with 2010 Assumptions. Savings updated. Measure life and incremental cost as per Navigant. FR as per EB 2008-0384 and 0385
	~~2a. Faucet Aerator~~	~~Average Existing Stock~~	~~base~~	~~14~~	~~-~~	~~6,520~~	~~10~~	~~$2~~	~~-~~	~~10%~~	No longer Applicable
33a	Faucet Aerator (kitchen, installed, 1.5 GPM)	Average existing stock	base	26	-	5,377	10	$2	-	10%	As submitted with 2010 Assumptions. Navigant savings values. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
33b	Faucet Aerator (kitchen, installed, 1.0 GPM)	Average existing stock	base	39	-	8,072	10	$2	-	10%	As submitted with 2010 Assumptions. Navigant savings values adjusted for 1.0 GPM aerator. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.

Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Resource Savings Assumptions			Equipment Life	Incremental Cost		Free Ridership	Reference
				Natural Gas	Electricity	Water					
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%	
34a	Faucet Aerator (bathroom, installed, 1.5 GPM)	Average existing stock	base	7	-	1,382	10	$2	-	10%	As submitted with 2010 Assumptions. Navigant savings values. Incremental cost updated to reflect utility purchase. Measure life and FR as per EB 2008-0384 and 0385.
34b	Faucet Aerator (bathroom, installed, 1.0 GPM)	Average existing stock	base	11	-	2,371	10	$1.50	-	10%	As submitted with 2010 Assumptions. Navigant savings values adjusted for 1.0 GPM aerator. Incremental cost updated to reflect utility purchase. Measure life and FR as per EB 2008-0384 and 0385.
35	High Efficiency Furnace	Mid-Efficiency Furnace	weather	5.1 per 1000 BTUH furnace capacity	-	-	18	-	$650	17.50%	As per EB 2008-0384 and 0385. This is the last year for this measure due to a change in furnace standards.
	~~4. Low-Flow Showerhead (Contractor installed per multi-res. Household).~~	~~Average Existing Stock~~	~~base~~	~~115~~	~~-~~	~~30,966~~	~~10~~	~~-~~	~~15~~	~~10%~~	No longer Applicable
36	Low-Flow Showerhead (Per unit, distributed, 1.5 GPM)	Average existing stock	base	30	-	5,345	10	$4	-	10%	As submitted with 2010 Assumptions. Navigant savings updated to reflect percentage of showers taken with efficient units. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
37	Low-Flow Showerhead (Per unit, distributed, 1.25 GPM)	Average existing stock	base	54	-	8,916	10	$4	-	10%	as above
38a	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.0 -2.5 GPM showerhead (2.25 GPM)	base	53	-	9,078	10	$17	-	10%	As submitted with 2010 Assumptions. Navigant savings updated to reflect percentage of showers taken with efficient units. Incremental cost updated to reflect utility purchase and installation costs. Measure life and FR as per EV 2008-0384 and 0385.
38b	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.6 + GPM showerhead and above (3.0GPM)	base	87	-	14,341	10	$17	-	10%	as above
39a	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	2.0 -2.5 GPM showerhead (2.25 GPM)	base	28	-	5,197	10	$17	-	10%	as above
39b	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	2.6 -3.0 GPM GPM showerhead (2.75 GPM)	base	55	-	9,490	10	$17	-	10%	as above
39c	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	3.1 - 3.5 GPM showerhead (3.25 GPM)	base	79	-	13,250	10	$17	-	10%	as above
39d	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	3.6 GPM and above (3.6 GPM)	base	91	-	15,114	10	$17	-	10%	as above
40a	Low-Flow Showerhead (Per household, Installed, 2.0 GPM)	2.6 -3.0 GPM GPM showerhead (2.75 GPM)	base	4	-	1,727	10	$17	-	10%	As submitted with 2010 Assumptions. Navigant savings updated to reflect 2.0 GPM replacement unit and percentage of showers taken with efficient units. Incremental cost updated to reflect utility purchase and installation costs. Measure life and FR as per EV 2008-0384 and 0385.
40b	Low-Flow Showerhead (Per household, Installed, 2.0 GPM)	3.1 o 3.5 GPM (3.25 GPM)	base	28	-	5,487	10	$17	-	10%	as above
40c	Low-Flow Showerhead (Per household, Installed, 2.0 GPM)	3.6 GPM and above (3.6 GPM)	base	40	-	7,351	10	$17	-	10%	as above
41a	Pre-Rinse Spray Nozzle (1.24 GPM) (Full Service)	standard pre-rinse spray nozzle (3.0 GPM)	base	931	-	182,000	5	$100	-	12.4%	As submitted with 2010 Assumptions. Savings and free ridership adjusted as per Union Gas research with PA Consulting. Measure life and incremental cost as per EB 2008-0384 and 0385.
41b	Pre-Rinse Spray Nozzle (1.24 GPM) (Limited)	standard pre-rinse spray nozzle (3.0 GPM)	base	278	-	55,000	5	$100	-	12.4%	as above
41c	Pre-Rinse Spray Nozzle (1.24 GPM) (Other)	standard pre-rinse spray nozzle (3.0 GPM)	base	272	-	53,000	5	$100	-	12.4%	as above

				Resource Savings Assumptions							
Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Natural Gas	Electricity	Water	Equipment Life	Incremental Cost		Free Ridership	Reference
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%	
42a	Pre-Rinse Spray Nozzle (0.64 GPM) (Full Service)	standard pre-rinse spray nozzle (3.0 GPM)	base	1,286	-	252,000	5	$88	-	0%	As submitted with 2010 Assumptions. Savings and free ridership adjusted as per Union Gas research with PA Consulting. Incremental cost as per Union Gas purchase price. Measure life as per EB 2008-0384 and 0385.
42b	Pre-Rinse Spray Nozzle (0.64 GPM) (Limited)	standard pre-rinse spray nozzle (3.0 GPM)	base	339	-	66,400	5	$88	-	0%	as above
42c	Pre-Rinse Spray Nozzle (0.64 GPM) (Other)	standard pre-rinse spray nozzle (3.0 GPM)	base	318	-	62,200	5	$88	-	0%	as above
43a	Programmable Thermostats (Warehouse, Recreation, Agriculture, Industrial)	Standard thermostat	weather	674	524	-	15	$40	-	20%	As submitted with 2010 Assumptions. Savings updated based on 2 sub sectors. Incremental costs as per utility purchase price. Measure life and FR as per EB 2008-038 and 0385.
43b	Programmable Thermostats (Other, e.g., Retail, Office)	Standard thermostat	weather	191	246	-	15	$40	-	20%	as above
44	Rooftop Unit	Standard Rooftop Unit	weather	300	-	-	15	-	$375	5%	As submitted with 2010 Assumptions. Updated savings. Measure life and incremental cost as per Navigant. FR as per EB 2008-0384 and 0385.
45	Tankless Water Heater 50 - 150 USG/day, 84% thermal efficiency	Storage Tank Water Heater 91 gal tank, 80% efficiency	base	221	-	-	20	-	-$1,570	2%	As submitted with 2010 Assumptions. Savings updated. Incremental cost as per Navigant. Measure life and FR as per EB-2008-0384 and 0385.
46a	Enhanced Furnace - up to 299 mbtu/h (ECM only)	Mid-Efficiency Furnace	weather	-0.87 per 1000 BTUH	9.7 per 1000 BTUH	-	18	-	$550	10%	As per EB 2008-0384 and 0385. This is the last year for this measure due to a change in furnace standards.
46b	Enhanced Furnace - up to 299 mbtu/h (furnace only)	Mid-Efficiency Furnace	weather	5.1 per 1000 BTUH furnace capacity	-	-	18	-	$650	30%	as above
47	Heat Recovery Ventilator (HRV)	Ventilation without HRV	weather	3.77 / CFM	-	-	20	-	$3.40/CFM	5%	As submitted with 2010 Assumptions. Savings and measure life as per Navigant. Incremental costs and FR as per EB 2008-0384 and 0385.
48	Energy Recovery Ventilators (ERV)	Ventilation without ERV	weather	3.95 m3/CFM	-	-	20	-	$3.00/CFM	5%	As submitted with 2010 Assumptions. Savings, measure life and incremental costs as per Navigant. FR as per EB 2008-0384 and 0385.
49	Condensing Boilers	Non-condensing Boiler (76% estimated seasonal efficiency)	base	0.0119 m3/BTUH	-	-	25	-	$12.00/10^3 BTUH	5%	As submitted with 2010 Assumptions. Incremental cost updated as per Navigant. Savings, measure life and FR as per EB 2008-0384 and 0385.
50a	Infrared Heaters (0 - 49,999 BTUH)	Unit Heater	weather	0.0102 m3/BTUH	236	-	20	-	$0.009/10^3 BTUH/hr	33%	As submitted with 2010 Assumptions. Electricity savings and incremental costs updated. Gas savings, measure life and FR as per EB-2008-0384 and 0385.
50b	Infrared Heaters (49,9099 - 164,999 BTUH)	Unit Heater	weather	0.0102 m3/BTUH	534	-	20	-	$0.009/10^3 BTUH/hr	33%	as above
50c	Infrared Heaters (>165,000 BTUH)	Unit Heater	weather	0.0102 m3/BTUH	833	-	20	-	$0.009/10^3 BTUH/hr	33%	as above

				Resource Savings Assumptions								
Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Natural Gas	Electricity	Water	Equipment Life	Incremental Cost		Free Ridership		Reference
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%		
51a	Demand Control Kitchen Ventilation (0 - 4999 CFM)	Ventilation without DCKV	weather	3,972	7,231	-	15	-	$5,000	5%		As submitted with 2010 Assumptions. Savings updated. Measure life as per Navigant. Incremental cost and FR as per E 2008-0384 and 0385.
51b	Demand Control Kitchen Ventilation (5000 - 9999 CFM)	Ventilation without DCKV	weather	10,347	23,051	-	15	-	$10,000	5%		as above
51c	Demand Control Kitchen Ventilation (10000 - 15000 CFM)	Ventilation without DCKV	weather	18,941	40,692	-	15	-	$15,000	5%		as above
52a	Air Curtains (Single Door)		weather	2,191	172	-	15	-	$1,650	5%		As submitted with 2010 Assumptions. Gas savings updated as per Navigant. Electriity savings, measure life, incremental cost and FR as per EB 2008-0384 and 0385.
52b	Air Curtains (Double Door)		weather	4,661	1,023	-	15		$2,500	5%		as above
53	Destratification Fans	No destratification fans	weather	7,020	-123	-	15	-	$7,021	10%		As submitted with 2010 Assumptions. Savings updated based on EGD research. Measure life, incremental cost and FR as per EB 2008-0384 and 0385.
54	CEE Qualified Energy Efficient Washers	Conventional top loading washers.	base	222	296	80,000	11	-	$600	10%		As submitted with 2010 Assumptions. Savings updated based on revised Navigant calculation. Measure life as per Navigant. Incremental cost based on EGD route operator data. FR as per EB 2008-0384 and 0385.
55a	Prescriptive School Boilers (Elementary)	Space Heating, Hydronic Boiler with Comb. Eff. Of 80%-82%.	base	10,830	-	-	25	-	$8,646	Union 27% EGD 12%		As submitted with 2010 Assumptions. Savings, measure life and incremental costs as per EB 2008-0384 and 0385. Free ridership as per Board Decision re: 2008 Update.
55b	Prescriptive School Boilers (Secondary)	Space Heating, Hydronic Boiler with Comb. Eff. Of 80%-82%.	base	43,859	-	-	25	-	$14,470	Union 27% EGD 12%		as above
56	Energy Efficient Fryers	Standard fryer	base	916	-546	-	7	$1,500	-			As submitted with 2010 Assumptions.
57a	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 300 MBH 83-84% efficient	base	1,075	-	-	25	-	$3,900	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
57b	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 600 MBH 83-84% efficient	base	1,777	-	-	25	-	$5,800	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
57c	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1000 MBH 83-84% efficient	base	3,136	-	-	25	-	$7,400	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
57d	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1500 MBH 83-84% efficient	base	4,317	-	-	25	-	$5,900	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
58a	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 300 MBH 85-88% efficient	base	1,766	-	-	25	-	$4,500	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
58b	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 600 MBH 85-88% efficient	base	2,290	-	-	25	-	$6,000	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
58c	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1000 MBH 85-88% efficient	base	5,155	-	-	25	-	$10,300	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential

				Resource Savings Assumptions								
Item	Efficient Equipment & Technologies	Base Equipment & Technologies	Load Type	Natural Gas	Electricity	Water	Equipment Life	Incremental Cost		Free Ridership		Reference
				m3	kWh	L	Years	Customer Installed	Contractor Installed	%		
58d	High Efficiency Boilers (DHW) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1500 MBH 85-88% efficient	base	7,095	-	-	25	-	$7,400	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
59a	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 300 MBH 83-84% efficient	weather	2,105	-	-	25	-	$3,900	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
59b	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 600 MBH 83-84% efficient	weather	3,994	-	-	25	-	$5,800	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
59c	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1000 MBH 83-84% efficient	weather	7,310	-	-	25	-	$7,400	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
59d	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1500 MBH 83-84% efficient	weather	11,554	-	-	25	-	$5,900	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
59e	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 2000 MBH 83-84% efficient	weather	16,452	-	-	25	-	$4,950	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
60a	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 300 MBH 85-88% efficient	weather	3,125	-	-	25	-	$4,500	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
60b	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 600 MBH 85-88% efficient	weather	5,930	-	-	25	-	$6,000	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
60c	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1000 MBH 85-88% efficient	weather	10,856	-	-	25	-	$10,300	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
60d	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 1500 MBH 85-88% efficient	weather	17,157	-	-	25	-	$7,400	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential
60e	High Efficiency Boilers (Space) Small Commercial, Large Commercial and Multi-residential	higher efficiency boilers 2000 MBH 85-88% efficient	weather	24,431	-	-	25	-	$7,050	Enbridge: 10/12/20% Union: 10/59/42%		As submitted with 2010 Assumptions. FR for Small Commercial / Large Commercial / Multi-residential

				Resource Savings Assumptions								
Item	**Efficient Equipment & Technologies**	**Base Equipment & Technologies**	**Load Type**	**Natural Gas**	**Electricity**	**Water**	**Equipment Life**	**Incremental Cost**		**Free Ridership**		**Reference**
				m3	**kWh**	**L**	**Years**	**Customer Installed**	**Contractor Installed**	**%**		
	COMMERCIAL/INDUSTRIAL CUSTOM PROJECTS											
	Custom Projects			Actual	Actual	Actual	Actual	-	Actual	By sector from S.B. Report (dated Oct., 2008)		
	Union Gas									**Free Ridership**		
59	Agriculture									0%		as per EB 2008-0384 and 0385
60	Industrial									56%		as per EB 2008-0384 and 0385
61	Commercial									59%		as per EB 2008-0384 and 0385
62	Multi-Residential									42%		as per EB 2008-0384 and 0385
63	New construction									33%		as per EB 2008-0384 and 0385
	Enbridge Gas									**Free Ridership**		
64	Agriculture									40%		as per EB 2008-0384 and 0385
65	Industrial									50%		as per EB 2008-0384 and 0385
66	Commercial									12%		as per EB 2008-0384 and 0385
67	Multi-Residential									20%		as per EB 2008-0384 and 0385
68	New construction									26%		as per EB 2008-0384 and 0385
	OTHER MEASURES									**Free Ridership**		
69	1. CFL (13W)	60W Incandescent	n/a	-	45	-	8	$0.00	-	24%		As submitted with 2010 Assumptions. Incremental cost updated to reflect utility purchase price. Savings, Measure life and FR as per EB 2008-0384 and 0385.
70	2. CFL (23W)	75W Incandescent	n/a	-	49.7	-	8	$0.00	-	24%		as above
		Indicates no input assumption update from EB 2008-0384 and 0385										
		indicates assumption update										
		indicates new measure in 2009										
	See also attached Custom Resource Acqusition Technologies - Measure life assumptions											

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 2009 Input Assumptions

TABLE OF CONTENTS

RESIDENTIAL NEW CONSTRUCTION

TANKLESS WATER HEATERS

Residential New Homes

Efficient Technology & Equipment Description
Tankless water heater (EF = 0.82)
Base Technology & Equipment Description
Storage tank water heater (EF = 0.58)

Resource Savings Assumptions

Natural Gas	**237 m^3**
Natural gas savings claims are based on Exelon Services Report[1]. The consumption data was validated by Energy Technology based on the following: 1. Hourly gas consumption data for Domestic Hot Water (DHW) from Load Research - 645 m^3/year 2. Calculated average efficiency of sample population using data from Natural Resources Canada (NRCan) - 55% thermal efficiency 3. Calculated average litres of DHW based upon average consumption and efficiencies - 179 L/day 4. Used efficiency figures from the Okaloosa study** - 85.4% for tankless 5. Adjusted energy requirement for colder city water than in Okaloosa - inlet temperature 8°C instead of 23.3°C 6. Calculated gas consumption for tank and tankless water heaters based upon our average DHW usage - 415.9m^3/year for tankless versus 645m^3/year as provided by load research Assumptions: 1. Load Research sample population is representative of Enbridge Gas Distribution (EGD) franchise 2. NRCan efficiency and market composition data for Ontario adequately approximates the EGD franchise 3. Calculated efficiency is comparable or higher for colder inlet water so using the Okaloosa measured efficiencies for EGD city water temperatures is conservative 4. The load profile for Okaloosa and EGD approximate each other adequately As approved in EB 2008-0384 & 0385	
Electricity	**kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**20 Years**
Tankless water heaters have an estimated service life of 20 years[2]. Approved in EB 2008-0384 & 0385	
Incremental Cost (Contractor Installation)	**$694**
To validate/update installation costs, research was conducted by the Channel Consultants and Market Development (with manufacturers), across our franchise area to obtain installed costs for both Power Vented 50-gallon tank-type water heaters and tankless water heaters in the residential sector. Twenty-two contractors/installers were contacted to provide installed costs for both types of natural gas water heating;	

[1] Exelon Services Report, December 2002
[2] C. Aguilar, D.J. White, and David L. Ryan, "Domestic Water Heating and Water Heater Energy Consumption in Canada", CBEEDAC, April 2005

as well one retail outlet was visited to validate installation costs if the water heating equipment were purchased through a big box store.

RESULTS

- This research provided average installed costs of:

  Power Vented 50-gallon tank type average installed cost $1956
  Tankless average installed cost $3273

- Assuming a purchase of a second conventional tank-type water heater will be required in 12 years*** at a cost in current dollars of approximately $623 (= $1956/[1.1^12]), the incremental cost of a tankless water heater is $3273 - $1956 - $623 = $694

  As approved in EB 2008-0384 & 0385

Free Ridership	**2 %**
Free ridership rate will remain as filed in EB 2008-0384 & 0385.	

ENERGY STAR FOR NEW HOMES (VERSION 3)

Residential, New Construction

Efficient Technology & Equipment Description
Energy Star for New Homes, version 3, qualified home
Base Technology & Equipment Description
New Home built in Ontario, compliant to OBC-2006, prior to January 1, 2009.

Resource Savings Assumptions

Natural Gas	**1018 m^3**
Gas savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[3] 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. The software used for analysis is HOT2000 version 9.34b. This is the same software that is currently in use for application of the EnerQuality Version 3.0 Energy Star Criteria, which is what's mandatory to evaluate homes for ESNH. A mix of 90% AFUE furnace (weighted 80%) and 80% AFUE combo heater (weighted 20%) was assumed as the base case heating system. The upgrade system was a 92% AFUE. 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[4]	
Electricity	**1450 kWh**
Electrical savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[3] 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.[3] The results were weighted 70% UG South and 30% UG North. The software used for analysis is HOT2000 version 9.34b. This is the same software that is currently in use for application of the EnerQuality Version 3.0 Energy Star Criteria, which is what's mandatory to evaluate homes for ESNH. 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[6]	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**25 years**
Energy Star homes have an estimated service life of 25 years (before major renovations are expected).	
Incremental Cost (Cust. / Contr. Install)	**$4,701**
Cost estimates for the upgrade measures were obtained from HVAC Trades and Builders who are actively building energy star homes. The upgrade costs based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[3].	
Free Ridership	**5 %**
As recommended by Summit Blue and approved in EB 2008-0384 & 0385	

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[3] Based on *Comparison of EnergyStar vs.Ontario Building Code 2006 Energy Use*, spreadsheets, from July and August, 2008, by Bowser Technical Inc.

[4] Conversation with Jennifer Tausman, ESNH files coordinator, NRCAN OEE, July 21, 2008

ENERGY STAR FOR NEW HOMES (VERSION 4)

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.[5] 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[6].

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

[5] Bowser Technical, Inc., Comparison of EnerQuality EnergyStar Version 3.0 & EnergyStar Version 4.0 Vs Ontario Building Code 2009 Energy use, March 10 2009
[6] Jennifer Tausman, ESNH files coordinator, NRCAN OEE, July 21, 2008

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

Southern House[7]

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[8]

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**

[7] 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).
[8] 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..

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/ft2 upgrade from R20 to R25 (add codeboard to 2x6 wall)
$0.30/ft2 upgrade from R25 to R27.5 (increase codeboard thickness)
s $0.00/ft2 upgrade to 2x6 @ 20" c.c. R20 (possible savings)
Roof: $0.60/ft2 upgrade from R40 to R50
Basement: $0.20/ft2 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	

RESIDENTIAL EXISTING HOMES

ENHANCED FURNACE

Residential Existing Homes

Efficient Technology & Equipment Description
High efficiency furnace with ECM.
Base Technology & Equipment Description
Mid efficiency furnace w/o PSC.

Resource Savings Assumptions

Natural Gas **ECM Only** **Furnace Only**	 **- 65 m^3** **385 m^3**
Impact on natural gas use from an ECM and the resulting decrease in savings from a high efficiency furnace are based on the Final Report on ECM Motors by the Canadian Centre for Housing Technology. Using the Enbridge high-efficiency furnace savings number of 385m3, the net gas savings are reduced to 320m3.[1]	
Electricity **ECM Only** **Furnace Only**	 **730 kWh** **0 kWh**
Canadian Centre for Housing Technology – Final Report on the Effects of ECM Furnace Motors on Electricity and Gas Use: Results from the CCHT Research Facility and Projections.[1]	
Water	**n/a L**

Other Input Assumptions

Equipment Life	**18 years**
Enhanced furnaces have an estimated service life of 18 years.[1,2]	
Incremental Cost (Contractor Install) **ECM Only** **Furnace Only**	 **$550** **$650**
Enhanced furnaces have an estimated incremental cost of $1200.[1]	
Free Ridership (Updated) **ECM Only** **Furnace Only**	 **15 %** **90 %**
Free Ridership rate recommended by Summit Blue Consulting[3], excluding spillover.	

[1] Approved in EB 2008-0384 & 0385

[2] ASHRAE Applications Handbook – 2003, Chapter 36 – Owning and Operating Costs, Table 3

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

HIGH EFFICIENCY FURNACE

Residential Existing Homes

Efficient Technology & Equipment Description
High efficiency furnace
Base Technology & Equipment Description
Mid-efficiency furnace

Resource Savings Assumptions

Natural Gas	**385 m^3**
Natural gas savings are based on Enbridge research that indicates the average consumption for a mid-efficiency furnace is 2,430 m3 and 2,045 m3 for a high efficiency furnace, suggesting annual savings of 385 m3 as approved in the Decision for the Enbridge 2006 DSM Plan (EB2005-0001).[1]	
Electricity	**n/a kWh**
Water	**n/a L**

Other Input Assumptions

Equipment Life	**18 years**
High efficiency furnaces have an estimated service life of 18 years.[1, 2]	
Incremental Cost (Contractor Install)	**$650**
The incremental cost is based on a pricing survey of 15 contractors in the Union Gas franchise area. The single incremental cost number is weighted average of Union Gas South (70%) and Union Gas North (30%) average incremental costs.[1]	
Free Ridership (Updated)	**90 %**
Free Ridership rate recommended by Summit Blue Consulting[3], excluding spillover.	

[1] Approved in EB 2008-0384 & 0385

[2] ASHRAE Applications Handbook – 2003, Chapter 36 – Owning and Operating Costs, Table 3

[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.	

[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.	

[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 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	**10 %**
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

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.	
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[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

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.

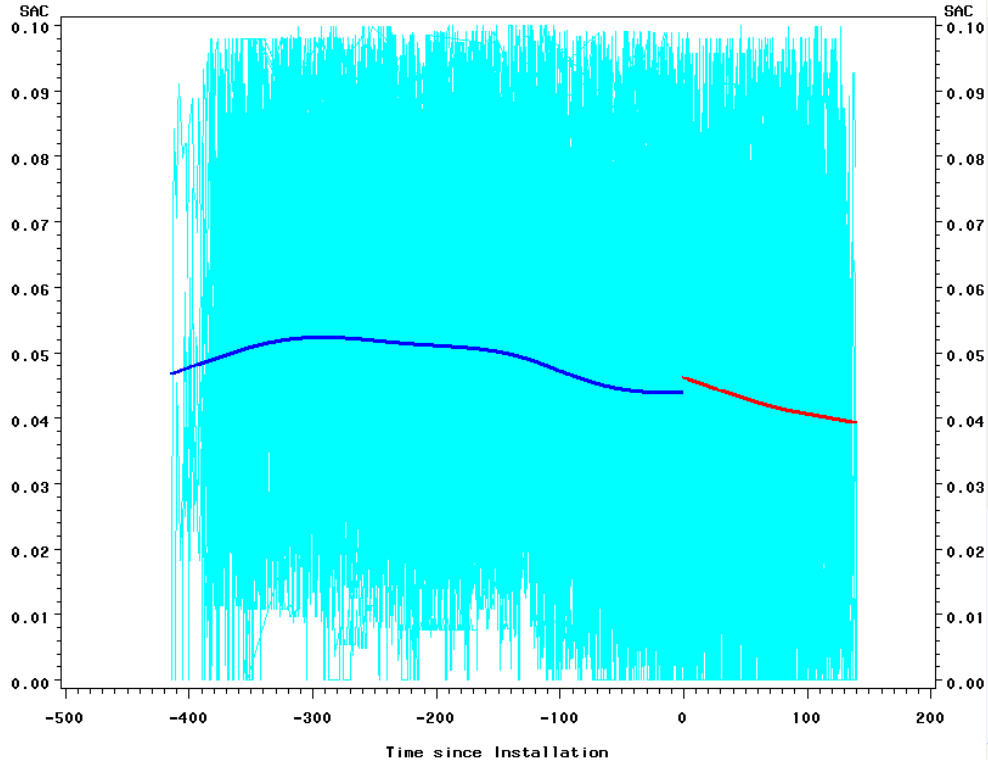
Data was analyzed for 69 households pre and post installation of low-flow shower-heads. Data records began on August 31 2007 until December 31 2008 date. Showerheads were installed between 13 August 2008 and 18 October 2008.
A simple paired t-test (before-after installation) was used to test for the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

MEAN	INTERACTION MODEL 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

                                                      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   SIMPLE MODEL

gpm)					
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.

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.	

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 ^{o}C (60 ^{o}F) [4]
- Average water heater set point temperature: 54 ^{o}C (130 ^{o}F) [5]
- Hot water temperature in outlet pipe: 52 ^{o}C (125 ^{o}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 (^{o}F)
T_{amb} = Ambient temperature around pipe (^{o}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

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 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	

[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, 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

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.	

[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

TANKLESS WATER HEATERS

Residential Existing Homes

Efficient Technology & Equipment Description
Tankless water heater (EF = 0.82)
Base Technology & Equipment Description
Storage tank water heater (EF = 0.58)

Resource Savings Assumptions

Natural Gas	**237 m^3**

Natural gas savings claims are based on Exelon Services Report[9]. The consumption data was validated by Energy Technology based on the following:

1. Hourly gas consumption data for Domestic Hot Water (DHW) from Load Research - 645 m³/year
2. Calculated average efficiency of sample population using data from Natural Resources Canada (NRCan) - 55% thermal efficiency
3. Calculated average litres of DHW based upon average consumption and efficiencies - 179 L/day
4. Used efficiency figures from the Okaloosa study** - 85.4% for tankless
5. Adjusted energy requirement for colder city water than in Okaloosa - inlet temperature 8°C instead of 23.3°C
6. Calculated gas consumption for tank and tankless water heaters based upon our average DHW usage - 415.9m³/year for tankless versus 645m³/year as provided by load research

Assumptions:

1. Load Research sample population is representative of Enbridge Gas Distribution (EGD) franchise
2. NRCan efficiency and market composition data for Ontario adequately approximates the EGD franchise
3. Calculated efficiency is comparable or higher for colder inlet water so using the Okaloosa measured efficiencies for EGD city water temperatures is conservative
4. The load profile for Okaloosa and EGD approximate each other adequately

As approved in EB 2008-0384 & 0385

Electricity	**kWh**
Water	**N/A L**

Other Input Assumptions

Equipment Life	**20 Years**

Tankless water heaters have an estimated service life of 20 years[10]. Approved in EB 2008-0384 & 0385

Incremental Cost (Contractor Installation)	**$694**

To validate/update installation costs, research was conducted by the Channel Consultants and Market Development (with manufacturers), across our franchise area to obtain installed costs for both Power Vented 50-gallon tank-type water heaters and tankless water heaters in the residential sector. Twenty-two contractors/installers were contacted to provide installed costs for both types of natural gas water heating;

[9] Exelon Services Report, December 2002

[10] C. Aguilar, D.J. White, and David L. Ryan, "Domestic Water Heating and Water Heater Energy Consumption in Canada", CBEEDAC, April 2005

as well one retail outlet was visited to validate installation costs if the water heating equipment were purchased through a big box store.

RESULTS

- This research provided average installed costs of:

  Power Vented 50-gallon tank type average installed cost $1956
  Tankless average installed cost $3273

- Assuming a purchase of a second conventional tank-type water heater will be required in 12 years*** at a cost in current dollars of approximately $623 (= $1956/[1.1^12]), the incremental cost of a tankless water heater is $3273 - $1956 - $623 = $694

  As approved in EB 2008-0384 & 0385

Free Ridership	**2 %**
Free ridership rate will remain as filed in EB 2008-0384 & 0385.	

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.

LOW INCOME

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

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 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 (UG/EGD)	**1/5 %**
Free Ridership rate recommended by Summit Blue Consulting.[2] As approved in EB 2008-0384 & 0385.	

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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 %**
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[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**

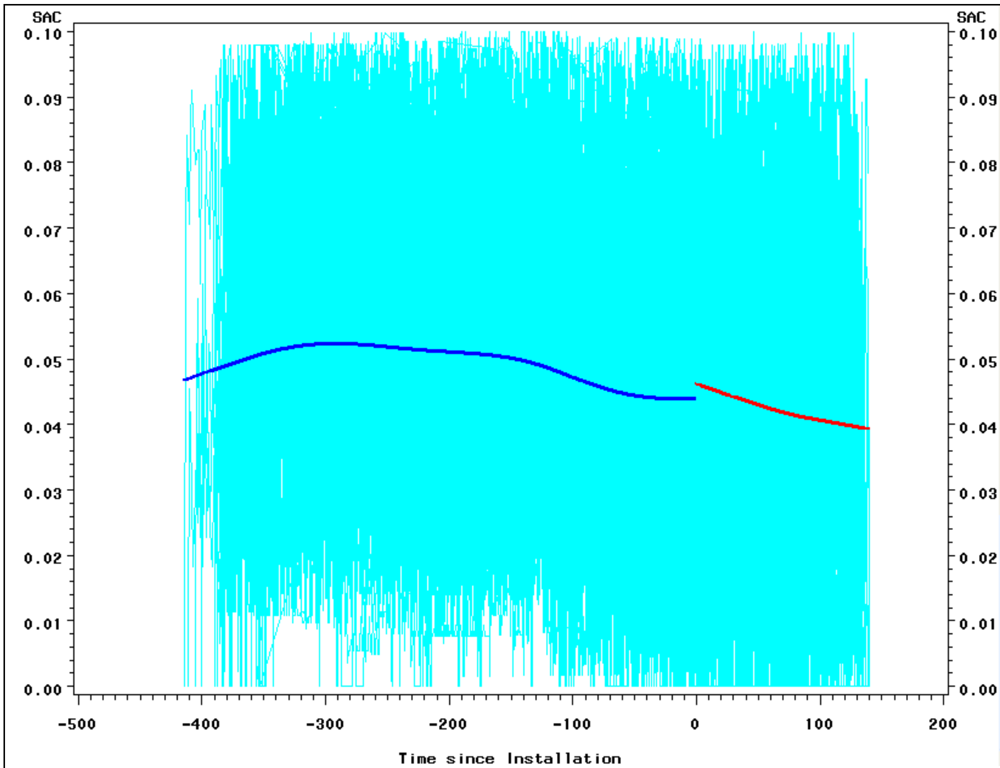
Gas savings as per results of EGD load research.

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.

MEAN	INTERACTION MODEL Average m^3/hour	Average daily m^3/day	Average annual m^3/year	Lower CI m3/hour	Upper CI m3/hour
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LOW FLOW - NO	0.0478	1.147	418.8	0.0428	0.0528
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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

                                                   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 SIMPLE MODEL

gpm)					
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.

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.	

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[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 ^oC (60 ^oF) [4]
- Average water heater set point temperature: 54 ^oC (130 ^oF) [5]
- Hot water temperature in outlet pipe: 52 ^oC (125 ^oF) [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 (^oF)
T_{amb} = Ambient temperature around pipe (^oF)
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

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 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	

[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, 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.[1]	
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.	
Electricity (Updated)	**255 kWh**
Based on the average actual results per participant from the 284 weatherized homes completed in 2007 & 2008.	
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.	
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.

COMMERCIAL NEW BUILDING CONSTRUCTION

CONDENSING GAS WATER HEATER

New Commercial

Efficient Technology & Equipment Description
Condensing Gas Water Heater[11] (95% thermal efficiency), 50 gallons. Resource savings were calculated for 950[12] USG/day hot water use[13]:
Base Technology & Equipment Description
Conventional storage tank gas water heater[14] (thermal efficiency[15]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	**1543 m^3/Btu/hr**
Assumptions and inputs: • Daily hot water draw – 950 USG/day[12] • Input rating for efficient and base equipment: 199,000 Btu. • Average water inlet temperature: 7.22 DegC (45 degF)[16],[17] • Average water heater set point temperature: 54 degC (130 degF)[18] • Stand-by loss of (condensing) Polaris PC 199-50 3NV: 244 Btu/hr.[19] • Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[20] Annual gas savings calculated as follows:	

[11] Locally available commercial condensing gas water heater, trade name: Polaris, model #: PC 199-50 http://www.johnwoodwaterheaters.com/pdfs/GSW_PolarisSpecSheet.pdf

[12] as per typical full service restaurant draw (EB-2006-0021, pg 31, Appendix B)

[13] 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.

[14] Locally available commercial conventional (non-condensing) gas water heater with the same input rating as the Polaris. Manufacturer: Rheem, model #: G91-200.

[15] 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

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

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[21] and Washington State[22]) use an EUL of 13 years, whereas one conducted for Enbridge and Union in 2000[23] uses an EUL of 15 years. Given that the two most recent studies both use 13 years, 13 years is deemed appropriate.	

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[16] Navigant draft report, pg B-224 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - February 6, 2009

[17] 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

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

[19] 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.

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

[21] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2

[22] Quantec Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027) Prepared for Puget Sound Energy

Incremental Cost (Cust. / Contr. Install)	**$ 2230**
Incremental cost determined from communication with local distributor[24,25]	
Free Ridership	**5 %**
Free-ridership rate as per EB-2008-0384 and 0385	

23 Jacques Whitford Environment Ltd, Prescriptive Incentives for Select Natural Gas Technologies, Sept 2000

24 Rheem G91-200: $3,650; Polaris PC 199-50: $5,880

25 Navigant Consulting, Draft Report MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS, February 6, 2009, pg 225

ROOFTOP UNIT

Commercial New

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[26], 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[27] 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[26]. 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).[27]		
Free Ridership	**5**	**%**
Free-ridership rate as per EB-2008-0384 and 0385		

[26] "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.

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

TANKLESS WATER HEATER

Commercial – New Build

Efficient Technology & Equipment Description
Tankless Water Heater (84% thermal efficiency (77% adjusted thermal efficiency[30]), where approximately 50-150 USG/day will be used.
Base Technology & Equipment Description
Conventional storage tank gas water heater (thermal efficiency[28]=80%), 91 gallons[30].

Resource Savings Assumptions

Natural Gas	**221 m^3**

Resource savings were calculated for 100 USG/day hot water use[29]:

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)[30],[31]
- Average water heater set point temperature: 54 degC (130 degF)[32]
- Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[33]

Annual gas savings calculated as follows[30],[34]:

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

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

[28] 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

[29] 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.

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[35], Canadian Building Energy End-Use Data and Analysis Centre[36], Energy Star's High Efficiency Water Heaters brochure[37], and Energy Star's website[38].	
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.[39] Costs for the two systems were determined to be: • WaiWela PH28CIFS tankless water heater and installation kit = $2,080[30],[40] • Rheem G91-200 storage tank water heater = $3,650[41],[42], [30]	
Free Ridership	**2 %**
Free-ridership rate as per EB-2008-0384 and 0385	

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[30] Navigant draft report, pg B-237 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - February 6, 2009
[31] 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
[32] As suggested by NRCan: http://oee.nrcan.gc.ca/residential/personal/new-homes/water-conservation.cfm?attr=4
[33] Consumer's Directory of Certified Efficiency Ratings http://www.neo.ne.gov/neq_online/july2006/commgaswtrhtr.pdf
[34] hot water heating - calculator - tankless comml - March 10 2009.xls
[35] "Introduction to Rinnai Water Heating Product – Course #101", page 7
[36] 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
[37] Energy Star's High Efficiency Water Heaters brochure, http://www.energystar.gov/ia/new_homes/features/WaterHtrs_062906.pdf pg 2, March 10, 2009
[38] Energy Star website, http://www.energystar.gov/index.cfm?c=gas_tankless.pr_savings_benefits , March 10, 2009
[39] 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
[40] http://www.tanklesswaterheaters.ca/waiwelaph28ci.html
[41] From correspondence with local distributor by Navigant Consulting.
[42] Rheem G91-200: $3,650

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 m³ / 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[43]		Blower Motor	Infrared	Savings
Capacity (BTU/H)		kW	kW	Unit Heater (hrs/yr)	Infrared (hrs/yr)	kWh/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.[44]

- 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.[45]	
Incremental Cost	**$0.009 / 10³ Btu/hr**
Local retailers reported an average of $0.009 / Btu/hr incremental cost as per Navigant's survey of local retailers.[46]	

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[43] from "Infrared Analysis (Agviro Replicated).xls", which included UG North & South climates as well as a 20% oversizing factor.

[44] http://solaronics.thomasnet.com/Asset/SSTG-SSTU-GB_200010_Spec_Sheet.pdf

[45] "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.

Free Ridership	**33 %**
Free Ridership based on EB-2008-0384 and 0385	

46 Navigant Consulting, MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - Draft Report, Pg 207

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[47],[48].

	CFM range		Savings			
			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)[48]

Water	**n/a L**

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

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[49].		
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		

[49] MELINK Canada, February, 2009

ENERGY RECOVERY VENTILATOR (ERV)

New Building Construction

Efficient Technology & Equipment Description
Ventilation with ERV
Qualifier/Restriction
1) Restriction for New Building Construction: This measure is not applicable to systems >=5,000 CFM with >=70% OA ratio because energy recovery is required by Ontario Building Code 2006 2) Restriction for New Building Construction: This measure is not applicable to systems serving health care spaces indicated in **Table 1** because heat recovery is required by CSA Z317.2-01

Table 1 - Health Care Spaces Not Eligible

Anaesthetic gas scavenging	Cart and can washers	Areas using hazardous gases
Animal facilities	Chemical storage	Isolation rooms
Autopsy suite	Cooking facilities	Perchloric hoods
Biohazard and fume hoods	Ethylene oxide	Radioisotope hoods

Base Technology & Equipment Description
Ventilation without ERV

Resource Savings Assumptions

Natural Gas	**3.75 m^3 / CFM**

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.
- For example, input assumptions for a typical Ontario retail store are:

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	500	UG[†]
B	Exhaust air flow (cfm)	500	UG
C	Average indoor air temperature (^oF)	70	UG
D	Average indoor relative humidity (%)	30	UG
E	Average outside air temperature (^oF)	31.5	UG
F	Average outdoor relative humidity (%)	70	NCI[Δ]
G	Atmospheric pressure (psia)	14.3	UG
H	No. of hours in heating season (hrs)	4,800	UG
I1	Demand Controlled Ventilation	no	UG
I2	No. of hours of operation per week (hrs/wk)	108	UG
J	Make and Model of Heat Recovery Equipment	Eng A, HRW-2100	UG
K	Effectiveness of Heat Recovery Equipment (%)	60	NCI
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET exhaust air	22.0	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET supply air	10.4	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of OUTLET supply air	17.3	UG
P	Average Temperature of OUTLET supply air (^oF)	55	UG
Q	Average Hourly Moisture Addition (lb/hr)	2.6	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	14.7	UG

U	Average annual gas reduction (m3)	1,571	UG
V	Incremental natural gas rate ($/m3)	0.3	UG
W	Average annual gas savings ($)	471.3	UG

†*UG: Union Gas*
Δ*NCI: Navigant Consulting, Inc*

NG Savings = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery /
(35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**
- 168 hour = 7 days/week x 24hours/day
Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[50] %) **(B)**

- Operating hours for each sectors being considered are as the following

Building Occupancy	Typical Hrs of Operation per week
Hotel	168
Restaurant	108
Retail	108
Office	60
School	84
Health Care	168
Nursing Home	168
Warehouse	168

- New buildings and existing buildings mainly differ in the enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula (B).
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated, and a simple average is taken to be the general savings.

		Existing Buildings	
Market Segment	**ERV Capacity (CFM)**	**NG Savings (m3)**	**NG Savings per CFM (m3/CFM)**
Hotel	500	2,444	4.89
Restaurant	500	1,571	3.14
Retail	500	1,571	3.14
Office	500	873	1.75
School	500	1,222	2.44
Health Care	500	2,444	4.89
Nursing Home	500	2,444	4.89
Warehouse	500	2,444	4.89
Average (m3/CFM)			**3.75**

Electricity	**n/a kWh**

[50] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

Water	**n/a L**

Other Input Assumptions

Equipment Life	**20 years**
ERVs originally had an estimated service life of 15 years based on Jacques Whitford study[51]. Questar Gas[52] and Puget Sound[53] which are newer studies both report 20 years as an ERV's effective useful life. Union Gas and Enbridge Gas Distribution estimate 20 years as an effective useful life for ERVs.	
Incremental Cost	**$3 / CFM**
The incremental costs are based on communication with local contractors[54].	
Free Ridership	**5 %**
Free ridership is based on EB-2008-0384 and 0385.	

[51] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.
[52] Questar Gas, DSM Market Characterization Report, by Nexant, August 9, 2006
[53] Quantec — Puget Sound Energy Demand-Side Management Resource Assessment
[54] Navigant Consulting Inc., Draft Report MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS, FEBRUARY 6, 2009

HEAT RECOVERY VENTILATOR (HRV)

New Building Construction

Efficient Technology & Equipment Description

Ventilation with HRV

1) Restriction for New Building Construction: This measure is not applicable to systems >=5,000 CFM with >=70% OA ratio because energy recovery is required by Ontario Building Code 2006

2) Restriction for New Building Construction: This measure is not applicable to systems serving health care spaces indicated in Table 1 because heat recovery is required by CSA Z317.2-01

Table 1 - Health Care Spaces Not Eligible

Anaesthetic gas scavenging	Cart and can washers	Areas using hazardous gases
Animal facilities	Chemical storage	Isolation rooms
Autopsy suite	Cooking facilities	Perchloric hoods
Biohazard and fume hoods	Ethylene oxide	Radioisotope hoods

Base Technology & Equipment Description

Ventilation without HRV

Resource Savings Assumptions

Natural Gas	3.49 m^3 / CFM

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.
- For example, input assumptions for a typical Ontario retail store are:

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	500	UG†
B	Exhaust air flow (cfm)	500	UG
C	Average indoor air temperature (^oF)	70	UG
D	Average indoor relative humidity (%)	30	UG
E	Average outside air temperature (^oF)	31.5	UG
F	Average outdoor relative humidity (%)	70	NCI$^\Delta$
G	Atmospheric pressure (psia)	14.3	UG
H	No. of hours in heating season (hrs)	4,800	UG
I1	Demand Controlled Ventilation	no	UG
I2	No. of hours of operation per week (hrs/wk)	108	UG
J	Make and Model of Heat Recovery Equipment	Eng A, HRW-2100	UG
K	Effectiveness of Heat Recovery Equipment (%)	70	NCI
L	Sensible Heat Recovery Only	yes	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET exhaust air	22.0	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET supply air	10.4	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of OUTLET supply air	16.9	UG
P	Average Temperature of OUTLET supply air (^oF)	58	UG
Q	Average Hourly Moisture Addition (lb/hr)	0.0	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	13.7	UG
T	Seasonal Efficiency of Gas-Fired Equipment (%)	82	UG

V	Incremental natural gas rate ($/m^3)	0.3	UG
W	Average annual gas savings ($)	438.4	UG

†*UG: Union Gas*

Δ*NCI: Navigant Consulting, Inc*

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m3/MJ) / (Seasonal Efficiency / 100%) **(A)**

- 168 hour = 7 days/week x 24hours/day
- Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[55] %) **(B)**

- Operating hours for each sectors being considered are as the following

Building Occupancy	Typical Hrs of Operation per week
Hotel	168
Restaurant	108
Retail	108
Office	60
School	84
Health Care	168
Nursing Home	168
Warehouse	168

- New buildings and existing buildings mainly differ in enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula **(A)** and input assumptions above, the natural gas savings for each of the commercial sectors are calculated, and a simple average is taken to be the general savings.

		New Buildings	
Market Segment	**HRV Capacity (CFM)**	**NG Savings (m3)**	**NG Savings per CFM (m3/CFM)**
Hotel	500	2,273	4.55
Restaurant	500	1,461	2.92
Retail	500	1,461	2.92
Office	500	812	1.62
School	500	1,137	2.27
Health Care	500	2,273	4.55
Nursing Home	500	2,273	4.55
Warehouse	500	2,273	4.55
Average (m3/CFM)			**3.49**

Electricity	**n/a kWh**

[55] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

Water	**n/a L**

Other Input Assumptions

Equipment Life	**20 years**
HRVs have an estimated service life of 15 years based on Jacques Whitford study[56]. Since Questar Gas3[57]and Puget Sound[58] both report 20 years as its effective useful life, Union Gas and Enbridge Gas Distribution also estimate the EUL to be 20 years.	
Incremental Cost	**$3.40 / CFM**
The incremental costs are based on relative scaling of incremental costs $1,700 / 500 CFM[59].	
Free Ridership	**5 %**
Free ridership is as per EB 2008-0384 and 0385	

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

[57] Questar Gas, DSM Market Characterization Report, by Nexant, August 9, 2006

[58] Quantec — Puget Sound Energy Demand-Side Management Resource Assessment

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

CONDENSING BOILERS

Commercial New Building Construction

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.[60]	
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.[61] Local Canadian manufacturers reported $9,800 for 230,000 Btu/hour condensing boilers[62], 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	

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

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 with ceiling heights 25ft and higher.
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[63] As approved in EB 2008-0384 & 0385.	
Free Ridership	**10 %**
Based on market & total sales data for Ontario[64] and building type data from UG's Customer database. As per EB 2008-0384 & 0385.	

[63] 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.
[64] Email from Joan Wood (EnviraNorth) to Victoria Falvo (UG), May 30, 2008

PROGRAMMABLE THERMOSTAT

New 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[65],[66]. 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[67],[68]. Setback duration was estimated for each market[69]. 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

[65] NEUD database space heating for 1990-2006 & HHV of natural gas (as of January 2009)
[66] NEUD database space cooling using for 1990-2006, (as of January 2009)
[67] "UG Thermostat_calculator_rv2 - JO.xls"
[68] This analysis includes a weighted average of UG North 30% and UG South 70%.
[69] As per UG's understanding of typical operating schedules

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[70],[71],[72]. The institutional market varied so much that the floor areas were determined separately by its components[73]. 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[74]	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[75] and the Energy Star/Honeywell Commercial calculator. Not all buildings have cooling, therefore the percentage of each segment that has cooling was included[76]. Otherwise, the electricity savings below were calculated in much the same way as the gas savings above.

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[70] Kim Ellis, Sr. Salesperson at Engineered Air, London office, Feb 13, 2009
[71] Ian Dunbar, Feb 13, 2009 referring to a restaurant designed by Millennium Engineering, Burlington
[72] John Paleczny, March 6, 2009, from Yorkland Controls, London
[73] The "Institutional" market was assumed to comprise of "Information & Cultural Industries" and "Educational Services" for the purposes of this analysis.
[74] Refers to table above.
[75] National Energy Use Database, Commercial/Institutional Sectors, NRCAN, September 2008, covering 1990 to 2006.
[76] "Natural Gas Energy Efficiency Potential Commercial Sector –Draft Final Report", Dec 2, 2008, Marbek Resource Consultants

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

HIGH EFFICIENCY COMMERCIAL FRYER

New Commercial

Efficient Technology & Equipment Description
Energy Star commercial fryer (at least 50% cooking efficiency[77]) or at least 50% efficiency and less than 9,000 BTU/H idle energy rate according to ASTM2144-07[78].
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	65	lb/hour	FSTC 2004
Idle Energy Rate	9,000	Btu/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	60	lb/hour	FSTC 2007

[77] 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.

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

Capacity			
Idle Energy Rate	14,000	Btu/hour	FSTC 2004
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	days/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.[79] 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 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.[78]

Water	**n/a L**

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

Other Input Assumptions

Equipment Life	**7 years**
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.[78] 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.[79]	
Free Ridership	**%**

COMMERCIAL EXISTING BUILDINGS

CONDENSING GAS WATER HEATER

Existing Commercial

Efficient Technology & Equipment Description
Condensing Gas Water Heater[80] (95% thermal efficiency), 50 gallons. Resource savings were calculated for 950[81] USG/day hot water use[82]:
Base Technology & Equipment Description
Conventional storage tank gas water heater[83] (thermal efficiency[84]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	**1543 m^3/Btu/hr**
Assumptions and inputs: • Daily hot water draw – 950 USG/day[12] • Input rating for efficient and base equipment: 199,000 Btu. • Average water inlet temperature: 7.22 DegC (45 degF)[85],[86] • Average water heater set point temperature: 54 degC (130 degF)[87] • Stand-by loss of (condensing) Polaris PC 199-50 3NV: 244 Btu/hr.[88] • Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[89] Annual gas savings calculated as follows:	

[80] Locally available commercial condensing gas water heater, trade name: Polaris, model #: PC 199-50 http://www.johnwoodwaterheaters.com/pdfs/GSW_PolarisSpecSheet.pdf

[81] as per typical full service restaurant draw (EB-2006-0021, pg 31, Appendix B)

[82] 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.

[83] Locally available commercial conventional (non-condensing) gas water heater with the same input rating as the Polaris. Manufacturer: Rheem, model #: G91-200.

[84] 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

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

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[90] and Washington State[91]) use an EUL of 13 years, whereas one conducted for Enbridge and Union in 2000[92] uses an EUL of 15 years. Given that the two most recent studies both use 13 years, 13 years is deemed appropriate.	

[85] Navigant draft report, pg B-224 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - February 6, 2009

[86] 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

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

[88] 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.

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

[90] Iowa Utilities Board. Docket No. EEP-08-02 MidAmerican Energy Company. Volume IV, Appendix D, Part 1 of 2

[91] Quantec Comprehensive Assessment of Demand-Side Resource Potentials (2008-2027) Prepared for Puget Sound Energy

Incremental Cost (Cust. / Contr. Install)	**$ 2230**
Incremental cost determined from communication with local distributor[93,94]	
Free Ridership	**5 %**
Free-ridership rate as per EB-2008-0384 and 0385	

[92] Jacques Whitford Environment Ltd, Prescriptive Incentives for Select Natural Gas Technologies, Sept 2000

[93] Rheem G91-200: $3,650; Polaris PC 199-50: $5,880

[94] Navigant Consulting, Draft Report MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS, February 6, 2009, pg 225

1.5 GAL/MIN FAUCET AERATOR (KITCHEN)

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
1.5 GPM Faucet Aerator
Base Technology & Equipment Description
Average existing stock / 2.5 GPM Faucet Aerator

Resource Savings Assumptions

Natural Gas (Updated)	**26 m^3**
As recommended by Navigant.	
Electricity	**n/a kWh**
Water (Updated)	**5,377 L**
As recommended by Navigant.	

Other Input Assumptions

Equipment Life	**10 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Install)	**$2**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
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
Average existing stock / 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	

1.5 GAL/MIN FAUCET AERATOR (BATHROOM)

Commercial Building Retrofit (Installed) – Multi-Residential

Efficient Technology & Equipment Description
1.5 GPM Faucet Aerator
Base Technology & Equipment Description
Average existing stock / 2.2 GPM Faucet Aerator

Resource Savings Assumptions

Natural Gas (Updated)	**7 m^3**
As recommended by Navigant.	
Electricity	**n/a kWh**
Water (Updated)	**1,382 L**
As recommended by Navigant.	

Other Input Assumptions

Equipment Life	**10 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Install)	**$2**
As recommended by Navigant.	
Free Ridership (Updated)	**10 %**
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
Average existing stock / 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	

HIGH EFFICIENCY FURNACE (UP TO 299 MBTU/H)

Commercial - Existing Buildings

Efficient Technology & Equipment Description
High efficiency furnace
Base Technology & Equipment Description
Mid-efficiency furnace

Resource Savings Assumptions

Natural Gas	**5.1 m^3/ 1000 Btu/h**
Based on residential high-efficiency gas savings of 385 m3 (see Existing Homes – High Efficiency Furnace) and a typical residential furnace input of 75,000 Btu/h furnace –> 385/75 = 5 m3 / 1000 Btu/h.	
Electricity	**n/a kWh**
Water	**n/a L**

Other Input Assumptions

Equipment Life	**18 years**
High efficiency furnaces have an estimated service life of 18 years.[95]	
Incremental Cost (Contractor Install)	**650 $**
The incremental cost is based on a pricing survey of 15 contractors in the Union Gas franchise area. The single incremental cost number is weighted average of Union Gas South (70%) and Union Gas North (30%) average incremental costs.	
Free Ridership	**17.5 %**
As per EB-2006-0021	

[95] ASHRAE Applications Handbook – 2003, Chapter 36 – Owning and Operating Costs, Table 3

1.5 GAL/MIN LOW-FLOW SHOWERHEAD (PER SUITE)

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 and approved in EB-2008-0384 & 0385.	
Free Ridership	**10 %**
As per EB 2008-00384 & 0385	

1.25 GAL/MIN LOW-FLOW SHOWERHEAD (PER SUITE)

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 and approved in EB-2008-0384 & 0385.	
Free Ridership	**10 %**
As per EB 2008-00384 & 0385	

1.25 GAL/MIN LOW-FLOW SHOWERHEAD (PER SUITE)

Commercial Building Retrofit (Installed) – Multi-Residential

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

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 2008-00384 & 0385	

1.5 GAL/MIN LOW-FLOW SHOWERHEAD (PER SUITE)

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 **79 m3** **91 m3**	**2.6 - 3.0 GPM** **3.1 – 3.5 GPM** **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 **13250 L** **15114 L**	**2.6 - 3.0 GPM** **3.1 – 3.5 GPM** **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 (PER SUITE)

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 to account for 2.0 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	**1,727 L**	**2.6 – 3.0 GPM**
	5,487 L	**3.1 – 3.5 GPM**
	7,351 L	**3.6 + GPM**
Based on Navigant savings calculation adjusted to account for 2.0 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 per EB 2008 – 0384 & 0385	
Incremental Cost (Contractor Install)	**$17**
As per utility program costs.	
Free Ridership	**10 %**
As per EB 2008 – 0384 & 0385	

PRE-RINSE SPRAY NOZZLE (1.24 GPM)

Commercial, Existing

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[96] and Calgary[97]. 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[98] 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 researh undertaken by FSTC[99], and ASHRAE[100] 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.

96 "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005

97 "City of Calgary" – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., December 2005.

98 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

99 Charles Wallace and Don Fisher Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants. FSTC April 2007

100 ASHRAE Handbook 2007HVAC Applications. Chapter 49

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[101,102]	
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[103]	
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)	

[101] CEE Commercial Kitchens Initiative - Program Guidance on Pre-Rinse Spray Valves

[102] Enbridge market survey of average usage

[103] "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005

PRE-RINSE SPRAY NOZZLE (0.64 GPM)

Commercial, Existing

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 m^3**

Market Segment	Natural Gas (m^3/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[104] and Calgary[105]. 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[106] 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[107], and ASHRAE[108] 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[109].

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[104] "Region of Waterloo – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., January 2005

[105] "City of Calgary" – Pre-Rinse Spray Valve Pilot Study – Final Report", Veritec Consulting Inc., December 2005.

[106] 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

[107] Charles Wallace and Don Fisher Energy Efficiency Potential of Gas-Fired Commercial Hot Water Heating Systems in Restaurants. FSTC April 2007

[108] ASHRAE Handbook 2007HVAC Applications. Chapter 49

[109] pg 32 & 37 "Deemed Savings for (Low Flow) Pre-Rinse Spray Nozzles" by Energy Profiles, January 30, 2009.

Electricity	0 kWh

Water	See below L

Market Segment	Water (L)[109]
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[110,111]	

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.	

110 CEE Commercial Kitchens Initiative - Program Guidance on Pre-Rinse Spray Valves

111 Enbridge market survey of average usage

PROGRAMMABLE THERMOSTAT

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[112],[113]. 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[114],[115]. Setback duration was estimated for each market[116]. 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

112 NEUD database space heating for 1990-2006 & HHV of natural gas (as of January 2009)
113 NEUD database space cooling using for 1990-2006, (as of January 2009)
114 "UG Thermostat_calculator_rv2 - JO.xls"
115 This analysis includes a weighted average of UG North 30% and UG South 70%.
116 As per UG's understanding of typical operating schedules

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[117],[118],[119]. The institutional market varied so much that the floor areas were determined separately by its components[120]. 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[121]	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[122] and the Energy Star/Honeywell Commercial calculator. Not all buildings have cooling, therefore the percentage of each segment that has cooling was included[123]. Otherwise, the electricity savings below were calculated in much the same way as the gas savings above.

[117] Kim Ellis, Sr. Salesperson at Engineered Air, London office, Feb 13, 2009
[118] Ian Dunbar, Feb 13, 2009 referring to a restaurant designed by Millennium Engineering, Burlington
[119] John Paleczny, March 6, 2009, from Yorkland Controls, London
[120] The “Institutional” market was assumed to comprise of “Information & Cultural Industries” and “Educational Services” for the purposes of this analysis.
[121] Refers to table above.
[122] National Energy Use Database, Commercial/Institutional Sectors, NRCAN, September 2008, covering 1990 to 2006.
[123] "Natural Gas Energy Efficiency Potential Commercial Sector –Draft Final Report", Dec 2, 2008, Marbek Resource Consultants

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

ROOFTOP UNIT

Commercial 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**	**m³**
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[124], 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[125] 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[124]. 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). [125]		
Free Ridership	**5**	**%**
Free-ridership rate as per EB-2008-0384 and 0385		

[124] "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.

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

TANKLESS WATER HEATER

Commercial - Existing

Efficient Technology & Equipment Description
Tankless Water Heater (84% thermal efficiency (77% adjusted thermal efficiency[30]), where approximately 50-150 USG/day will be used.
Base Technology & Equipment Description
Conventional storage tank gas water heater (thermal efficiency[126]=80%), 91 gallons.

Resource Savings Assumptions

Natural Gas	**221 m³**

Resource savings were calculated for 100 USG/day hot water use[127]:
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)[128],[129]
- Average water heater set point temperature: 54 degC (130 degF)[130]
- Stand-by loss of (non-condensing) Rheem G91-200: 1,050 Btu/hr.[131]

Annual gas savings calculated as follows[30],[132]:

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

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

[126] 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

[127] 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.

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[133], Canadian Building Energy End-Use Data and Analysis Centre[134], Energy Star's High Efficiency Water Heaters brochure[135], and Energy Star's website[136].	
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.[137] Costs for the two systems were determined to be: • WaiWela PH28CIFS tankless water heater and installation kit = $2,080[138] • Rheem G91-200 storage tank water heater = $3,650[139],[140]	
Free Ridership	**2 %**
Free-ridership rate as per EB-2008-0384 and 0385	

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

[129] 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

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

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

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

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

[134] 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

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

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

[137] 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

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

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

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

ENHANCED FURNACE (UP TO 299 MBTU/H)

Commercial - Existing Buildings

Efficient Technology & Equipment Description
Two-stage furnace with ECM
Base Technology & Equipment Description
Mid-efficiency furnace

Resource Savings Assumptions

Natural Gas *(Furnace / ECM)*	**5.1 / -0.87 m^3/ 1000 Btu/h**
Based on residential enhanced furnace gas savings of 385 m3 and gas penalty of -65 m3 (see Existing Homes – Enhanced Furnace) and a typical residential furnace input of 75,000 Btu/h furnace –> 385/75 = 4.3 m3 / 1000 Btu/h and -65/75 = -0.87 m3 / 1000 Btu/h.	
Electricity *(Furnace / ECM)*	**0 / 9.7 kWh**
Based on residential enhanced furnace electricity savings of 730 m3 (see Existing Homes – Enhanced Furnace) and a typical residential furnace input of 75,000 Btu/h furnace –> 730/75 = 9.7 kWh / 1000 Btu/h.	
Water	**n/a L**

Other Input Assumptions

Equipment Life *(Furnace / ECM)*	**18 years**
Two-stage, high efficiency furnaces have an estimated service life of 18 years.[141]	
Incremental Cost *(Furnace / ECM)*	**$650 / $550**
The incremental cost is based on a pricing survey of 15 contractors in the Union Gas franchise area. The single incremental cost number is weighted average of Union Gas South (70%) and Union Gas North (30%) average incremental costs.	
Free Ridership *(Furnace / ECM)*	**30% / 10%**
As per EB-2006-0021	

[141] ASHRAE Applications Handbook – 2003, Chapter 36 – Owning and Operating Costs, Table 3

HEAT RECOVERY VENTILATOR (HRV)

Existing Building Construction

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

Resource Savings Assumptions

Natural Gas	**3.77 m^3 / CFM**

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.
- For example, input assumptions for a typical Ontario retail store are:

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	500	UG†
B	Exhaust air flow (cfm)	500	UG
C	Average indoor air temperature (°F)	70	UG
D	Average indoor relative humidity (%)	30	UG
E	Average outside air temperature (°F)	31.5	UG
F	Average outdoor relative humidity (%)	70	NCI^Δ
G	Atmospheric pressure (psia)	14.3	UG
H	No. of hours in heating season (hrs)	4,800	UG
I1	Demand Controlled Ventilation	no	UG
I2	No. of hours of operation per week (hrs/wk)	108	UG
J	Make and Model of Heat Recovery Equipment	Eng A, HRW-2100	UG
K	Effectiveness of Heat Recovery Equipment (%)	70	NCI
L	Sensible Heat Recovery Only	yes	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET exhaust air	22.0	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET supply air	10.4	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of OUTLET supply air	16.9	UG
P	Average Temperature of OUTLET supply air (°F)	58	UG
Q	Average Hourly Moisture Addition (lb/hr)	0.0	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	13.7	UG
T	Seasonal Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average annual gas reduction (m^3)	1,461	UG
V	Incremental natural gas rate ($/$m^3$)	0.3	UG
W	Average annual gas savings ($)	438.4	UG

†*UG: Union Gas*

Δ*NCI: Navigant Consulting, Inc*

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**

- 168 hour = 7 days/week x 24hours/day
- Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[142] %) **(B)**

- Operating hours for each sectors being considered are as the following

Building Occupancy	Typical Hrs of Operation per week
Hotel	168
Restaurant	108
Retail	108
Office	60
School	84
Health Care	168
Nursing Home	168
Warehouse	168

- New buildings and existing buildings mainly differ in enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula **(A)** and input assumptions above, the natural gas savings for each of the commercial sectors are calculated, and a simple average is taken to be the general savings.

		Existing Buildings	
Market Segment	HRV Capacity (CFM)	NG Savings (m3)	NG Savings per CFM (m3/CFM)
Hotel	500	2,452	4.9
Restaurant	500	1,576	3.15
Retail	500	1,576	3.15
Office	500	876	1.75
School	500	1,226	2.45
Health Care	500	2,452	4.9
Nursing Home	500	2,452	4.9
Warehouse	500	2,452	4.9
Average (m3/CFM)			**3.77**

Electricity	**n/a kWh**
Water	**n/a L**

[142] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

Other Input Assumptions

Equipment Life	**20 years**
HRVs have an estimated service life of 15 years based on Jacques Whitford study[143]. Since Questar Gas[144] and Puget Sound[145] both report 20 years as its effective useful life, Union Gas and Enbridge Gas Distribution also estimate the EUL to be 20 years.	
Incremental Cost	**$3.40 / CFM**
The incremental costs are based on relative scaling of incremental costs $1,700 / 500 CFM[146].	
Free Ridership	**5 %**
Free ridership is as per EB 2008-0384 and 0385	

143 "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

144 Questar Gas, DSM Market Characterization Report, by Nexant, August 9, 2006

145 Quantec — Puget Sound Energy Demand-Side Management Resource Assessment

146 "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.

ENERGY RECOVERY VENTILATOR (ERV)

Existing Building Construction

Efficient Technology & Equipment Description
Ventilation with ERV
Qualifier / Restriction
None
Base Technology & Equipment Description
Ventilation without ERV

Resource Savings Assumptions

Natural Gas	**3.95 m^3 / CFM**

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.
- For example, input assumptions for a typical Ontario retail store are:

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	500	UG†
B	Exhaust air flow (cfm)	500	UG
C	Average indoor air temperature (°F)	70	UG
D	Average indoor relative humidity (%)	30	UG
E	Average outside air temperature (°F)	31.5	UG
F	Average outdoor relative humidity (%)	70	NCI$^{\Delta}$
G	Atmospheric pressure (psia)	14.3	UG
H	No. of hours in heating season (hrs)	4,800	UG
I1	Demand Controlled Ventilation	no	UG
I2	No. of hours of operation per week (hrs/wk)	108	UG
J	Make and Model of Heat Recovery Equipment	Eng A, HRW-2100	UG
K	Effectiveness of Heat Recovery Equipment (%)	60	NCI
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET exhaust air	22.0	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of INLET supply air	10.4	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) of OUTLET supply air	17.3	UG
P	Average Temperature of OUTLET supply air (°F)	55	UG
Q	Average Hourly Moisture Addition (lb/hr)	2.6	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	14.7	UG
T	Seasonal Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average annual gas reduction (m^3)	1,571	UG
V	Incremental natural gas rate ($/$m^3$)	0.3	UG
W	Average annual gas savings ($)	471.3	UG

†*UG: Union Gas*

$^{\Delta}$*NCI: Navigant Consulting, Inc*

NG Savings = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery /(35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**

- 168 hour = 7 days/week x 24hours/day
- Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply

air)/Specific
Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[147]%) **(B)**

- Operating hours for each sectors being considered are as the following

Building Occupancy	Typical Hrs of Operation per week
Hotel	168
Restaurant	108
Retail	108
Office	60
School	84
Health Care	168
Nursing Home	168
Warehouse	168

- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated, and a simple average is taken to be the general savings.

		Existing Buildings	
Market Segment	**ERV Capacity (CFM)**	**NG Savings (m3)**	**NG Savings per CFM (m3/CFM)**
Hotel	500	2,569	5.14
Restaurant	500	1,652	3.30
Retail	500	1,652	3.30
Office	500	918	1.84
School	500	1,285	2.57
Health Care	500	2,569	5.14
Nursing Home	500	2,569	5.14
Warehouse	500	2,569	5.14
Average (m3/CFM)			**3.95**

Electricity	**n/a kWh**

Water	**n/a L**

[147] From Union Gas, all air-to-air heat recovery equipment requires frost control in colder climates to prevent freeze-up of exhaust air condensate on heat exchange components. Depending on the defrost control system, annual heat recovery estimates should be reduced by 5 to 15 %. Equipment manufacturers and suppliers can provide an estimated defrost derating factor given the operating conditions of the equipment.

Other Input Assumptions

Equipment Life	**20 years**
ERVs originally had an estimated service life of 15 years based on Jacques Whitford study[148]. Questar Gas[149] and Puget Sound[150] both are more recent studies and report 20 years as an ERV's effective useful life. Union Gas and Enbridge Gas Distribution estimate 20 years as an effective useful life for ERVs.	
Incremental Cost	**$3 / CFM**
The incremental costs originally based on relative scaling of incremental costs $2,500 / 1000 CFM[5]. This was updated based on communication with local contractors. The incremental costs are $3/CFM[151].	
Free Ridership	**5 %**
Free ridership is based on EB-2008-0384 and 0385.	

[148] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.
[149] Questar Gas, DSM Market Characterization Report, by Nexant, August 9, 2006
[150] Quantec — Puget Sound Energy Demand-Side Management Resource Assessment
[151] Navigant Consulting Inc., Draft Report MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS, FEBRUARY 6, 2009

CONDENSING BOILERS

Commercial Existing Buildings

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.[152]	
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.[153] Local Canadian manufacturers reported $9,800 for 230,000 Btu/hour condensing boilers[154], 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	

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

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[155]		Blower Motor	Infrared	Savings
Capacity (BTU/H)		kW	kW	Unit Heater (hrs/yr)	Infrared (hrs/yr)	kWh/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.[156]

- 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.[157]

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.[158]

Free Ridership	**33 %**

Free Ridership based on EB-2008-0384 and 0385

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[155] from "Infrared Analysis (Agviro Replicated).xls", which included UG North & South climates as well as a 20% oversizing factor.

[156] http://solaronics.thomasnet.com/Asset/SSTG-SSTU-GB_200010_Spec_Sheet.pdf

[157] "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.

[158] Navigant Consulting, MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING APPENDIX C: SUBSTANTIATION SHEETS - Draft Report, Pg 207

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[159].		
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		

[159] MELINK Canada, February, 2009

SINGLE AIR DOOR INSTALLATION

Commercial Existing Buildings

Efficient Technology and Equipment Description
Installing a single air barrier on an exterior entrance door in a retail facility to maintain indoor air temperature
Base Technology & Equipment Description
Door without an air curtain.

Resource Savings Assumptions

Natural Gas	**2,191 m^3**
As recommended by Navigant.	
Electricity	**172 kWh**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Water	**N/A L**

Other Input Assumptions

Equipment Life	**15 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Installation)	**$1,650**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Free Ridership	**5 %**
As per EB-2008-0384 / 0385.	

DOUBLE AIR DOOR INSTALLATION

Commercial Existing Buildings

Efficient Technology and Equipment Description
Installing a double air barrier on an exterior entrance door in a retail facility to maintain indoor air temperature.
Base Technology & Equipment Description
Door without an air curtain.

Resource Savings Assumptions

Natural Gas	**4,661 m^3**
As recommended by Navigant.	
Electricity	**1,023 kWh**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Water	**N/A L**

Other Input Assumptions

Equipment Life	**15 years**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Incremental Cost (Contractor Installation)	**$2,500**
As recommended by Navigant and approved in EB-2008-0384 / 0385.	
Free Ridership	**5 %**
As per EB-2008-0384 / 0385.	

DESTRATIFICATION FAN

Commercial Existing 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 with ceiling heights 25ft and higher.
Base Technology & Equipment Description
No destratification fan.

Resource Savings Assumptions

Natural Gas	**7,020 m³**
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[160] As approved in EB 2008-0384 & 0385.	
Free Ridership	**10 %**
Based on market & total sales data for Ontario[161] and building type data from UG's Customer database. As per EB 2008-0384 & 0385.	

[160] 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.

[161] Email from Joan Wood (EnviraNorth) to Victoria Falvo (UG), May 30, 2008

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[162] cycles per day x 365)
- Water use per cycle, base equipment: 29.26[163] 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%[164]
- Percentage of water used by efficient equipment which is hot water: 10%[165]
- Average water inlet temperature:7.22°C (45oF)
- Average water heater set point temperature: 54°C (130°F)
- Water heater thermal efficiency: 65%[166]
- 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[167]
- Gas dryer penetration in Ontario Multi-family and Laundromat market:60%[168]

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

Electricity	**296 kWh**

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

Water	**80,000 L**

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162 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.

163 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.

164 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.

165 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%.

166 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.

167 Dryer energy usage is calculated using the US DOE Life-Cycle and Cost and Payback spreadsheet (0.9 kwh/cycle)

168 60% penetration for commercial clothes dryers "CEE Commercial, Family-Sized Washers:An Initiative Description of the Consortium for Energy Efficiency) 1998

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

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	

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: Elementary Schools Prescriptive Savings Analysis Report, Agviro Inc., November 23, 2007. Incremental costs are based on the weighted average of boiler types as noted above. As approved in EB-2008-0384 & 0385.	
Free Ridership (EGD/UG)	**12% / 27%**
As recommended in Summit Blue and approved in EB 2008-0384 & 0385.	

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. As approved in EB-2008-0384 & 0385	
Free Ridership (EGD)	**12% / 27%**
As recommended in Summit Blue and approved in EB 2008-0384 & 0385.	

HIGH EFFICIENCY COMMERCIAL FRYER

Existing Commercial

Efficient Technology & Equipment Description
Energy Star commercial fryer (at least 50% cooking efficiency[169]) or at least 50% efficiency and less than 9,000 BTU/H idle energy rate according to ASTM2144-07[170].
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	65	lb/hour	FSTC 2004
Idle Energy Rate	9,000	Btu/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	60	lb/hour	FSTC 2007

[169] 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.

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

Capacity			
Idle Energy Rate	14,000	Btu/hour	FSTC 2004
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	days/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.[171] 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 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.[172]

Water	**n/a L**

[171] NGTC, DEVELOPMENT OF MARKET INFORMATION AND DSM MEASURE FOR HIGH EFFICIENCY GAS FRYERS Final Report ver 1.2, October 30, 2008, Pg 33
[172] NGTC, DEVELOPMENT OF MARKET INFORMATION AND DSM MEASURE FOR HIGH EFFICIENCY GAS FRYERS Final Report ver 1.2, October 30, 2008, Pg 36

Other Input Assumptions

Equipment Life	**7 years**
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.[172] 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.[171]	
Free Ridership	**%**

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)	**kWh**

Water	**L**

Other Input Assumptions

Equipment Life	**25 years**
EB 2008-0384 & 0385	
Incremental Cost (Contr. Install)	**Domestic Water Heating (Non Seasonal) Incremental Cost by Combustion Efficiency** **<u>Boiler Size</u> — <u>83-84%</u> — <u>85-88%</u>** **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**
Source: Prescriptive Commercial Boiler Program – Prescriptive Savings Analysis – Agviro Report Sept 10, 2008.	
Free Ridership	**Enbridge:** Small Commercial 10%; Large Commercial 12%; Multi-Family 20% **Union:** Small Commercial 10%; Large Commercial 59%; Multi-Family 42%
EB 2008-0384 - 0385	

PRESCRIPTIVE BOILERS –SPACE HEATING

Existing and New Commercial and Multi- Residential

Efficient Technology & Equipment Description
Hydronic Boilers for space (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)	**kWh**
Water	**L**

Other Input Assumptions

Equipment Life	**25**	**years**
EB 2008-0384 & 0385		

Incremental Cost (Contr. Install)

Boiler Size	**Space Heating (Seasonal) Incremental Cost by Combustion Efficiency 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**

Free Ridership

Enbridge		**Union**	
Small Commercial	**10%**	**Small Commercial**	**10%**
Large Commercial	**12%**	**Large Commercial**	**59%**
Multi-Family	**20%**	**Multi-Family**	**42%**

EB 2008-0384 - 0385

OTHER MEASURES

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 September 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.	