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July 4, 2011

VIA COURIER, EMAIL, RESS

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

Dear Ms Walli:

Re: Enbridge Gas Distribution Inc. ("Enbridge")
EB-2011-0254 - 2011 DSM Measures

Enbridge Gas Distribution ("Enbridge") requests the approval of the Ontario Energy Board (the "Board") for the enclosed new and updated DSM measures for its 2011 program year.

On August 25, 2006, the Board issued its EB-2006-0021 Decision which outlined a process allowing for updates to the DSM input assumptions (page 57). Enbridge followed the approved process to establish the 2011 Update DSM input assumptions. Enbridge initiated consultation during 2010 and 2011 with the 2010 Enbridge Evaluation and Audit Committee ("EAC") on all the measures and, having worked extensively with the EAC, achieved complete consensus on all the proposed input assumptions.

Attachment A contains the following Substantiation Documents for new and revised 2011DSM measures:

1. Air Door (Shipping & Receiving);
2. Condensing Make-up Air;
3. Condensing Boiler (Under 300 MBH);
4. High Efficiency Boiler (Under 300 MBH);
5. Low Flow Showerheads (Residential & Multi-Family)
6. Programmable Thermostat (Commercial);
7. Programmable Thermostat (Multi-Family); and
8. Energy Star Home (Version 3)

Attachment B contains Free Ridership rates established for the following new prescriptive measures:

1. Air Door (Shipping & Receiving);
2. Condensing Make-up Air;
3. Condensing Boiler (Under 300 MBH); and
4. High Efficiency Boiler (Under 300 MBH)

Attachment C contains the Assumptions Table for all existing, revised, and new 2011DSM measures.

Enbridge requests that all 2011 DSM measure assumptions approved in the Union Gas 2011 Update submission (EB-2011-0225) be applicable to Enbridge.

If you have any questions, please contact the undersigned.

Yours truly,

Bonnie Jean Adams

Bonnie Jean Adams
Regulatory Coordinator

AIR CURTAINS (SHIPPING & RECEIVING DOORS)

Commercial/Industrial – New/Existing

Efficient Technology & Equipment Description
Air curtains are used to reduce infiltration of cold outside air through doorways. A reduction in air infiltration means a reduction in natural gas heating during heating season and a reduction in air conditioning during the summer season. For shipping/receiving doors with minimum size of 8' wide by 8' high, 8' wide by 10' high and 10' wide by 10' high located in warehousing, manufacturing, industrial or retail buildings with forced air space heating, including unit heaters.
Base Technology & Equipment Description
No air curtain.

Resource Savings Assumptions

Natural Gas			
	8' x 8'	**7,565**	**m^3**
	8' x 10'	**9,457**	**m^3**
	10' x 10'	**20,605**	**m^3**

Estimation Based on Agviro Study for Enbridge

- Based on Agviro's report[1], the energy analysis compares use of an air curtain versus a doorway without an air curtain. For the purposes of this analysis, the base case is assumed to be a doorway without any air restricting device. The following key input assumptions are used:

ETool Input	*Value*
Season of Operation	Winter, Spring, Fall
Door Location	Exterior
Motor Loading	85%
Motor Efficiency	80%
Curtain Effectiveness	70%
Outdoor Balance Point [Heating]	18C
Equipment Efficiency [Heating]	80%
Equipment Efficiency [Seasonal Reduction]	15%

- On a square footage per door basis, the natural gas savings for an 8' x 8' door $= 7{,}565\ m^3 / 64\ ft^2 = 118.2\ m^3 / ft^2$
- On a square footage per door basis, the natural gas savings for an 8' x 10' door $= 9{,}457\ m^3 / 80\ ft^2 = 118.2\ m^3 / ft^2$
- On a square footage per door basis, the natural gas savings for an 10' x 10' door $= 20{,}605\ m^3 / 100\ ft^2 = 206.1\ m^3 / ft^2$

The 8x8 and the 8x10 doors are considered back-up doors with various periods of either full or partial coverage by a van or trailer. This coverage reduces the Base Case airflow and thus the savings.

[1] Commercial/Industrial Air Curtain Program – Prescriptive Savings Analysis, Agviro Inc., Sep. 13, 2010

The 10x10 doors are drive-through doors. These doors are wide open and the Base Case has no restriction to airflow. More airflow provides more savings.

Electricity	**8' x 8'**	**-5,380**	**kWh**
	8' x 10'	**-5,220**	**kWh**
	10' x 10'	**-936**	**kWh**

- Installation and operation of air curtains results in a net increase in electricity consumption as a result of:
  - Increased electricity use to operate the air curtain.
- On a square footage per door basis, the electrical consumption for an 8' x 8' door = -5,380 kWh / 64 ft^2 = -84.1 kWh / ft^2
- On a square footage per door basis, the electrical consumption for an 8' x 10' door = -5,220 kWh / 80 ft^2 = -65.3 kWh / ft^2
- On a square footage per door basis, the electrical consumption for an 10' x 10' door = -936 kWh / 100 ft^2 = -9.36 kWh / ft^2

The smaller doors as discussed above are back-up doors with a van or trailer parked in front. The doors remain open during the entire loading period. This causes a larger electrical load since the air curtains are operating for the period the doors are open.

The 10x10 doors, being drive through doors, are only open while the vehicle is being driven through. The open period for the both the door and air curtain is much lower for these doors than the small doors.

Water	**0 L**

Other Input Assumptions

Equipment Life	**15 yrs**

- The estimated equipment life for air curtains was developed in conjunction with equipment manufacturers. It is also confirmed by SEED Program Guidelines[2].

Incremental Cost	**8' x 8'**	**$8,242**
	8' x 10'	**$8,242**
	10' x 10'	**$10,170**

- The costs are based on air curtain list prices plus installation cost. Installation cost includes both mechanical and electrical costs. The costs are an estimation based on discussions with an air curtain manufacturer and assuming electrical power is within 30' of the air curtain installation.
- On a square footage per door basis, the incremental cost for an 8' x 8' door = $8,242 / 64 ft^2 = 128.8 $ / ft^2

[2] Cost Effectiveness Analysis, SEED Program Guidelines. http://www.oregon.gov/ENERGY/CONS/SEED/docs/AppendixJ.pdf

- On a square footage per door basis, the incremental cost for an 8’ x 10’ door = $8,242 / 80 ft^2 = 103.0 $ / ft^2
- On a square footage per door basis, the incremental cost for an 10’ x 10’ door = $10,170 / 100 ft^2 = 101.7 $ / ft^2

The 8x8 and 8x10 air curtains are physically identical. The costs are also identical.

Condensing Make-Up Air (MUA) Unit

Revision #	Description/Comment	Date Revised
		January 28, 2011

Efficient Equipment and Technologies Description

Condensing Make-up air unit (MUA) with:

a. Improved Efficiency (91%)
b. Improved Efficiency (91%) and 2 speed motor
c. Improved Efficiency (91%) and a variable frequency drive (VFD)

Base Equipment and Technologies Description

Conventional MUA unit with constant speed drive

Decision Type	Target Market(s)	End Use
New, Existing	Commercial	Space heating

Codes, Standards, and Regulations

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Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3/cfm)	Electricity (kWh/cfm)	Water (L)	($)	($)
1	0.41-2.92	0-1.48			
2	0.41-2.92	0-1.48			
3	0.41-2.92	0-1.48			
4	0.41-2.92	0-1.48			
5	0.41-2.92	0-1.48			
6	0.41-2.92	0-1.48			
7	0.41-2.92	0-1.48			
8	0.41-2.92	0-1.48			
9	0.41-2.92	0-1.48			
10	0.41-2.92	0-1.48			
11	0.41-2.92	0-1.48			
12	0.41-2.92	0-1.48			
13	0.41-2.92	0-1.48			
14	0.41-2.92	0-1.48			
15	0.41-2.92	0-1.48			
TOTALS	**6.15-43.8**	**0-22.2**	**0**	**$(0.66-1.02) per cfm +$870**	

Resource Savings Assumptions

Annual Natural Gas Savings	MR & LTC 0.84 m^3/cfm – 2.92 m^3/cfm Retail & Comm 0.41 m^3/cfm– 2.07 m^3/cfm

To estimate the gas savings for this measure, Navigant relied on the results of evaluations, completed by Agviro Inc., of 18 projects in which condensing MUA with improved efficiencies and in some cases 2 speed or variable frequency drives were installed in commercial applications[1]. 14 of these projects were multi-residential, 1 for long term care, 2 for retail and 1 for other commercial.

The analysis considered several heating input ranges based on the available Make-up air (MUA) models.

The efficiency for the base case and for condensing MUA's is provided by manufacturers[1] for the various heating input ranges as shown below:

	Combustion Efficiency (%)	
Input Range (MBH)	Base Case (@ High Fire)	Condensing
100-200	82	91
200-400	82	91
450-600	80.5	91
600-1,000	80	91
1,100-1,400	80	91

Gas savings for each of the 18 projects were estimated by Agviro by applying project-specific inputs (e.g., air-flow, indoor set-point temperature, hours of operation, etc.) to the proprietary Enbridge ETools calculator[2].

The ETools calculator estimates gas savings in the following manner:

The annual heat requirement to maintain the set-point air temperature is the sum of the annual heat requirement to maintain the set-point temperature between midnight and 8am, 8am and 4pm and 4pm and midnight:

$$q_{vent} = q_{vent\,00-08} + q_{vent\,08-16} + q_{vent\,16-24} \quad (1)$$

Where:

q_{vent} = Annual heat requirement (Btu)
$q_{vent00-08}$ = Annual heat requirement (Btu) between midnight and 8am
$q_{vent09-16}$ = Annual heat requirement (Btu) between 8am and 4pm
$q_{vent16-24}$ = Annual heat requirement (Btu) between 4pm and midnight

Note that in the base case, when the circulating fan runs at a constant speed the above equation is equivalent to:

$$q_{vent} = q_{vent\,00-24} \quad (2)$$

The savings for three types of condensing MUA units have been evaluated:

1. A unit with improved efficiency (91%)
2. A unit with improved efficiency (91%) and a 2 speed motor
3. A unit with improved efficiency (91%) and a VFD.

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[1] Prescriptive Condensing MUA Program Prescriptive Savings Analysis, Agviro Inc., Oct. 25, 2010 (Rev. 21-Jan-11).
[2] An external review of Enbridge's program processes, data tracking, and oversight activities has indicated that the development and continual improvement of the ETools custom project screening tool is reflective of industry best practices.
The Cadmus Group, *Independent Audit of 2008 DSM Program Results*, June 2009. Report filed with the OEB in connection with Enbridge's application to clear DSM deferral accounts for 2008, EB-2009-0341.

The condensing MUAs with 2 speed motors and VFDs do not run at a constant speed. Schedules of the percent airflow for Multi-Res, LTC and Other Commercial applications are included in Appendix A of this document.

The annual heating requirement, q_{vent}, is calculated as shown below:

$$q_{vent} = \sum_{-5}^{T_i} 1.08QH(T_i - T_o) \quad (3)$$

Where:

- q_{vent} = Annual heat requirement (Btu)
- Q = Ventilation rate (cfm)
- 1.08 = Energy required to raise the temperature of 1 ft^3 of air 1°F (Btu/°F/hour)
- T_i = Desired supply air temperature (°F)
- T_o = Outside temperature (°F)
- H = Total number of hours in a year which occur inside a specific 5° temperature range (as determined by average of 30 years)

The summation indicates that the equation above is calculated for a number of different outdoor temperature buckets each of five degrees C (e.g., -5 to 0, 0 to 5, etc.)

T_o and H vary with each term of the summation, where T_o is the mid-point of the given temperature bucket (e.g., for -5 to 0, T_o would be -2.5) and where H is the average number of hours in the year in which the temperature falls in the given bucket.

Gas savings are driven by the change in the annual heating requirement and the change in efficiency of the condensing MUA. The annual heating requirement for a condensing MUA with a VFD or with a 2 Speed motor can be calculated as follows:

$$q_{vent,VFD/2Speed} = (\%AirFlow_{VFD/2speed}) \times q_{vent} \quad (4)$$

Where:

$\%AirFlow_{VFD/2speed}$ = The average airflow following the installation of the VFD or 2 speed motor expressed as a percentage of the airflow when the base technology was in place found in Appendix A.

It should be noted that when a conventional MUA is replaced with a condensing MUA that has neither a 2 speed or VFD-controlled motor, there will not be a change in airflow. In this case equation 4 will not be required in order to estimate the annual heat requirements.

Gas savings for the condensing MUA are then determined using the following equation:

$$NG_E = \left(\frac{q_{vent}}{NG_{cal}(Eff_{Base}/100)} - \frac{q_{vent,VFD/2speed}}{NG_{cal}(Eff_{VFD/2speed}/100)} \right) \times \%FA \quad (5)$$

Where:

- NG_E = Annual gas consumption (m^3)
- q_{vent} = Annual heat requirement of the ventilation system (Btu)
- NG_{cal} = Calorific value of Natural Gas (35,000 Btu/m^3)
- Eff = Equipment efficiency (%)
- %FA = % of Fresh Air (for make-up air units this value will always be 100%)

Note that for the condensing MUA without a VFD or 2 speed fan, $q_{vent} = q_{vent,VFD/2speed}$, and gas savings are driven only by the increase in efficiency.

The savings obtained by Agviro[1] from the ETools calculator for the various cases are given below:

MUA Inputs		NG Savings m^3		
Airflow (cfm)	**MBH**	**Improved Efficiency**	**2 Speed Motor**	**VFD**
Multi-Residential				
1,700	150	1,249	3,124	4,791
3,300	300	2,424	6,064	9,300
6,000	525	5,238	11,855	17,740
9,000	800	8,282	18,208	27,036
14,000	1,250	12,884	28,324	42,055
Long Term Care				
1,700	150	1,269	3,167	4,868
3,300	300	2,539	6,335	9,735
6,000	525	5,229	11,810	17,704
9,000	800	8,269	18,139	26,980
14,000	1,250	12,934	28,372	42,200
Retail/Other Commercial				
1,700	150	616	2,047	3,425
3,300	300	1,197	3,974	6,649
6,000	525	2,586	7,635	12,499
9,000	800	4,089	11,663	18,958
14,000	1,250	6,361	18,143	29,491

MUA Inputs		Annual NG Savings m^3/cfm		
Airflow (cfm)	**MBH**	**Improved Efficiency**	**2 Speed Motor**	**VFD**
Multi-Residential				
1,700	150	0.73	1.84	2.82
3,300	300	0.73	1.84	2.82
6,000	525	0.87	1.98	2.96
9,000	800	0.92	2.02	3.00
14,000	1,250	0.92	2.02	3.00
Long Term Care				
1,700	150	0.75	1.86	2.86
3,300	300	0.77	1.92	2.95
6,000	525	0.87	1.97	2.95
9,000	800	0.92	2.02	3.00
14,000	1,250	0.92	2.03	3.01
MR & LTC Average				
1,700	150	0.74	1.84	2.82
3,300	300	0.74	1.84	2.83
6,000	525	0.87	1.98	2.96
9,000	800	0.92	2.02	3.00
14,000	1,250	0.92	2.02	3.00
MR & LTC Annual Gas Savings m^3/cfm		**0.84**	**1.94**	**2.92**
Retail/Other Commercial				
1,700	150	0.36	1.20	2.01
3,300	300	0.36	1.20	2.01
6,000	525	0.43	1.27	2.08
9,000	800	0.45	1.30	2.11
14,000	1,250	0.45	1.30	2.11
Retail/Commercial Annual Gas Savings m^3/cfm		**0.41**	**1.25**	**2.07**

In the case of the multi-residential and long term care sectors, the savings were averaged based on the number of cases in each sector to obtain the final gas savings in m^3/(cfm) for each type of condensing MUA. Enbridge has informed Navigant that the distribution of projects by sector is anticipated to be the same going forward as it has been in the past. Following program implementation if Enbridge finds the distribution of projects has changed in any significant way the savings should be re-calculated to reflect the actual distribution.

Annual Electricity Savings	**MR&LTC (0-1.48)kWh per cfm** **Retail & Comm (0-0.48)kWh per cfm**

The electricity savings for each of the 18 projects were estimated by Agviro[1] by applying project-specific inputs (e.g., air-flow, indoor set-point temperature, hours of operation, etc.) to the proprietary Enbridge ETools calculator.

No electricity savings are achieved by replacing a conventional MUA with a condensing MUA of improved efficiency. The annual electricity savings attained from installing a condensing MUA with a 2 speed motor or with a VFD is simply the difference between the electricity consumed by the constant speed drive and the 2 speed motor or the VFD.

The annual electricity consumed by the MUA motor is calculated in the following manner:

$$MotorkWh = \sum_{\%Flow_{Partial}}^{\%Flow_{Peak}} kW_{Peak,Partial} \times Operation_{Peak,Partial} (hrs/yr) \qquad (6)$$

Where:

The annual electricity consumed by the motor is calculated in the following manner:

Where:

$kW_{Peak,Partial}$= The electrical demand (kW) of the motor at peak or partial air-flow. This is itself a function of the motor's horse-power, percent motor loading, motor efficiency and control factor.

$Operation_{Peak,Partial}$= The number of hours per year at which the motor/VFD operates at peak or partial airflow.

The summation indicates that the equation above is calculated for peak and partial airflow. Appendix 1 includes scheduling of the Base Case, 2-Stage and VFD motors for Multi-Res, LTC and Commercial applications.

The annual energy savings may then be calculated as the difference in motor energy use between the Base Case and 2-Stage or VFD.

The electricity savings achieved by either a condensing MUA with a 2 speed motor or a condensing MUA with a VFD as reported by Agviro[1] are presented below:

MUA Inputs			Annual Electricity Savings by Condensing MUA Type (kWh)		
Airflow (cfm)	**Motor HP**	**Input (MBH)**	**Improved Efficiency**	**2 Speed Motor**	**VFD**
Multi-Residential					
1,700	1	150	-	953	2,597
3,300	2	300	-	1,906	5,195
6,000	3	525	-	2,859	7,792
9,000	5	800	-	4,765	12,987
14,000	8.5	1,250	-	8,101	22,077
Long Term Care					
1,700	1	150	-	953	2,597
3,330	2	300	-	1,906	5,195
6,000	3	525	-	2,859	7,792
9,000	5	800	-	4,765	12,987
14,000	8.5	1,250	-	8,101	22,077
MR & LTC Average					
1,700	1	150	-	953	2,597
3,330	2	300	-	1,906	5,195
6,000	3	525	-	2,859	7,792
9,000	5	800	-	4,765	12,987
14,000	8.5	1,250	-	8,101	22,077
MR & LTC Annual Electricity Savings kWh/cfm			**-**	**0.54**	**1.48**
Retail/Other Commercial					
1,700	1	150	-	522	846
3,300	2	300	-	1,045	1,693
6,000	3	525	-	1,567	2,539
9,000	5	800	-	2,612	4,232
14,000	8.5	1,250	-	4,441	7,195
Retail/Comm Annual Electricity Savings kWh/cfm			**-**	**0.30**	**0.48**

These savings were averaged based on the number of cases in each sector to obtain the final electricity savings in kWh for each type of condensing MUA. Enbridge has informed Navigant that the distribution of projects by sector is anticipated to be the same going forward as it has been in the past. Following program implementation if Enbridge finds the distribution of projects has changed in any significant way the savings should be re-calculated to reflect the actual distribution.

Annual Water Savings	0 L
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	15 Years

Measure life estimates for condensing MUAs are not currently available. It is expected that these units may last longer than conventional MUAs, but until robust estimates of condensing MUA EULs are available, the EUL of a conventional MUA will be used. The Iowa Utility association[3] and Puget Sound Energy[4] estimated the EUL for a conventional gas MUA to be 15 years.

Incremental Costs	$870 + ($0.66 to $1.02) per cfm

The total incremental costs versus the base case for the different units are included in the table below as given in the Agviro Inc. report[1]. The condensing MUA requires a neutralizer tank to adjust the pH of the condensate before going to the drain. The condensate must then have access to a drain. Drainage can be accomplished by a number of methods including plumbing to a roof drain or plumbing through the roof and into an interior drain. Costs for the neutralizer and plumbing to drain the condensate have also been included.

cfm	Incremental Costs vs. Base Case				
	Neutralizer	Drain	Improved Efficiency	Improved Efficiency & 2 Speed Motor	Improved Efficiency & VFD
1,700	$ 120	$ 750	$ 2,007	$ 3,060	$ 3,102
3,300	$ 120	$ 750	$ 2,250	$ 3,734	$ 3,793
6,000	$ 120	$ 750	$ 3,167	$ 4,615	$ 4,673
9,000	$ 120	$ 750	$ 4,196	$ 6,325	$ 6,410
14,000	$ 120	$ 750	$ 6,418	$ 8,764	$ 8,858
Average $/cfm			**$ 0.66**	**$ 1.01**	**$ 1.02**
Incremental Cost			**$870 + $0.66*cfm**	**$870 + $1.01*cfm**	**$870 + $1.02*cfm**

[3] Summit Blue Consulting et al, Prepared for the Iowa Utility Association, *Assessment of Energy and Capacity Savings Potential in Iowa*, February, 2008.

[4] Quantec, Prepared for Pudget Sound Energy, *Comprehensive Asssessment of Demand Side Resource Potentials,* May, 2007.

Appendix A:

(Taken from the Prescriptive Condensing MUA Program Prescriptive Savings Analysis, Agviro Inc., Oct.25, 2010(Rev. 21-Jan-11)

Base Case, 2 Speed, VFD

These inputs calculate the energy and electrical savings comparing the base case unit having a single speed motor to a condensing MUA having a 2-speed motor for multi-residential, long term care, and retail/other commercial facility types. Tables of the inputs are included in Appendix B & C of the Agviro report. A schedule of hourly percent of airflow for Multi-Res and LTC are shown in Table 6.

Table 7 shows the modelled airflow schedules for Retail and Other Commercial applications. This type of facility is considered to require MUA for 12 hrs/day, 6 days/week at 72F. The Base Case unit provides 100% airflow during this period. The 2-Speed Condensing unit is considered to operate on high-speed for half the time and low-speed for the remaining; resulting in an average of 75% of the airflow over the entire operational period versus the base case. The VFD calculation assumes 50% airflow versus the Base Case.

Table 6: Schedule of Multi-Res & LTC Applications

	Multi-Res & LTC		
Hr of Day	**Base Case**	**2 Stage**	**VFD***
0	100	50	50
1	100	50	50
2	100	50	50
3	100	50	50
4	100	50	50
5	100	50	50
6	100	100	100
7	100	100	100
8	100	100	70
9	100	100	70
10	100	100	70
11	100	100	100
12	100	100	100
13	100	100	70
14	100	100	70
15	100	100	70
16	100	100	100
17	100	100	100
18	100	100	100
19	100	100	100
20	100	50	50
21	100	50	50
22	100	50	50
23	100	50	50
Weighted Ave (%):	**100.0**	**79.2**	**71.7**

Table 7: Schedule of Commercial Applications

	Commercial		
Hr of Day	**Base Case**	**2 Stage**	**VFD**
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	100	75	50
9	100	75	50
10	100	75	50
11	100	75	50
12	100	75	50
13	100	75	50
14	100	75	50
15	100	75	50
16	100	75	50
17	100	75	50
18	100	75	50
19	100	75	50
20	0	0	0
21	0	0	0
22	0	0	0
23	0	0	0
Weighted Ave (%):	**50.0.**	**37.5**	**25.0**

CONDENSING BOILERS UNDER 300 MBH

Small Commercial – New/Existing

Efficient Technology & Equipment Description
Condensing boilers having annual fuel utilization efficiency (AFUE) of 90% or greater. Boiler input size is under 300,000 Btu/hr. Application is for seasonal or non-seasonal use. MBH is defined throughout this document as 1,000 Btu/hr.
Base Technology & Equipment Description
Non-condensing boiler having an AFUE of 80% for either seasonal or non-seasonal use. Boiler input size is under 300,000 Btu/hr.

Resource Savings Assumptions

Natural Gas	**<u>Seasonal</u>** **0.0108 m^3 /(Btu/hr Boiler Input)** **<u>Non-Seasonal</u>** **Boiler Input Under 100 MBH = 0.03579 m^3 /(Btu/hr Boiler Input)** **Boiler Input 100 To Under 200 MBH = 0.02196 m^3 /(Btu/hr)** **Boiler Input 200 To Under 300 MBH = 0.01643 m^3 /(Btu/hr)**

<u>Estimation Based on Agviro Study for Enbridge</u>

- Based on Agviro's report[1], the energy analysis compares use of a condensing boiler having an AFUE of 93% versus a base case non-condensing boiler having an AFUE of 80%.
- The normalized gas use for a seasonal base case boiler is determined by the relationship:

  $$Normalized\ Gas\,Use = 77.575 \times BoilerIP$$

  where:

  BoilerIP = seasonal boiler input size (MBH)
  Normalized Gas Use = normalized annual seasonal gas use (m3/yr)

- The gas savings for a non-seasonal base case boiler is determined by the relationship:

  $$NonSeasonal\ Gas\,Use = 36.282 \times BoilerIP + 9256.9$$

  where:

  BoilerIP = seasonal boiler input size (MBH)
  Non Seasonal Gas Use = annual non-seasonal gas use (m3/yr)

- The gas savings of the condensing versus the base case boiler is determined by the relationship:

  $$GasSavings = GasUse \times (1 - \frac{\%Eff_{BC}}{\%Eff_{CE}})$$

---

[1] Prescriptive Savings Analysis – Condensing Boilers Under 300MBH, Agviro Inc., Jan 17, 2011

where:

GasUse = seasonal or non-seasonal gas use (m3)
$\%Eff_{BC}$ = Efficiency of the Base Case boiler
[seasonal = 80%; non-seasonal=66.2%]
$\%Eff_{CE}$ = Efficiency of the Condensing boiler
[seasonal = 93%; non-seasonal=85.32%]
GasSavings = annual gas savings (m3/yr)

- On a per Btu/hr boiler input basis, the natural gas savings is:
  - seasonal boiler = 0.0108 m^3 / (Btu/hr)
  - non-seasonal boiler =
    - Boiler Input Under 100 MBH = 0.03579 m^3 /(Btu/hr Boiler Input)
    - Boiler Input 100 To Under 200 MBH = 0.02196 m^3 /(Btu/hr)
    - Boiler Input 200 To Under 300 MBH = 0.01643 m^3 /(Btu/hr)

Electricity	**0 kWh**

Water	**0 L**

Other Input Assumptions

Equipment Life	**25 yrs**

-

Incremental Cost

Existing Construction

Boiler Input (MBH)	**Incremental Cost ($)**
Under 100	**$2,045**
100 To Under 200	**$2,984**
200 To Under 300	**$3,797**

New Construction

Boiler Input (MBH)	**Incremental Cost ($)**
Under 100	**$1,475**
100 To Under 200	**$2,414**
200 To Under 300	**$3,227**

Incremental costs account for differences in venting, controls and labour.

Incremental Cost – Existing Construction

- Boiler Input Under 100 MBH = $2,045
- Boiler Input 100 To Under 200 MBH = $2,984
- Boiler Input 200 To Under 300 MBH = $3,797

<u>Incremental Cost – New Construction</u>

- Boiler Input Under 100 MBH = $1,475
- Boiler Input 100 To Under 200 MBH = $2,414
- Boiler Input 200 To Under 300 MBH = $3,227

HIGH EFFICIENCY BOILERS UNDER 300 MBH

Small Commercial – New/Existing

Efficient Technology & Equipment Description
High Efficiency non-condensing boilers having annual fuel utilization efficiency (AFUE) of 85% or greater. Boiler input size is under 300,000 Btu/hr. Application is for seasonal or non-seasonal use. MBH is defined throughout this document as 1,000 Btu/hr.
Base Technology & Equipment Description
Non-condensing boiler having an AFUE of 80% for either seasonal or non-seasonal use. Boiler input size is under 300,000 Btu/hr.

Resource Savings Assumptions

Natural Gas	**Seasonal** **0.00665 m^3 /(Btu/hr Boiler Input)** **Non-Seasonal** **Boiler Input Under 100 MBH = 0.02430 m^3 /(Btu/hr Boiler Input)** **Boiler Input 100 To Under 200 MBH = 0.01491 m^3 /(Btu/hr)** **Boiler Input 200 To Under 300 MBH = 0.01115 m^3 /(Btu/hr)**

Estimation Based on Agviro Study for Enbridge

- Based on Agviro's report[1], the energy analysis compares use of a high efficiency non-condensing boiler having an AFUE of 87.5% versus a base case non-condensing boiler having an AFUE of 80%.
- The normalized gas use for a seasonal base case boiler is determined by the relationship:

$$Normalized\ Gas\ Use = 77.575 \times BoilerIP$$

where:

BoilerIP = seasonal boiler input size (MBH)
Normalized Gas Use = normalized annual seasonal gas use (m3/yr)

- The gas savings for a non-seasonal base case boiler is determined by the relationship:

$$NonSeasonal\ Gas\ Use = 36.282 \times BoilerIP + 9256.9$$

where:

BoilerIP = seasonal boiler input size (MBH)
Non Seasonal Gas Use = annual non-seasonal gas use (m3/yr)

- The gas savings of the condensing versus the base case boiler is determined by the relationship:

[1] Prescriptive Savings Analysis – Condensing Boilers Under 300MBH, Agviro Inc., Jan 17, 2011

$$GasSavings = GasUse \times (1 - \frac{\%Eff_{BC}}{\%Eff_{CE}})$$

where:

GasUse = seasonal or non-seasonal gas use (m3)
$\%Eff_{BC}$ = Efficiency of the Base Case boiler
[seasonal = 80%; non-seasonal=66.2%]
$\%Eff_{CE}$ = Efficiency of the Condensing boiler
[seasonal = 87.5%; non-seasonal=78.08%]
GasSavings = annual gas savings (m3/yr)

- On a per Btu/hr boiler input basis, the natural gas savings is:
  - seasonal boiler = 0.00665 m^3 / (Btu/hr)
  - non-seasonal boiler =
    - Boiler Input Under 100 MBH = 0.02430 m^3 /(Btu/hr Boiler Input)
    - Boiler Input 100 To Under 200 MBH = 0.01491 m^3 /(Btu/hr)
    - Boiler Input 200 To Under 300 MBH = 0.01115 m^3 /(Btu/hr)

Electricity	**0 kWh**

Water	**0 L**

Other Input Assumptions

Equipment Life	**25 yrs**

-

Incremental Cost

<u>Existing Construction</u>

Boiler Input (MBH)	**Incremental Cost ($)**
Under 100	**$1,808**
100 To Under 200	**$2,114**
200 To Under 300	**$1,958**

<u>New Construction</u>

Boiler Input (MBH)	**Incremental Cost ($)**
Under 100	**$1,238**
100 To Under 200	**$1,544**
200 To Under 300	**$1,388**

Incremental costs account for differences in venting, controls and labour.

<u>Incremental Cost – Existing Construction</u>

- Boiler Input Under 100 MBH = $1,808
- Boiler Input 100 To Under 200 MBH = $2,114
- Boiler Input 200 To Under 300 MBH = $1,958

Incremental Cost – New Construction

- Boiler Input Under 100 MBH = $1,238
- Boiler Input 100 To Under 200 MBH = $1,544
- Boiler Input 200 To Under 300 MBH = $1,388

Low-Flow Showerhead (Various GPM, Enbridge TAPS, ESK and Multi-Family)

Revision #	Description/Comment	Date Revised
		September 20, 2010

Efficient Equipment and Technologies Description	
Low-flow Showerhead (1.25 or 1.5 GPM) – distributed to participants under Enbridge's TAPS program, Enbridge's ESK program, Enbridge's Multi-Family program and Enbridge's Low-Income program.	
Base Equipment and Technologies Description	
Enbridge TAPS (existing only)	– 2.45 GPM or – 3.07 GPM[1]
Enbridge ESK (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Multi-Family (MF) (existing only)	– 2.25 GPM – 2.8 GPM – 3.3 GPM – 3.6 GPM[2]
Enbridge Multi-Family (MF) (new only)	– Maximum allowable by OBC (2.5 GPM)
Enbridge Low-Income	– 2.45 GPM or – 3.07[3]

Decision Type	Target Market(s)	End Use
Enbridge TAPS - Existing, Enbridge ESK – New Only, Enbridge MF – New and Existing	Residential, Low-Income, Multi-family	Water heating

[1] Enbridge load research indicates that that the average bag-tested flow rate for showerheads that fall within the 2.0 – 2.5 GPM bucket is 2.45 GPM and that the average bag-tested flow rate for showerheads that fall within the >2.5 GPM bucket is 3.07.

[2] Enbridge contractors install the showerheads as part of the Enbridge Multi-Family program. The base measure is reported as falling in one of four buckets, 2.0 – 2.5 GPM, 2.6 – 3.0 GPM, 3.1 – 3.5 GPM and greater than 3.6 GPM. Navigant has assumed that in each case the average base technology GPM for each of the first three buckets is the mid-point and that the average GPM for the fourth bucket is the lowest possible value; 3.6 GPM

[3] The average GPM of low-income households' showerheads is assumed by Navigant to be no different than that of standard single family households'.

Codes, Standards, and Regulations

Ontario Building Code (2006)[4] requires shower heads to have a maximum flow of 2.5 GPM (9.5 L/min).

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	21 – 82	0	5,931 – 23,374	6	0
2	21 – 82	0	5,931 – 23,374	0	0
3	21 – 82	0	5,931 – 23,374	0	0
4	21 – 82	0	5,931 – 23,374	0	0
5	21 – 82	0	5,931 – 23,374	0	0
6	21 – 82	0	5,931 – 23,374	0	0
7	21 – 82	0	5,931 – 23,374	0	0
8	21 – 82	0	5,931 – 23,374	0	0
9	21 – 82	0	5,931 – 23,374	0	0
10	21 – 82	0	5,931 – 23,374	0	0
TOTALS	**215 - 815**	**0**	**59,307 – 233,744**	**EG TAPS 1.25 GPM = $19.00 EG LI 1.25 GPM = $18.71 EG ESK 1.25 GPM = $4.26 EG ESK 1.5 GPM = $12.50 EG ESK 1.5 & 1.25 GPM = $16.76 EG Multi-Fam 1.5 GPM = $12.50 EG Multi-Fam 1.25 GPM = $12.50**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	21 – 82 m^3

Enbridge Gas commissioned a study by the SAS Institute (Canada)[5] to estimate natural gas savings for low-flow showerheads in Enbridge territory. Data was collected August 31, 2007 until August 31, 2009 for both treatment and control groups. Low flow showerheads were installed in treatment households between August 13, 2008 and October 30, 2008. There were 54 households with low-flow showerheads and 124 households without low-flow showerheads.

To calculate the gas savings, three different models were used to analyze the gas consumption data

1) a comparison made during the same time frame (post-installation) between a control set of households[6] and households that had them installed
2) a Pre & Post installation analysis on the same households, and
3) a complex time trend model analysis that factored in many household characteristics over the whole Pre & Post time period.

All three analyses agreed well with each other.[7]

Three buckets for pre-existing showerheads 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. The natural gas savings for the other two buckets are estimated to be as follows:

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[4] Ontario Regulations 350/06, 2006 Building Code
[5] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010
[6] Where no low-flow showerheads were ever installed
[7] Model 1 – a blended rate of 71.3 m3/yr (only models II and II provided bucketed savings estimates)
Model 2 – a blended rate of 67.4 m3/yr (45.4 m3/yr for 2 to 2.5 GPM bucket and 87.8 m3/yr for over 2.5 GPM), and
Model 3 – a blended rate of 77.2 m3/yr (46.4 m3/yr for 2 to 2.5 GPM bucket and 87.9 m3/yr for over 2.5 GPM).

Table 1 - SAS Study Results

Bucket for Base Showerhead	Average Flow Rate of SAS Sample (GPM)	Annual Natural Gas Savings (m3)
2.0 to 2.5 GPM	2.36	46
> 2.5 GPM	3.19	88

To extrapolate the savings estimates reported in the SAS study to the base technologies under consideration several steps are required.

1. **Estimate the "as-used" flow of the base and efficient technologies.**

In its report on showerhead savings, Summit Blue[8], notes that the actual flow-rate as used in showers has been found to differ somewhat from the nominal flow-rate. Citing a 1994 California study, they provide an equation for calculating the "as-used" flow:

As-used flow rate (GPM) = 0.691 + 0.542*Nominal flow rate (GPM)

Navigant notes that applying this equation to a showerhead with a 1.25 GPM flow rate would result in an as-used flow rate that is greater than the nominal flow rate. Navigant has therefore applied a somewhat modified version of the equation above to determine the as-used flow rate. The as-used flow rate is estimated to be the minimum of either the result of the equation above or the nominal flow rate.

Applying the modified equation to Table 1, above, we obtain the following:

Table 2 - As-Used Flow

Nominal Flow (GPM)		As-Used Flow (GPM)		Delta As-Used Flow (GPM)	Observed Savings (m^3)
Base Technology	Efficient Measure	Base Technology	Efficient Measure		
2.36	1.25	1.97	1.25	0.72	46
3.19	1.25	2.42	1.25	1.17	88

2. **Estimate the average annual natural gas consumption of a 1.25 GPM showerhead.**

Based on the values above, Navigant has estimated that the annual natural gas consumption of the 1.25 GPM showerhead is 87 m^3 per year.

Table 3 - Annual Natural Gas Consumption of a 1.25 GPM Showerhead

Delta As-Used Flow (GPM)	Observed Savings (m^3)	Efficient Technology As-Used Flow (GPM)	Implied Annual Gas Consumption of Efficient Technology (m^3)	Average (m^3)
A	B	C	D = (C/A)*B	E = Average(D)
0.72	46	1.25	80	87
1.17	88	1.25	94	

8 Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, prepared for Union Gas and Enbridge Gas Distribution, June 2008

3. Extrapolate the implied annual natural gas consumption of showerheads in both buckets identified by the SAS Institute.

Extrapolating these values is simply a matter of adding the estimated savings by bucket to the estimated annual consumption of the 1.25 GPM showerhead.

Table 4 - Implied Annual Natural Gas Consumption by Showerhead Flow Rate

Nominal Flow Rate (GPM)	Implied Annual Natural Gas Consumption (m3)
1.25	87
2.36	133
3.19	175

4. Estimate an equation from which the annual natural gas consumption of showerheads with flow rates different to those above may be extrapolated.

Fitting a polynomial equation to the three data-points in Table 4 above delivers the following equation which may be used to extrapolate the annual natural gas consumption of a given showerhead:

$$y = 49.06 + 24.39x + 4.72x^2$$

Where:

y = Annual natural gas consumption (m^3)
x = Nominal GPM of showerhead

Navigant notes that given the manner in which this equation was derived, and the values of the parameters, it may be inappropriate to use this equation to extrapolate the annual natural gas consumption of showerheads with a nominal flow rate that is less than 1.25 GPM.

In multi-family homes, Navigant has adjusted savings based on number of occupants per household to reflect differences in patterns of use. The adjustment factor is the fraction of average number of occupants per household in an apartment building over the average number of occupants per household in a single-detached house[9]. This factor is (2/2.9) = 69% for buildings over 5 stories and (1.9/2.9) = 66% for buildings of five stories or less. The average of these two factors, weighted by the number of each type of household is 68%.

It should be noted that the savings below are per household and predicated on the assumption that all showers taken in that household are taken using a shower with the low-flow showerhead. In the program measurement and verification stage, Enbridge will undertake to determine what proportion of showers per household were taken with the efficient measure and apply this factor to previously calculated savings.

[9] Statistics Canada. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and Census Agglomerations, 2006 Census - 100% Data* (Table) *Census 2006.* Last updated Dec 6, 2008.
http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

Table 5 - Natural Gas Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Annual Gas Savings (m^3)	Lifetime Gas Savings (m^3)
EG TAPS	Standard Res	2.45	1.25	50	502
EG TAPS	Standard Res	3.07	1.25	82	815
EG Low-Income	LIA	2.45	1.25	50	502
EG Low-Income	LIA	3.07	1.25	82	815
EG ESK (New Only)	Standard Res	2.50	1.25	53	526
EG ESK (New Only)	Standard Res	2.50	1.50	43	433
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	48	480
EG MF (New Only)	Multi-Family	2.50	1.25	36	358
EG MF (New Only)	Multi-Family	2.50	1.50	29	294
EG MF	Multi-Family	2.25	1.50	21	215
EG MF	Multi-Family	2.80	1.50	40	395
EG MF	Multi-Family	3.30	1.50	58	576
EG MF	Multi-Family	3.60	1.50	69	692

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Annual Electricity Savings — 0 kWh

N/A

Annual Water Savings — 5,931 – 23,374 L

Since the SAS report did not look at water savings, Navigant Consulting proposes the following method for calculating resulting water savings:

Assumptions and inputs:

- As-used flow rate with base and efficient equipment:

Base Technology	
Nominal GPM	As-Used GPM
2.45	2.02
3.07	2.35
2.5	2.05
2.25	1.91
2.8	2.21
3.3	2.48
3.6	2.64

Efficient Technology	
Nominal GPM	As-Used GPM
1.25	1.25
1.5	1.50

- Average household size: 3.1 persons (Standard Res and LIA)[10], 2.09 persons (Multi-family)[11]

[10] Summit Blue (2008).

[11] To maintain consistency with Summit Blue number but to reflect the fact that apartments are generally occupied by fewer people than houses, the Summit Blue number was degraded by the ratio of the average number of inhabitants per apartment (1.96) to the average number of inhabitants of a fully detached house in Ontario (2.9). Statistics Canada. No date. *Structural Type of Dwelling (10) and Household Size (9) for Occupied Private Dwellings of Canada, Provinces, Territories, Census Metropolitan Areas and*

- Showers per capita per day: 0.75[12]
- Average showering time per capita per day with base and efficient equipment[13]:

Base Technology	
As-Used GPM	Showering Time
2.02	7.28
2.35	7.13
2.05	7.27
1.91	7.33
2.21	7.20
2.48	7.08
2.64	7.01

Efficient Technology	
As-Used GPM	Showering Time
1.25	7.62
1.5	7.51

Annual water savings calculated as follows:

$$Savings = Ppl * Sh * 365 * \left(T_{base} * Fl_{base} - T_{eff} * Fl_{eff}\right)$$

Where:

Ppl = Number of people per household
Sh = Showers per capita per day
365 = Days per year
T_{base} = Showering time with base equipment (minutes)
T_{eff} = Showering time with efficient equipment (minutes)
Fl_{base} = As-used flow rate with base equipment (GPM)
Fl_{eff} = As-used flow rate with efficient equipment (GPM)

Census Agglomerations, 2006 Census - 100% Data (Table) *Census 2006.* Last updated Dec 6, 2008. http://www12.statcan.ca/english/census06/data/topics/RetrieveProductTable.cfm?ALEVEL=3&APATH=3&CATNO=&DETAIL=0&DIM=&DS=99&FL=0&FREE=0&GAL=0&GC=99&GID=837983&GK=NA&GRP=1&IPS=&METH=0&ORDER=1&PID=89071&PTYPE=88971&RL=0&S=1&SUB=0&ShowAll=No&StartRow=1&Temporal=2006&Theme=69&VID=0&VNAMEE=&VNAMEF=

[12] Summit Blue (2008), based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007

[13] Relationship modeled as: Average shower length = 8.17 – 0.448 * as-used GPM. From Energy Center of Wisconsin Analysis of data from Resource Management Strategies, Inc., *Regional Municipality of York Water Efficiency Master Plan Update,* April 2007. Cited in Summit Blue (2008)

Table 6 - Annual Water Savings

Program	Applicable Customer Group	Base Flow Rate	Efficient Measure Flow Rate	Base Flow Rate (as-used)	Efficient Measure Flow Rate (as-used)	Annual Water Savings (L)	Lifetime Water Savings (L)
EG TAPS	Standard Res	2.45	1.25	2.02	1.25	16,631	166,309
EG TAPS	Standard Res	3.07	1.25	2.35	1.25	23,374	233,744
EG Low-Income	LIA	2.45	1.25	2.02	1.25	16,631	166,309
EG Low-Income	LIA	3.07	1.25	2.35	1.25	23,374	233,744
EG ESK (New Only)	Standard Res	2.50	1.25	2.05	1.25	17,187	171,866
EG ESK (New Only)	Standard Res	2.50	1.50	2.05	1.50	11,596	115,958
EG ESK (New Only)	Standard Res	2.50	1.25 & 1.5*	2.05	1.38	14,391	143,912
EG MF (New Only)	Multi-Family	2.50	1.25	2.05	1.25	11,587	115,871
EG MF (New Only)	Multi-Family	2.50	1.50	2.05	1.50	7,818	78,178
EG MF	Multi-Family	2.25	1.50	1.91	1.50	5,931	59,307
EG MF	Multi-Family	2.80	1.50	2.21	1.50	10,036	100,362
EG MF	Multi-Family	3.30	1.50	2.48	1.50	13,621	136,214
EG MF	Multi-Family	3.60	1.50	2.64	1.50	15,705	157,054

** Participants in Enbridge's ESK program receive both a 1.25 and 1.5 GPM showerhead. Navigant has assumed that both are used equally and that resultant household savings are equivalent to the average savings of a household that receives only 1.5 GPM showerheads and a household that receives only 1.25 GPM showerheads. Enbridge has indicated that in the future new households may receive either only 1.5 or 1.25 GPM showerheads. These households would attain the corresponding savings shown above.*

Other Input Assumptions

Effective Useful Life (EUL)	**10 Years**
Summit Blue (2008) suggests an EUL of 10 years based on a survey of five studies of showerheads in other jurisdictions (California – two studies, New England, Vermont, Arkansas).	
Incremental Costs	**EG TAPS 1.25 GPM = $19.00** **EG LI 1.25 GPM = $18.71** **EG ESK 1.25 GPM = $4.26** **EG ESK 1.5 GPM = $12.50** **EG ESK 1.5 & 1.25 GPM = $16.76** **EG Multi-Fam 1.5 GPM = $12.50** **EG Multi-Fam 1.25 GPM = $12.50**
Incremental cost for EG TAPS, ESK, LI and Multi-Family based on utility bulk purchase costs.	

Programmable Thermostat - Commercial

Revision #	Description/Comment	Date Revised
		September 29, 2010

Efficient Equipment and Technologies Description

Programmable thermostat assuming full set-back.

Base Equipment and Technologies Description

Standard non-programmable thermostat.

Decision Type	Target Market(s)	End Use
Existing	Commercial	Space heating

Codes, Standards, and Regulations

- To be an Energy Star®-qualified programmable thermostat, the device must have at least two different programming periods, four possible temperature settings and allow for temporary user-override.
- CSA C828-99- CAN/CSA Performance Requirements for Thermostats

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	10 - 132	8 – 87			
2	10 - 132	8 – 87			
3	10 - 132	8 – 87			
4	10 - 132	8 – 87			
5	10 - 132	8 – 87			
6	10 - 132	8 – 87			
7	10 - 132	8 – 87			
8	10 - 132	8 – 87			
9	10 - 132	8 – 87			
10	10 - 132	8 – 87			
11	10 - 132	8 – 87			
12	10 - 132	8 – 87			
13	10 - 132	8 – 87			
14	10 - 132	8 – 87			
15	10 - 132	8 – 87			
TOTALS	**144 – 1,984**	**127 – 1,301**	**0**	**$110**	

Resource Savings Assumptions

Annual Natural Gas Savings	10 – 132 m^3

The online Energy Star® spreadsheet calculator for programmable thermostats suggests that for every degree Fahrenheit in temperature reduction there is a 3% reduction in space-heating natural gas consumption.

Union Gas estimates that, corrected for the average outdoor heating season temperature, for every degree Fahrenheit in temperature reduction there is a 2.4% reduction in natural gas consumption in southern and central Ontario and a 2.05% reduction in natural gas consumption in northern Ontario[1]. The weighted average percentage savings, based on Enbridge's overall distribution of customers (80% Central, 20% Eastern) is 2.33%.

Given the climatic similarity between Union's northern Ontario (North Bay) territory and Enbridge's eastern territory (Ottawa) and the climatic similarity between Union's south/central territory (London) and Enbridge's central territory (Toronto), Navigant has assumed that gas savings would not substantially differ between Union's northern and Enbridge's eastern territories or between Union's south/central and Enbridge's central territories.

Under the assumption that full thermostat setback is 8 degrees Fahrenheit[2] this implies that for every hour in which the thermostat is fully set back, there is an 18.64% reduction in space-heating natural gas consumption.

It is likely that not all commercial customers will practice full set-back, and it is also likely that some percentage of commercial customers already practice manual set-back with a non-programmable thermostat. No robust data-set exists for Ontario that tracks this behaviour for commercial natural gas customers.

As a proxy, Navigant has used the results of a survey conducted as part of Navigant's evaluation of the Ontario Power Authority's (OPA) Hot and Cool Savings program, which asked participants about how they habitually set their thermostat both before and after obtaining a programmable thermostat. Residential customers that set back their thermostats an additional three or more degrees Celsius are assumed to be a proxy for the percentage of commercial customers that practiced full set-back as outlined by the Energy Star calculator (i.e., 8 degrees Fahrenheit). Residential customers that set back their thermostats an additional 1 – 3 degrees Celsius only are assumed to be a proxy for the percentage of commercial customers that practiced half of the full set-back as outlined by the Energy Star calculator (i.e., 4 degrees Fahrenheit).

Table 1 – Space-Heating Behaviour Change

Behaviour		Sub-Behaviour, With Programmable T-Stat	
Practiced Manual Set-Back	40%	No additional set-back	73%
		Additional full set-back	9%
		Additional partial set-back	19%
Did Not Practice Manual Set-Back	50%	No additional set-back	44%
		Additional full set-back	20%
		Additional partial set-back	35%
Data Not Available (Refused to Answer)	10%	N/A	N/A
		N/A	N/A
		N/A	N/A

Note that in some cases values may add to more or less than 100% due to rounding error

Navigant notes that the above distribution is very conservative. It is highly unlikely that those responding to

[1] Based on average temperatures in London, Ontario and North Bay, respectively. Estimated by Union Gas based on the 3% savings for the Energy Star calculator, adjusted by temperature norms in Union Gas territories. Drawn from Union Gas' March 13, 2009 response to Navigant's initial draft of *Measures and Assumptions For Demand Side Management* prepared for the Ontario Energy Board.

[2] Energy Star Calculator assumption. U.S. DOE, *Programmable Thermostat Tool*, http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=TH

the survey that practice manual thermostat set-back do so punctually every single evening of the year during the heating season. There are almost certainly incremental savings not captured in this sheet due to the automation of thermostat set-back amongst those that practice manual set-back. Lacking firm empirical data, however, these savings cannot accurately be estimated and are thus not included.

The Hot and Cool Savings findings in the table above (excluding those that did not answer the survey questions) imply:

Table 2 – Aggregated Behaviour and Savings

Implied Overall Behaviour (Excluding Those That Refused to Answer)	Distribution of Households	Natural Gas Savings
No additional set-back	57%	0%
Additional full set-back	15%	18.64%
Additional partial set-back	28%	9.32%

The average natural gas savings per business on any given hour when the temperature is set back may therefore be calculated as: 57% x 0% + 15% x 18.64% + 28% x 9.32% = 5.41%

This percentage saving may then be applied to

a. All hours in which it is expected that the thermostat could be set back for a given market segment
b. The space-heating energy intensity of that market segment
c. The area of a building in that market segment which may reasonably be supposed to be controlled by an individual programmable thermostat.

The setback duration (a., above) has been estimated by Navigant and is shown in Table 3, below.

The energy intensity of each market segment, except Small Fitness/Spa[3], (b., above) has been drawn from a Marbek report recently completed for Enbridge Gas[4] and is shown in Table 3, below. The energy intensities used in Table 3 below are a weighted average based on the distribution of Enbridge customers between the Central and Eastern zones (80% Central, 20% Eastern).

The thermostat control area (c., above) has been provided by Union Gas based on internal research done by Union Gas staff and provided to Navigant and is shown in Table 4, below.

The segments identified by Marbek and those identified by Union Gas were mapped to each other as shown in Table 4, below.

Not all segments identified by Marbek are included. Some segments (e.g., Large Offices) identified by Marbek generally have large-scale central controls for temperature settings and do not make use of individual thermostats, programmable or otherwise.

[3] This intensity was drawn from table C24 of the 2003 CBECS tables published the U.S. DOE and calibrated to Ontario's climate through a comparison with other CBECs intensities and those found in the Marbek report.

[4] Marbek Resource Consultants, *Natural Gas Energy Efficiency Potential: Update 2008 Commercial Sector*, May 2009

Table 3 – Annual Gas Savings per ft^2

Marbek Segment	Times in which thermostat set-back is possible	% of Time Set-Back Possible	% Savings	Energy Intensity (m^3/ft^2)	Gas Savings (m^3/ft^2)
Warehouse / Wholesale	12 hours/weekday & Sat, 24 hours Sunday	57%	3.1%	1.43	0.04
Small Office	12 hours/weekday, 24 hours weekends	64%	3.5%	1.72	0.06
Strip Mall	7 hours/night	29%	1.6%	1.18	0.02
Non-food retail (Mall)	7 hours/night	29%	1.6%	1.46	0.02
Food Retail	7 hours/night	29%	1.6%	2.30	0.04
Restaurant/Tavern	7 hours/night	29%	1.6%	3.74	0.06
Large Hotel	7 hours/night	29%	1.6%	1.43	0.02
Motel/Hotel	7 hours/night	29%	1.6%	1.32	0.02
School	12 hours/weekday, 24 hours weekends	64%	3.5%	1.91	0.07
University/College	12 hours/weekday, 24 hours weekends	64%	3.5%	1.71	0.06
Small Fitness/Spa	5 hours/night	21%	1.1%	1.24	0.01

Table 4 - Annual Gas Savings per Thermostat, by Segment

Union Gas Market Segment	Marbek Segment	Area of Thermostat Control Zone (ft^2)	Gas Savings (m^3/ft^2)	Annual Gas Savings (m^3/per thermostat)
Warehouse	Warehouse / Wholesale	3000	0.04	132
Office	Small Office	650	0.06	39
Retail	Strip Mall	600	0.02	11
Retail	Non-food retail (Mall)	600	0.02	14
Retail	Food Retail	600	0.04	22
Food Service	Restaurant/Tavern	1175	0.06	69
Hotels/Motels	Large Hotel	461	0.02	10
Hotels/Motels	Motel/Hotel	461	0.02	10
Educational Services	School	986	0.07	65
Educational Services	University/College	986	0.06	58
Recreation	Small Fitness/Spa	2500	0.01	35

Annual Electricity Savings	8 – 87 kWh

The online Energy Star® spreadsheet calculator for programmable thermostats suggests that for every degree Fahrenheit in temperature increase there is a 6% reduction in space cooling electricity consumption.

Under the assumption that full thermostat setup is 4 degrees Fahrenheit (from 74^{o} to 78^{o}F), this implies that for every hour in which the thermostat is set back, there is an 24% reduction in space-cooling electricity consumption.

It is likely that not all commercial customers will practice full set-back, and it is also likely that some percentage of commercial customers already practice manual set-back with a non-programmable thermostat. No robust data-set exists for Ontario that tracks this behaviour for commercial natural gas customers.

As a proxy, Navigant has used the results of a survey conducted as part of Navigant's evaluation of the Ontario Power Authority's (OPA) Hot and Cool Savings program, which asked participants about how they habitually set their thermostat after receiving a programmable one. Unfortunately participants (unlike for heating) were not asked to what temperature they set their thermostat to prior to having the programmable thermostat. Residential customers that set up their thermostats an additional three or more degrees Celsius are assumed to be a proxy for the percentage of commercial customers that practiced full set-up as outlined by the Energy Star calculator (i.e., 4 degrees Fahrenheit). Residential customers that set up their thermostats an additional 1 – 3 degrees Celsius only are assumed to be a proxy for the percentage of commercial customers that practiced half of the full set-up as outlined by the Energy Star calculator (i.e., 2 degrees Fahrenheit).

Table 5 - Space Cooling Behaviour Change

Thermostat set-back	Distribution of Households	Electricity Savings
No additional thermostat set-back	64%	0%
3 or more additional degrees set-back	13%	24%
1 - 3 additional degrees set-back	22%	12%

The average electricity savings per business on any given hour when the temperature is set up may therefore be calculated as: 64% x 0% + 13% x 24% + 22% x 12% = 5.87%

This percentage saving may then be applied to

a. All hours in which it is expected that the thermostat could be set up for a given market segment
b. The space-cooling energy intensity of that market segment
c. The area of a building in that market segment which may reasonably be supposed to be controlled by an individual programmable thermostat.
d. The market saturation (incidence of A/C) of central air-conditioning for a given market segment[5].

The setback duration (a., above) has been estimated by Navigant and is shown in Table 5, below.

The energy intensity of each market segment, except Small Fitness/Spa[6], segment (b., above) has been drawn from a Marbek report recently completed for Enbridge Gas[7] and is shown in Table 5, below. The energy intensities used in Table 6below are a weighted average based on the distribution of Enbridge customers between the Central and Eastern zones (80% Central, 20% Eastern).

The thermostat control area (c., above) has been provided by Union Gas based on internal research done by Union Gas staff and provided to Navigant and is shown in Table 6, below.

The segments identified by Marbek and those identified by Union Gas were mapped to each other as

[5] While there will of course be no electricity savings when this device is installed in a building without central air-conditioning, it is assumed that these devices will be installed in a representative sample of the population for that segment, thus making the average electricity savings per thermostat a function of the percent of the population in question that has central air-conditioning.

[6] Since the Marbek report does not include a space cooling energy intensity or A/C saturation for this segment, Navigant has assumed that both of these will be approximately the average of the space cooling intensity and A/C saturation of the Non-food Retail and Restaurant/Tavern segments.

[7] Marbek Resource Consultants, *Natural Gas Energy Efficiency Potential: Update 2008 Commercial Sector*, May 2009.

shown in Table 6, below.

The market saturation of central air-conditioning of each market segment, except Small Fitness/Spa (d., above) has been drawn from a Marbek report recently completed for Enbridge Gas[8] and is shown in Table 5, below. The saturations used are the weighted average of the Central and Eastern zone saturations, based on the distribution of Enbridge customers by zone (80% Central, 20% Eastern).

Not all segments identified by Marbek are included. Some segments (e.g., Large Offices) identified by Marbek generally have large-scale central controls for temperature settings and do not make use of individual thermostats, programmable or otherwise.

Table 6 – Annual Electricity Savings per ft²

Marbek Segment	Times in which thermostat set-back is possible	% of Time Set-Back Possible	Space Cooling Market Saturation	% Savings	Energy Intensity (kWh/ft^2)	Electricity Savings (kWh/ft^2)
Warehouse / Wholesale	12 hours/weekday & Sat, 24 hours Sunday	57%	10%	0.3%	0.90	0.003
Small Office	12 hours/weekday, 24 hours weekends	64%	86%	3.2%	2.06	0.07
Strip Mall	7 hours/night	29%	85%	1.5%	2.18	0.03
Non-food retail (Mall)	7 hours/night	29%	85%	1.5%	2.18	0.03
Food Retail	7 hours/night	29%	80%	1.4%	1.98	0.03
Restaurant/Tavern	7 hours/night	29%	85%	1.5%	4.50	0.07
Large Hotel	7 hours/night	29%	85%	1.5%	2.12	0.03
Motel/Hotel	7 hours/night	29%	85%	1.5%	1.68	0.02
School	12 hours/weekday, 24 hours weekends	64%	15%	0.6%	1.52	0.01
University/College	12 hours/weekday, 24 hours weekends	64%	75%	2.8%	2.04	0.06
Small Fitness/Spa	5 hours/night	21%	85%	1.0%	3.34	0.03

[8] Marbek Resource Consultants, *Natural Gas Energy Efficiency Potential: Update 2008 Commercial Sector*, May 2009.

Table 7 - Annual Electricity Savings per Thermostat, by Segment

Union Gas Market Segment	Marbek Segment	Area of Thermostat Control Zone (ft^2)	Electricity Savings (kWh/ft^2)	Annual Electricity Savings (kWh/ per thermostat)
Warehouse	Warehouse / Wholesale	3000	0.003	9
Office	Small Office	650	0.07	43
Retail	Strip Mall	600	0.03	19
Retail	Non-food retail (Mall)	600	0.03	19
Retail	Food Retail	600	0.03	16
Food Service	Restaurant/Tavern	1175	0.07	77
Hotels/Motels	Large Hotel	461	0.03	14
Hotels/Motels	Motel/Hotel	461	0.02	11
Educational Services	School	986	0.01	8
Educational Services	University/College	986	0.06	57
Recreation	Small Fitness/Spa	2500	0.03	87

Annual Water Savings	**0 L**
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	**15 Years**
Navigant has assumed the effective useful life of this measure to be fifteen years, in accordance with that given on the Energy Star® web-site.	
Incremental Costs	**$110**
Navigant has assumed that the average incremental cost of a commercial-grade programmable thermostat is $110 based on the on-line price for the Honeywell MULTIPRO Commercial Thermostat.	

Programmable Thermostat – Multi-Residential

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Programmable thermostat.
Base Equipment and Technologies Description
Standard thermostat.

Decision Type	Target Market(s)	End Use
Existing	Existing Multi-Residential	Space Heating

Codes, Standards, and Regulations

- For a programmable thermostat to receive Energy Star® qualification, it must meet specific criteria such as having at least two different programming periods (for weekday and weekend programming), at least four possible temperature settings and allow for temporary overriding by the user.
- In Canada, applicable CSA standards can be found in CSA C828-99- CAN/CSA Performance Requirements for Thermostats used with Individual Room Electric Space Heating Devices.

Resource Savings Table

	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
Year (EUL=)	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	15	13	0	80	0
2	15	13	0	0	0
3	15	13	0	0	0
4	15	13	0	0	0
5	15	13	0	0	0
6	15	13	0	0	0
7	15	13	0	0	0
8	15	13	0	0	0
9	15	13	0	0	0
10	15	13	0	0	0
11	15	13	0	0	0
12	15	13	0	0	0
13	15	13	0	0	0
14	15	13	0	0	0
15	15	13	0	0	0
TOTALS	**225**	**195**	**0**	**80**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	15 m^3

- The savings calculated below for a household living in a multi-residential dwelling (i.e., an apartment) are predicated on the assumption that the occupants of the dwelling are responsible for paying for the natural gas they use and thus subject to the economic incentive to actually program the thermostat.
- Two utility studies[1] are used to determine savings resulting from residential programmable thermostats on natural gas consumptions.

  - In the ***GasNetworks*** study[2], 4,061 mail-in surveys and bills were analyzed. Results were normalized for temperature and the energy impacts were determined through a multivariate regression analysis. The study found that programmable thermostat saved 6 % of total household annual natural gas use. GasNetworks is proposing 75 ccf (212 m^3) natural gas savings based on a Non-Programmable Thermostat annual consumption of 1,253 ccf (3,548 m^3) natural gas.
  - In the ***Enbridge Billing Analysis***[3], 911 customers' natural gas consumption was analyzed in 2005. Enbridge determined an average savings of 159 m^3 for a house using 2,878 m^3 of natural gas.

- Canadian Centre for Housing Technology (CCHT) also conducted a study in 2005 on programmable thermostat natural gas savings[4]. The study was done in two identical research homes located in Ottawa to allow direct comparison of changes in operating conditions in a home. It reports a 6.5% predicted savings for 18^{o}C night setback.
- Based on these three studies, Navigant is assuming an average saving at 6% for natural gas consumptions for full temperature set back in single-family homes.

Table 1 - Gas Savings From Previous Studies

Studies	Baseline Gas Consumption (m^3)	Gas Savings (m^3)	Gas Savings%
GasNetworks (2007)	3,548	212	6.0%
Enbridge (2005)	2,878	159	5.5%
CCHT (2005)	-	-	6.5%
NCI Average			6.0%

- Applying the 6% savings estimated above for single-family homes to multi-family homes would require that multi-family household space-heating natural gas use is the same proportion of total multi-family household natural gas use as single-family household space-heating natural gas use is of total single family household natural gas use. An examination of NRCan data[5] implies that this is not, in fact, the case.

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[1] "Resource Savings Values in Selected Residential DSM Prescriptive Programs", Summit Blue Consulting, June 2008.
[2] RLW Analytics, Validating the impact of programmable thermostats: final report. Prepared for GasNetworks by RLW Analytics. Middletown, CT, January 2007.
[3] "Resource Savings Values in Selected Residential DSM Prescriptive Programs", Summit Blue Consulting, June 2008.
[4] The Effects of Thermostat Setting on Seasonal Energy Consumption at the CCHT Research Facility, Manning, Swinton, Szadkowski, Gusdorf, Ruest, February 14, 2005, http://irc.nrc-cnrc.gc.ca/pubs/rr/rr191/rr191.pdf
[5] Comprehensive Energy Use Database Tables, Residential Sector – Ontario, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_on.cfm?attr=0

Table 2 - Estimate of Proportion of NG Use for Space-Heating

Structural Type of Dwelling	Total Natural Gas Use (PJ)	Total Space-Heating Energy Use (PJ)	% of Space-Heating Energy Use That is NG*	Implied Space-Heating Natural Gas Use (PJ)	% of NG Use That is Space-Heating
Apartment	56	42	72%	30	53%
Single-Family Detached	252	272		196	78%

** Estimates are available only for all of Ontario and are not split by dwelling type.*

- The above table implies that a 6% reduction in total natural gas use in single-family homes is equivalent to a (6%/78%) = 7.74% reduction in space-heating natural gas use.
- Applying these savings to the multi-family sector (i.e., apartments), implies that for full set-back multi-family homes save (7.74%*53%) = 4.13% of total annual natural gas use.

Taking into account behavioural changes:

- Based on a recent Statistics Canada report[6], approximately 41% of Ontario households with non-programmable or non-programmed thermostats manually set back their thermostat at night (19% lowered by 3 or more degrees, 21% lowered by 1 or 2 degrees) in the winter season, whereas 59% did not lower their thermostat before going to sleep.
- Similar values were found based on an evaluation Ontario Power Authority's 2007 Hot and Cool Savings Program conservation program, a summary of which are presented in the table below.

Table 3 - Distribution of Behaviour 1

Behaviour		Sub-Behaviour, With Programmable T-Stat	
Practiced Manual Set-Back	40%	No additional set-back	73%
		3 or more degrees additional set-back	9%
		1 - 3 more degrees additional set-back	19%
Did Not Practice Manual Set-Back	50%	No additional set-back	44%
		3 or more degrees additional set-back	20%
		1 - 3 more degrees additional set-back	35%
Data Not Available (Refused to Answer)	10%	N/A	N/A
		N/A	N/A
		N/A	N/A

Note that in some cases values may add to more or less than 100% due to rounding error

- Navigant notes that the above distribution is very conservative. It is highly unlikely that those responding to the survey (either Navigant's or StatCan's) that practice manual thermostat set-back do so punctually every single evening of the year during the heating season. There are almost certainly incremental savings not captured in this sheet due to the automation of thermostat set-back amongst those that practice manual set-back. Lacking firm empirical data, however, these savings cannot accurately be estimated and are thus not included.
- The Hot and Cool Savings findings in the table above (excluding those that did not answer the survey questions) imply[7]:

[6] Statistics Canada, Household and Environment Survey, 2006

[7] For example: (40% Practiced Manual Set-Back*73% No Additional Set-Back + 50% Did Not Practice Manual Set-Back * 44% No Additional Set-Back)/(40% Practiced Manual Set-Back+50% Did Not Practice Manual Set-Back) = 57%

Table 4 - Distribution of Behaviour 2

Implied Overall Behaviour (Excluding Those That Refused to Answer)	Distribution of Households	Natural Gas Savings
No additional set-back	57%	0%
3 or more degrees additional set-back	15%	4.13%
1 - 3 more degrees additional set-back	28%	2.07%

- Average Ontario annual natural gas consumption by structural dwelling type may be estimated from NRCan data[8]:

Table 5 - Provincial Average NG Consumption

Structural Type of Dwelling	Total Housing Stock (thousands)	Total Natural Gas Use (PJ)	Natural Gas Use Per Household (m^3)*
Apartment	1400	56	1,046
Single-Family Detached	2774	252	2,379

** 1 GJ = 26.137 m^3 of NG*

- The average furnace natural gas consumption of a single family home in Enbridge's service territory is 2,291 m^3 and that of a water heater[9] is 550 m^3 for a total of 2,841 of m^3. This is somewhat higher than the average number reported by NRCan due to the fact that the NRCan number is an Ontario average and thus will include homes that use electricity for space and water heat. Scaling up the NRCan average annual natural gas consumption of apartments by the Enbridge single-family home/NRCan single-family home ratio (2,841/2,379 = 119%) implies that the average natural gas consumption for apartments in Enbridge's service territory is 1,249 m^3.
- Using the annual consumption derived above and the distribution derived in Table 4, above, Navigant estimates the following natural gas savings from the installation of programmable thermostats are:

  $1,249\ m^3 \times [15\%\times4.13\% + 28\% \times 2.07\%)] = 15\ m^3$
- This represents an overall savings of 1.2% of total annual natural gas use (15 m^3 / 1,249 m^3 = 1.2%)

Annual Electricity Savings	13 kWh

Heating Season Savings (Furnace fan)

- The following is based on the CCHT study analysing furnace fan consumption in relation to set back temperatures from programmable thermostats[10], adjusted by the ratio of apartment space-heating natural gas use to single-family space-heating natural gas use (30%).

Temperature Set Back	Total Winter Furnace Electricity Consumption (kWh)	Seasonal Savings (%)
None (22C)	700	0%
18 C night time set back	694	0.8%
18 C daytime and night time set back	687	1.9%

[8] Comprehensive Energy Use Database Tables, Residential Sector – Ontario, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_res_on.cfm?attr=0

[9] The average gas water heater consumption in Enbridge's service territory is 625 m^3 per year. According to EGD Load Research, 88% of EGD customers have a natural gas water heater, therefore the average annual consumption of gas for heating water in an EGD customer's home is 88%*625 m^3 = 550 m^3

Annual savings for full set-back night-time setback during the heating season are therefore 6 kWh.

- Applying the same behaviour changes as presented above in Table 4,furnace fan savings during the heating season are estimated to be as follows:

  6 kWh x (15% + 28%) = 2.58 kWh

Cooling Season Savings

- A side-by-side housing study conducted by the CCHT[10]. determined seasonal energy savings for a residential unit from a programmable thermostat as follows (the values below have been adjusted by the ratio of apartment space-heating natural gas use to single-family space-heating natural gas use, as above):

Temp Set Back	Total Summer Furnace and CAC Electricity Consumption (kWh)	Seasonal Savings (%)
None (22C)	938	0%
24 C daytime set back	837	11%
25 C daytime set back	719	23%

- A BC Hydro study[11] reports savings between 10% and 15% for 4°C set back during night and unoccupied periods, Energy Star Calculator[12] reports 6% saving per degree (Fahrenheit) for *cooling season*.
- Full-load cooling hours were estimated for Enbridge's service territory based on the findings of the Energy Center of Wisconsin[13]. The full-load cooling hours for Eau Claire and La Crosse were reported to be 293 and 361, respectively. These correspond to the average annual cooling degree days (CDD) in each location of 556 and 840, respectively. The average annual CDD for Ottawa and Toronto between 2000 and September 2010 were 570 and 718, respectively[14]. Using the relative CDD of Ottawa/Eau Claire and Toronto/La Crosse to factor the full-load cooling hours, the implied full-load cooling hours for Ottawa are 293 x (570/556) = 300 and for Toronto are 361 x (718/840) = 309. The average (304) of both cities' full-load cooling hours may be used as a reasonable proxy for the full-load cooling hours of Enbridge's service territory.
- Assuming that baseline multi-residential dwelling is equipped with a SEER 11[15], 1 ton[16] A/C unit and is used 304 hours per year[17], this implies that

  Base A/C electricity use = 304 (cooling hours)*[12,000 (Btu/hr)/(11 (SEER)* 1,000)] = 332 kWh

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[10] The Effects of Thermostat Setting on Seasonal Energy Consumption at the CCHT Research Facility, Manning, Swinton, Szadkowski, Gusdorf, Ruest, February 14, 2005, http://irc.nrc-cnrc.gc.ca/pubs/rr/rr191/rr191.pdf

[11] Marbek Resource Consultants, TheSheltair Group Inc, BC Hydro BC Hydro Conservation Potential Review 2002, Residential Sector Support (Base Year: Fiscal 2000/01) (Revision 1) Submitted to: BC Hydro, June 2003

[12] US EPA (EPA Energy Star® Simple Savings Calculator – Programmable Thermostat), http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorProgrammableThermostat.xls

[13] Energy Center of Wisconsin, *Central Air Conditioning in Wisconsin: A Compilation of Recent Field Research*, May 2008

[14] Although typically in Canada CDD are calculated based on Celsius, for comparative purposes in this case CDD were calculated based on Fahrenheit, with 65° F used as the threshold temperature.

[15] NRCan's Comprehensive Energy Use Data-Base for Ontario (Residential, Table 27) indicates that the average stock SEER of an Ontario CAC unit is 10.7 for 2008 – no data exist for 2009 or 2010. Projecting historical SEER for stock out to 2010 using a linear trend estimated on the historical data beginning in 2001, Navigant estimates that current (2010) stock SEER is approximately 11 (11.05).

[16] Ontario Power Authority, 2009 OPA Measures and Assumptions Lists (Mass Market), November 2008, referenced from: Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI), 2006 Cool Savings Rebate Program, Prepared for the Ontario Power Authority, April 2007, adjusted to reflect the fact that, on average multi-residential dwellings are 46% the size of single-family dwellings upon which the OPA Measures and Assumptions are based.

[17] Number of full-load cooling hours provided by http://energyexperts.org/ac%5Fcalc/ and based on the assumption that Ontario's climate is sufficiently similar to that of the north-eastern U.S.

Taking into Account Changes in Behaviour (Cooling Season)

- Based on the same program evaluation survey for the OPA[18], found that following the installation of a programmable thermostat, respondents:

Thermostat set-back	Distribution
No thermostat set-back	64%
3 or more degrees set-back	13%
1 - 3 more degrees set-back	22%

- The OPA Hot and Cool Savings survey did not ask about customer behaviour previous to the installation of the programmable thermostat and thus the percent of customers that practiced manual set-back in the summer cannot be estimated from these survey results.
- Statistics Canada's report, *Households and the Environment* does not report the percent of the population that manually adjusts the thermostat when they are away from home during the summer. Navigant Consulting has therefore assumed that the distribution of behaviour changes (shown above) is identical for both the population which practice manual temperature changes and that which did not. This implies :

Thermostat set-back	Distribution of Households	Electricity Savings
No additional thermostat set-back	64%	0%
3 or more additional degrees set-back	13%	23%
1 - 3 additional degrees set-back	22%	11%

- NCI estimates the following cooling season electricity savings for each programmable thermostat installed in households with central air conditioning:
  332 kWh x (64% x 0% + 13% x23% +22% x 11%) = 18 kWh

- However, assuming a penetration rate of central air conditioners in Ontario = 57%[19], NCI estimates that the average home in Ontario will save the following in electricity during the cooling savings:
  57% x 18 kWh = 10 kWh

- Total electricity savings for both heating (furnace fan) and cooling savings for an average Ontario home are estimated to be kWh (3 kWh + 10 kWh = 13 kWh).

Annual Water Savings	**0 L**
N/A	

Other Input Assumptions

Effective Useful Life (EUL)	**15 Years**
Navigant Consulting is estimating 15 years as the effective useful life based on the average lifetime of programmable thermostat from Energy Star ® website.	

Base & Incremental Conservation Measure Equipment and O&M Costs	**$80**
Enbridge, in consultation with trade allies has estimated the installation cost of this retrofit measure to be $40 (to be paid by Enbridge mail-in rebate) and estimated the equipment cost to be $40 following a review of retail outlets such as Home Depot by Enbridge Program Manager.	

[18] Navigant Consulting, Evaluation Report: 2007 Hot and Cool Savings Programs, prepared for the Ontario Power Authority (OPA), July 2008.
[19] Natural Resource Canada, Survey of Household Energy Use (SHEU), December 2005

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, permits issued prior to March 31, 2009.

Resource Savings Assumptions

Natural Gas	**1018 m³**
As approved in EB 2008-0384 & 0385. Gas savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[1] 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[2]	
Electricity	**1450 kWh**
As approved in EB 2008-384 & 0384. Electrical savings is based on a simple average of a new reference house, a 1 storey house, and a 2 storey house[1] 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.[1] 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[3]	
Water	**n/a L**

[1] Based on *Comparison of EnergyStar vs.Ontario Building Code 2006 Energy Use*, spreadsheets, from July and August, 2008, by Bowser Technical Inc.
[2] Conversation with Jennifer Tausman, ESNH files coordinator, NRCAN OEE, July 21, 2008
[3] 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..

Other Input Assumptions

Equipment Life	**25 years**
As approved in EB 2008-0384 & 0385. Energy Star homes have an estimated service life of 25 years (before major renovations are expected)	
Incremental Cost (Installed)	**$3,200**
As per Costing Analysis of Energy Star version 3 Specifications over the 2006 Ontario Building Code by Lio & Associates, May 2011.	
Free Ridership	**48 %**
As per 2009 Audit recommendation. Based on Auditors review of the Salt River Project (SRP) Powerwise Homes program (FY2009) in Arizona.	

2011 Free Ridership for New Measures

The following Free Ridership values for new measures were developed with complete consensus with the Enbridge EAC.

2011 Free Ridership for New Measures			
Measure	**Sector**	**Building Segment**	**Value**
Air Door (Shipping & Receiving)	Commercial and Industrial	New and Existing	5%
Condensing Make-up Air	Commercial	New and Existing	5%
Condensing Boiler (Under 300 MBH)	Commercial	New and Existing	5%
High Efficiency Boiler (Under 300 MBH)	Commercial	New and Existing	5%

Enbridge Gas Distribution

UPDATED DSM Input Assumptions for 2011 Program Year

(orange) Indicates Updated Assumption, Reviewed and Accepted by the EAC
(dark orange) Indicates New measure, Reviewed and Accepted by the EAC

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	$	%	
	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)	(k)	
	RESIDENTIAL NEW CONSTRUCTION									
1	CFL (13W) (8 bulbs)	60W Incandescent	n/a	-	360	-	8	$0.00	24%	
2	Energy Star Home (version 3)	Home built to OBC 2006	weather	1,018	1,450	0	25	$3,200.00	48%	Updated Assumption. Free Ridership consistent with 2009 Audit.
3	Energy Star Home (version 4)	Home built to OBC 2006 as of Mar 31, 2009	weather	881	734	0	25	$4,275.00	48%	Updated Assumption. Free Ridership consistent with 2009 Audit.
4	Faucet Aerator - 1.0 GPM (Kitchen, installed)	Ontario Building Code 2006 (2.2 GPM)	base	32	-	10,631	10	$1.00	31%	
5	Faucet Aerator - 1.0 GPM (Bathroom, installed)	Ontario Building Code 2006 (2.2 GPM)	base	10	-	3,435	10	$0.55	31%	
6	Faucet Aerator - 1.5 GPM (Kitchen, installed)	Average Existing Stock, 2.5 GPM	base	23	-	7,797	10	$1.65	31%	
7	Faucet Aerator - 1.5 GPM (Bathroom, installed) (3 aerators)	Average Existing Stock, 2.2 GPM	base	18	-	6,012	10	$2.72	31%	
8	Low-Flow Showerhead - 1.5 GPM (Per household)	Average Existing Stock, 2.5 GPM	base	43	-	11,596	10	$12.50	10%	Updated Assumption
9	Low-Flow Showerhead - 1.25 GPM (Per household)	Average Existing Stock, 2.5 GPM	base	53	-	17,187	10	$4.26	10%	Updated Assumption
10	Low-Flow Showerhead - 1.25 & 1.50 GPM (Per household)	Average Existing Stock, 2.5 GPM	base	48	-	14,391	10	$16.76	10%	Updated Assumption
11	High Efficiency Fireplace with Pilotless Ignition - Freestanding = Minimum 70% EnerGuide Rating	Freestanding fireplace = 65% median efficiency	weather	110	(31)	-	20	$135.00	17%	
12	High Efficiency Fireplace with Pilotless Ignition - Insert = Minimum 60% EnerGuide Rating	Insert = 55% median efficiency	weather	109	(31)	-	20	$135.00	17%	
13	High Efficiency Fireplace with Pilotless Ignition - Zero Clearance >= 40 kBtu.h =Minimum 60% EnerGuide Rating	Zero Clearance >= 40kBtu/h median efficiency	weather	122	(31)	-	20	$135.00	17%	
14	High Efficiency Fireplace with Pilotless Ignition - Zero Clearance < 40 kBtu.h =Minimum 70% EnerGuide Rating	Zero Clearance <40kBtu/h median efficiency	weather	108	(31)	-	20	$135.00	17%	
15	Programmable Thermostat	Standard Thermostat	weather	53	54	-	15	$53.22	10%	
16	Tankless Water Heater	Storage Tank Water Heater	base	130	-	-	18	$750.00	2%	
	RESIDENTIAL EXISTING HOMES									
17	Faucet Aerator - 1.0 GPM (Kitchen, installed)	Average Existing Stock, 2.5 GPM	base	35	-	11,694	10	1.00	31%	
18	Faucet Aerator - 1.0 GPM (Bathroom, installed)	Average Existing Stock, 2.2 GPM	base	10	-	3,435	10	.55	31%	
19	Faucet Aerator - 1.5 GPM (Kitchen, distributed)	Average Existing Stock, 2.5 GPM	base	23	-	7,797	10	$1	31%	
20	Faucet Aerator - 1.5 GPM (Bathroom, distributed)	Average Existing Stock, 2.2 GPM	base	6	-	2,004	10	$1	31%	
21	Low-Flow Showerhead - 1.25 GPM (Distributed)	2.0 -2.5 GPM Showerhead (2.45 GPM)	base	50	-	16,631	10	$4.26	10%	Updated Assumption
22	Low-Flow Showerhead - 1.25 GPM (Distributed)	2.6 + GPM Showerhead (3.07 GPM)	base	82	-	23,374	10	$4.26	10%	Updated Assumption
23	Low-Flow Showerhead - 1.25 GPM (Installed)	2.0 -2.5 GPM Showerhead (2.45 GPM)	base	50	-	16,631	10	$19.00	10%	Updated Assumption
24	Low-Flow Showerhead - 1.25 GPM (Installed)	2.6 + GPM Showerhead (3.07 GPM)	base	82	-	23,374	10	$19.00	10%	Updated Assumption
25	High Efficiency Condensing Furnace AFUE 96	High-Efficiency Furnace AFUE 90	weather	129	-	-	18	$1,767.00		
26	High Efficiency Fireplace with Pilotless Ignition - Freestanding = Minimum 70% EnerGuide Rating	Freestanding fireplace = 65% median efficiency	weather	110	(31)	-	20	$135.00	17%	
27	High Efficiency Fireplace with Pilotless Ignition - Insert = Minimum 60% EnerGuide Rating	Insert = 55% median efficiency	weather	109	(31)	-	20	$135.00	17%	
28	High Efficiency Fireplace with Pilotless Ignition - Zero Clearance >= 40 kBtu.h =Minimum 60% EnerGuide Rating	Zero Clearance >= 40kBtu/h median efficiency	weather	122	(31)	-	20	$135.00	17%	

	Enbridge Gas Distribution										
	UPDATED DSM Input Assumptions for 2011 Program Year										
		Indicates Updated Assumption, Reviewed and Accepted by the EAC									
29	High Efficiency Fireplace with Pilotless Ignition - Zero Clearance < 40 kBtu.h =Minimum 70% EnerGuide Rating	Zero Clearance <40kBtu/h median efficiency	weather	108	(31)	-	20	$135.00	17%		
30	Pipe Insulation	Water Heater w/o pipe insulation	base	18	-	-	10	$2/$4	4%		
31	Programmable Thermostat	Standard Thermostat	weather	53	54	-	15	$50	43%		
32	Reflector Panels	Radiant heat w/o reflector panels	weather	143.0	-	-	18	$238.00	0%		
33	Solar Pool Heater	Natural Gas Pool Heater	base	1,116	(57)	-	20	$1,450.00	10%		
34	Tankless Water Heater	Storage Tank Water Heater	base	130	-	-	18	$750.00	2%		
	RESIDENTIAL LOW INCOME										
35	Faucet Aerator - 1.0 GPM (Kitchen, installed)	Average Existing Stock (2.5 gpm)	base	35	-	11,694	10	1.00	1%		
36	Faucet Aerator - 1.0 GPM (Bathroom, installed)	Average Existing Stock (2.2 gpm)	base	10	-	3,435	10	.55	1%		
37	Faucet Aerator - 1.5 GPM (Kitchen, installed)	Average Existing Stock (2.5 gpm)	base	23	-	7,797	10	$0.94	1%		
38	Faucet Aerator - 1.5 GPM (Bathroom, installed)	Average Existing Stock (2.2 gpm)	base	6	-	2,004	10	$0.46	1%		
39	Low-Flow Showerhead - 1.25 GPM (Installed)	2.0 -2.5 GPM Showerhead (2.45 GPM)	base	50	-	16,631	10	$18.71	5%		Updated Assumption
40	Low-Flow Showerhead - 1.25 GPM (Installed)	2.6 + GPM Showerhead (3.07 GPM)	base	82	-	23,374	10	$18.71	5%		Updated Assumption
41	CFL (13W) (2 bulbs)	60 W Incandescent	n/a	0	90	-	8	$0.00	5%		
42	CFL (23W) (2 bulbs)	75 W Incandescent	n/a	0	100	-	8	$0.00	5%		
43	Programmable Thermostat	Standard Thermostat	weather	53	54	-	15	$69.18	1%		
	COMMERCIAL NEW BUILDING CONSTRUCTION										
44	* Air Curtains (Shipping and Receiving Doors) 8 x 8	No air curtain	weather	7,565	(5,380)	-	15	$8,242.00	5%		New Measure
45	* Air Curtains (Shipping and Receiving Doors) 8 X 10	No air curtain	weather	9,457	(5,220)	-	15	$8,242.00	5%		New Measure
46	* Air Curtains (Shipping and Receiving Doors) 10 X 10	No air curtain	weather	20,605	(936)	-	15	$10,170.00	5%		New Measure
47	CEE Qualified Energy Efficient Washers	Conventional top loading washers.	base	117	396	58,121	11	$600.00	10%		
48	Condensing Boiler - Space (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	weather	.0108 m3/(Btu/hr)	-	-	25	<100 MBH = $1,475, 100-199 MBH = $2,414, 200-299 MBH = $3,227	5%		New Measure
49	Condensing Boiler - DHW (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	base	<100 MBH = .03579, 100-199 MBH = .02196, 200-299 MBH = .01643 m3/(Btu/hr)	-	-	25	<100 MBH = $1,475, 100-199 MBH = $2,414, 200-299 MBH = $3,227	5%		New Measure
50	Condensing Gas Water Heater 100 gals	Storage Tank Water Heater	base	332	-	-	13	$2,230.00	5%		
51	Condensing Gas Water Heater 500 gals	Storage Tank Water Heater	base	873	-	-	13	$2,230.00	5%		
52	Condensing Gas Water Heater 1000 gals	Storage Tank Water Heater	base	1,551	-	-	13	$2,230.00	5%		
53	Condensing Make Up Air Unit - MR and LTC	Conventional MUA with constant speed drive	weather	.84 m3/cfm - 2.92 m3/cfm	(0-1.48) kwh/cfm	-	15	$870 + (.66 - 1.02) per cfm	5%		New Measure
54	Condensing Make Up Air Unit - Retail and Comm	Conventional MUA with constant speed drive	weather	.41 m3/cfm - 2.07 m3/cfm	(0- .48) kwh/cfm	-	15	$870 + (.66 - 1.02) per cfm	5%		New Measure
55	Condensing Unit Heater	% Sales Weighted Average model - Equivalent in efficiency to a power-vented or separated combustion unit heater (78% Annually Efficient)	weather	.00631 m3 / (BTU/H)	(.00186) kWh / (BTU/H)	-	18	$.0129 / (BTU/H)	0%		
56	Demand Control Kitchen Ventilation (0 - 4999 CFM)	Ventilation without DCKV	weather	4,801	13,521	-	15	$10,000.00	5%		
57	Demand Control Kitchen Ventilation (5000 - 9999 CFM)	Ventilation without DCKV	weather	11,486	30,901	-	15	$15,000.00	5%		
58	Demand Control Kitchen Ventilation (10000 - 15000 CFM)	Ventilation without DCKV	weather	18,924	49,102	-	15	$20,000.00	5%		
59	Destratification Fans	No destratification fans	weather	0.5 $m3/ft^2$	(-)0.0034/ft^2	-	15	$7,021.00	10%		
60	Drain Water Heat Recovery (DWHR) - Commercial Laundry	No water pre-heating	base	50,451	-	-	25	$37,210.85	5%		New Measure. As approved by Union Gas EAC
61	Drain Water Heat Recovery (DWHR) - Food Services, Dishwashing	No water pre-heating	base	8,167	-	-	25	$1,770.00	5%		New Measure. As approved by Union Gas EAC
62	Drain Water Heat Recovery (DWHR) - Hospital Dishwashing	No water pre-heating	base	6,335	-	-	25	$1,770.00	5%		New Measure. As approved by Union Gas EAC
63	Drain Water Heat Recovery (DWHR) - Hospital Laundry	No water pre-heating	base	45,468	-	-	25	$37,210.85	5%		New Measure. As approved by Union Gas EAC

	Enbridge Gas Distribution										
	UPDATED DSM Input Assumptions for 2011 Program Year										
		Indicates Updated Assumption, Reviewed and Accepted by the EAC									
64	Drain Water Heat Recovery (DWHR) - Nursing Home, Dishwashing	No water pre-heating	base	4,549	-	-	25	$1,770.00	5%		New Measure. As approved by Union Gas EAC
65	Drain Water Heat Recovery (DWHR) - Recreation Facility/Arena, Showering	No water pre-heating	base	17,209	-	-	25	$14,820.00	5%		New Measure. As approved by Union Gas EAC
66	Energy Recovery Ventilators (ERV) - Multi-Family, Health Care, Nursing Home	Ventilation without ERV	weather	5.77 m3 / CFM	-	-	14	$3.18/CFM	5%		Updated Assumption. As approved by Union Gas EAC
67	Energy Recovery Ventilators (ERV) - Hotel, Restaurant, Retail	Ventilation without ERV	weather	3.21 m3 / CFM	-	-	14	$3.18/CFM	5%		Updated Assumption. As approved by Union Gas EAC
68	Energy Recovery Ventilators (ERV) - Office, Warehouse, School	Ventilation without ERV	weather	2.05 m3 / CFM	-	-	14	$3.18/CFM	5%		Updated Assumption. As approved by Union Gas EAC
69	Energy Star Dishwasher - Rack conveyor, multi (tank) - High Temperature	Non- Energy Star Dishwasher	base	3,708	15,822	522,192	20	$288.00	27%		
70	Energy Star Dishwasher - Rack conveyor, single (tank) - High Temperature	Non- Energy Star Dishwasher	base	2,203	9,811	310,271	20	$2,375.00	27%		
71	Energy Star Dishwasher - Stationary Rack (Door type or single rack) - High Temperature	Non- Energy Star Dishwasher	base	619	3,553	87,119	15	($350.00)	20%		
72	Energy Star Dishwasher - Stationary Rack (Door type or single rack) - Low Temperature	Non- Energy Star Dishwasher	base	841	855	118,369	15	($350.00)	20%		
73	Energy Star Dishwasher - Undercounter - High Temperature	Non- Energy Star Dishwasher	base	801	3,754	112,795	10	($13.00)	40%		
74	Energy Star Dishwasher - Undercounter - Low Temperature	Non- Energy Star Dishwasher	base	326	559	45,891	10	($13.00)	40%		
75	Energy Star Convection Oven (Full Size)	Standard Efficiency Convection Oven	base	847	1	-	12	$875.00	20%		New Measure. As approved by Union Gas EAC
76	Energy Star Fryers	Standard Efficiency Fryer	base	1,083	17	-	12	$1,028.00	20%		Updated Assumption. As approved by Union Gas EAC
77	Energy Star Steam Cookers	Standard Efficiency Steam Cooker	base	3,224	162	42,812	10	$2,000.00	20%		New Measure. As approved by Union Gas EAC
78	Energy Star Under Fired Broilers	Standard Efficiency Broiler	base	1,677	12	-	12	$1,270.00	20%		New Measure. As approved by Union Gas EAC
79	Heat Recovery Ventilators (HRV) - Multi-Family, Health Care, Nursing Home	Ventilation without HRV	weather	4.28 m3 / CFM	-	-	14	$3.61/CFM	5%		Updated Assumption. As approved by Union Gas EAC
80	Heat Recovery Ventilators (HRV) - Hotel, Restaurant, Retail	Ventilation without HRV	weather	2.38 m3 / CFM	-	-	14	$3.61/CFM	5%		Updated Assumption. As approved by Union Gas EAC
81	Heat Recovery Ventilators (HRV) - Office, Warehouse, School	Ventilation without HRV	weather	1.52 m3 / CFM	-	-	14	$3.61/CFM	5%		Updated Assumption. As approved by Union Gas EAC
82	High Efficiency Boilers - Space (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	weather	.00665 m3/(Btu/hr)	-	-	25	<100 MBH = $1,238, 100-199 MBH = $1,544, 200-299 MBH = $1,388	5%		New Measure
83	High Efficiency Boilers - DHW (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	base	<100 MBH = .02430, 100-199 MBH = .01491, 200-299 MBH = .01115 m3/(Btu/hr)	-	-	25	<100 MBH = $1,238, 100-199 MBH = $1,544, 200-299 MBH = $1,388	5%		New Measure
84	Infrared Heaters (< 50,000 BTUH)	Regular Unit Heater	weather	0.015 m3/BTUH	16	-	20	$0.0122 BTUH/hr	33%		Updated Assumption
85	Infrared Heaters (50,000 - 165,000 BTUH)	Regular Unit Heater	weather	0.015 m3/BTUH	409	-	20	$0.0122 BTUH/hr	33%		Updated Assumption
86	Infrared Heaters (>165,000 BTUH)	Regular Unit Heater	weather	0.015 m3/BTUH	873	-	20	$0.0122 BTUH/hr	33%		Updated Assumption
87	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.5 GPM	base	36	-	11,587	10	$12.50	10%		New Measure
88	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	2.5 GPM	base	29	-	7,818	10	$12.50	10%		New Measure
89	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Washer extractor - 60 lbs	base	.0328 m3 / (lbs/yr)	.00219 kWh / (lbs/yr)	2.01 L / (lbs/yr)	15	$10,970.00	8%		
90	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Washer extractor - 500 lbs	base	.0328 m3 / (lbs/yr)	.00219 kWh / (lbs/yr)	2.01 L / (lbs/yr)	15	$30,270.00	8%		

	Enbridge Gas Distribution										
	UPDATED DSM Input Assumptions for 2011 Program Year										
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91	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Tunnel Washer - 120 lbs	base	.0240 m3 / (lbs/yr)	.00152 kWh / (lbs/yr)	1.22 L / (lbs/yr)	15	$49,667.00	8%		
92	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Tunnel Washer - 500 lbs	base	.0240 m3 / (lbs/yr)	.00152 kWh / (lbs/yr)	1.22 L / (lbs/yr)	15	$160,065.00	8%		
93	Prescriptive Higher Efficiency Boiler - DWH (300-1500 MBH, 83-84% Efficient)	DWH Boiler (80% Combustion Efficiency)	base	1,075-4,317	-	-	25	$3900 -$5900	10/12/20%		
94	Prescriptive Higher Efficiency Boiler - DWH (300-1500 MBH, 85-88% Efficient)	DWH Boiler (80% Combustion Efficiency)	base	1,766-7,095	-	-	25	$4500-$7400	10/12/20%		
95	Prescriptive Higher Efficiency Boiler - Space (300-2000 MBH, 83-84% Efficient)	Space Heating Boiler (80% Combustion Efficiency)	weather	2,105-16,452	-	-	25	$3900-$4950	10/12/20%		
96	Prescriptive Higher Efficiency Boiler - Space (300-2000 MBH, 85-88% Efficient)	Space Heating Boiler (80% Combustion Efficiency)	weather	3,125-24,431	-	-	25	$4500-$7050	10/12/20%		
97	Pre-Rinse Spray Nozzle (0.64 GPM) (Full Service)	standard pre-rinse spray nozzle (3.0 GPM)	base	1,286	-	252,000	5	$150	0%		Updated Assumption. Consistent with 2010 Update Incremental Cost
98	Pre-Rinse Spray Nozzle (0.64 GPM) (Limited)	standard pre-rinse spray nozzle (3.0 GPM)	base	339	-	66,400	5	$150	0%		Updated Assumption. Consistent with 2010 Update Incremental Cost
99	Pre-Rinse Spray Nozzle 0.64 GPM) (Other)	standard pre-rinse spray nozzle (3.0 GPM)	base	318	-	62,200	5	$150	0%		Updated Assumption. Consistent with 2010 Update Incremental Cost
100	Rooftop Unit (2 stage roof top unit)	Single stage rooftop unit	weather	255	-	-	15	$375.00	5%		
101	Tankless Water Heater 100 USG/day, 84% thermal efficiency	Conventional Storage Tank Water Heater, 80% thermal efficiency	base	154	-	-	18	-$1,102.00	2%		
	COMMERCIAL EXISTING BUILDINGS										
102	Air Curtains (Double Door)	No air curtain	weather	1,529	1,023	-	15	$2,500.00	5%		
103	* Air Curtains (Shipping and Receiving Doors) 8 x 8	No air curtain	weather	7,565	(5,380)	-	15	$8,242.00	5%		New Measure
104	* Air Curtains (Shipping and Receiving Doors) 8 X 10	No air curtain	weather	9,457	(5,220)	-	15	$8,242.00	5%		New Measure
105	* Air Curtains (Shipping and Receiving Doors) 10 X 10	No air curtain	weather	20,605	(936)	-	15	$10,170.00	5%		New Measure
106	Air Curtains (Single Door)	No air curtain	weather	667	172	-	15	$1,650.00	5%		
107	CEE Qualified Energy Efficient Washers	Conventional top loading washers.	base	117	396	58,121	11	$600.00	10%		
108	Condensing Boiler - DHW (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	base	<100 MBH = .03579, 100-199 MBH = .02196, 200-299 MBH = .01643 m3/(Btu/hr)	-	-	25	<100 MBH = $1,475, 100-199 MBH = $2,414, 200-299 MBH = $3,228	5%		New Measure
109	Condensing Boiler - Space (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	weather	.0108 m3/(Btu/hr)	-	-	25	<100 MBH = $2,045, 100-199 MBH = $2,984, 200-299 MBH = $3,797	5%		New Measure
110	Condensing Gas Water Heater 100 gals 95% thermal efficiency	Storage Tank Water Heater	base	332	-	-	13	$2,230.00	5%		
111	Condensing Gas Water Heater 500 gals 95% thermal efficiency	Storage Tank Water Heater	base	873	-	-	13	$2,230.00	5%		
112	Condensing Gas Water Heater 1000 gals 95% thermal efficiency	Storage Tank Water Heater	base	1,551	-	-	13	$2,230.00	5%		
113	Condensing Make Up Air Unit - MR and LTC	Conventional MUA with constant speed drive	weather	.84 m3/cfm - 2.92 m3/cfm	(0-1.48) kwh/cfm	-	15	$870 + (.66 - 1.02) per cfm	5%		New Measure
114	Condensing Make Up Air Unit - Retail and Comm	Conventional MUA with constant speed drive	weather	.41 m3/cfm - 2.07 m3/cfm	(0- .48) kwh/cfm	-	15	$870 + (.66 - 1.02) per cfm	5%		New Measure
115	Condensing Unit Heater	% Sales Weighted Average model - Equivalent in efficiency to a power-vented or separated combustion unit heater (78% Annually Efficient)	weather	.00631 m3 / (BTU/H)	(.00186) kWh / (BTU/H)	-	18	$.0129 / (BTU/H)	0%		
116	Demand Control Kitchen Ventilation (0 - 4999 CFM)	Ventilation without DCKV	weather	4,801	13,521	-	15	$10,000.00	5%		
117	Demand Control Kitchen Ventilation (5000 - 9999 CFM)	Ventilation without DCKV	weather	11,486	30,901	-	15	$15,000.00	5%		

Enbridge Gas Distribution

UPDATED DSM Input Assumptions for 2011 Program Year

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118	Demand Control Kitchen Ventilation (10000 - 15000 CFM)	Ventilation without DCKV	weather	18,924	49,102	-	15	$20,000.00	5%		
119	Destratification Fans	No destratification fans	weather	0.5 m3/ft^2	(-)0.0034 / ft^2	-	15	$7,021.00	10%		
120	Drain Water Heat Recovery (DWHR) - Commercial Laundry	No water pre-heating	base	50,451	-	-	25	$40,810.85	5%		New Measure. As approved by Union Gas EAC
121	Drain Water Heat Recovery (DWHR) - Food Services, Dishwashing	No water pre-heating	base	8,167	-	-	25	$3,250.00	5%		New Measure. As approved by Union Gas EAC
122	Drain Water Heat Recovery (DWHR) - Hospital Dishwashing	No water pre-heating	base	6,335	-	-	25	$2,710.00	5%		New Measure. As approved by Union Gas EAC
123	Drain Water Heat Recovery (DWHR) - Hospital Laundry	No water pre-heating	base	45,468	-	-	25	$40,810.85	5%		New Measure. As approved by Union Gas EAC
124	Drain Water Heat Recovery (DWHR) - Nursing Home, Dishwashing	No water pre-heating	base	4,549	-	-	25	$2,710.00	5%		New Measure. As approved by Union Gas EAC
125	Drain Water Heat Recovery (DWHR) - Recreation Facility/Arena, Showering	No water pre-heating	base	17,209	-	-	25	$20,020.00	5%		New Measure. As approved by Union Gas EAC
126	Energy Recovery Ventilators (ERV) - Multi-Family, Health Care, Nursing Home	Ventilation without ERV	weather	6.12 m3 / CFM	-	-	14	$3.18/CFM	5%		Updated Assumption. As approved by Union Gas EAC
127	Energy Recovery Ventilators (ERV) - Hotel, Restaurant, Retail	Ventilation without ERV	weather	3.40 m3 / CFM	-	-	14	$3.18/CFM	5%		Updated Assumption. As approved by Union Gas EAC
128	Energy Recovery Ventilators (ERV) - Office, Warehouse, School	Ventilation without ERV	weather	2.17 m3 / CFM	-	-	14	$3.18/CFM	5%		Updated Assumption. As approved by Union Gas EAC
129	Energy Star Dishwasher - Rack conveyor, multi (tank) - High Temperature	Non- Energy Star Dishwasher	base	3,708	15,822	522,192	20	$288.00	27%		
130	Energy Star Dishwasher - Rack conveyor, single (tank) - High Temperature	Non- Energy Star Dishwasher	base	2,203	9,811	310,271	20	$2,375.00	27%		
131	Energy Star Dishwasher - Stationary Rack (Door type or single rack) - High Temperature	Non- Energy Star Dishwasher	base	619	3,553	87,119	15	($350.00)	20%		
132	Energy Star Dishwasher - Stationary Rack (Door type or single rack) - Low Temperature	Non- Energy Star Dishwasher	base	841	855	118,369	15	($350.00)	20%		
133	Energy Star Dishwasher - Undercounter - High Temperature	Non- Energy Star Dishwasher	base	801	3,754	112,795	10	($13.00)	40%		
134	Energy Star Dishwasher - Undercounter - Low Temperature	Non- Energy Star Dishwasher	base	326	559	45,891	10	($13.00)	40%		
135	Energy Star Convection Oven (Full Size)	Standard Efficiency Convection Oven	base	847	1	-	12	$875.00	20%		New Measure. As approved by Union Gas EAC
136	Energy Star Fryers	Standard Efficiency Fryer	base	1,083	17	-	12	$1,028.00	20%		Updated Assumption. As approved by Union Gas EAC
137	Energy Star Steam Cookers	Standard Efficiency Steam Cooker	base	3,224	162	42,812	10	$2,000.00	20%		New Measure. As approved by Union Gas EAC
138	Energy Star Under Fired Broilers	Standard Efficiency Broiler	base	1,677	12	-	12	$1,270.00	20%		New Measure. As approved by Union Gas EAC
139	Enhanced Furnace (continuous)	Standard PSC motor	weather	-2.7 m3/kBtu/h	22.7kWh/kBtu/h	-	15	$960.00	10%		
140	Enhanced Furnace (Non-continuous)	Standard PSC motor	weather	-0.4 m3/kBtu/h	4.8 kWh/kBtu/h		15	$960.00	10%		
141	Faucet Aerator (bathroom, installed, 1.0 GPM)	Average existing stock	base	7	-	2,371	10	$1.50	10%		
142	Faucet Aerator (bathroom, installed, 1.5 GPM)	Average existing stock	base	4	-	1,382	10	$2	10%		
143	Faucet Aerator (kitchen, installed, 1.0 GPM)	Average existing stock	base	24	-	8,072	10	$2	10%		
144	Faucet Aerator (kitchen, installed, 1.5 GPM)	Average existing stock	base	16	-	5,377	10	$2	10%		
145	Heat Recovery Ventilators (HRV) - Multi-Family, Health Care, Nursing Home	Ventilation without HRV	weather	4.70 m3 / CFM	-	-	14	$3.61/CFM	5%		Updated Assumption. As approved by Union Gas EAC
146	Heat Recovery Ventilators (HRV) - Hotel, Restaurant, Retail	Ventilation without HRV	weather	2.61 m3 / CFM	-	-	14	$3.61/CFM	5%		Updated Assumption. As approved by Union Gas EAC
147	Heat Recovery Ventilators (HRV) - Office, Warehouse, School	Ventilation without HRV	weather	1.67 m3 / CFM	-	-	14	$3.61/CFM	5%		Updated Assumption. As approved by Union Gas EAC
148	High Efficiency Boilers - Space (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	weather	.00665 m3/(Btu/hr)	-	-	25	<100 MBH = $1,808, 100-199 MBH = $2,114, 200-299 MBH = $1,958	5%		New Measure
149	High Efficiency Boilers - DHW (Under 300 MBH, 90% or greater AFUE)	Non-condensing Boiler, 80% AFUE	base	<100 MBH = .02430, 100-199 MBH = .01491, 200-299 MBH = .01115 m3/(Btu/hr)	-	-	25	<100 MBH = $1,808, 100-199 MBH = $2,114, 200-299 MBH = $1,958	5%		New Measure

	Enbridge Gas Distribution										
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150	High Efficiency Condensing Furnace (AFUE 96)	High Efficiency Furnace (AFUE 90)	weather	1.7/kBtu/hr	-	-	18	8.4/kBtu/hr	17.5%		
151	Infrared Heaters (< 50,000 BTUH)	Regular Unit Heater	weather	0.015 m3/BTUH	16	-	20	$0.0122 BTUH/hr	33%		Updated Assumption
152	Infrared Heaters (50,000 - 165,000 BTUH)	Regular Unit Heater	weather	0.015 m3/BTUH	409	-	20	$0.0122 BTUH/hr	33%		Updated Assumption
153	Infrared Heaters (>165,000 BTUH)	Regular Unit Heater	weather	0.015 m3/BTUH	873	-	20	$0.0122 BTUH/hr	33%		Updated Assumption
154	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.0 -2.5 GPM showerhead (2.25 GPM)	base	48	-	9,088	10	$17	10%		
155	Low-Flow Showerhead (Per household, Installed, 1.25 GPM)	2.6 + GPM showerhead and above (3.0GPM)	base	84	-	14,333	10	$12.50	10%		
156	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	2.0 -2.5 GPM showerhead (2.25 GPM)	base	21	-	5,931	10	$12.50	10%		Updated Assumption
157	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	2.6 -3.0 GPM GPM showerhead (2.80 GPM)	base	40	-	10,036	10	$12.50	10%		Updated Assumption
158	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	3.1 - 3.5 GPM showerhead (3.30 GPM)	base	58	-	13,621	10	$12.50	10%		Updated Assumption
159	Low-Flow Showerhead (Per household, Installed, 1.5 GPM)	3.6 GPM and above (3.6 GPM)	base	69	-	15,705	10	$12.50	10%		Updated Assumption
160	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Washer extractor - 60 lbs	base	.0328 m3 / (lbs/yr)	.00219 kWh / (lbs/yr)	2.01 L / (lbs/yr)	15	$10,970.00	8%		
161	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Washer extractor - 500 lbs	base	.0328 m3 / (lbs/yr)	.00219 kWh / (lbs/yr)	2.01 L / (lbs/yr)	15	$30,270.00	8%		
162	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Tunnel Washer - 120 lbs	base	.0240 m3 / (lbs/yr)	.00152 kWh / (lbs/yr)	1.22 L / (lbs/yr)	15	$49,667.00	8%		
163	Ozone Laundry - Commercial Laundry Washing Equipment with Ozone	Commercial Laundry Washing Equipment without Ozone - Tunnel Washer - 500 lbs	base	.0240 m3 / (lbs/yr)	.00152 kWh / (lbs/yr)	1.22 L / (lbs/yr)	15	$160,065.00	8%		
164	Pre-Rinse Spray Nozzle - 0.64 GPM (Full Service)	Standard Pre-Rinse Spray Nozzle (3.0 GPM)	base	1,286	-	252,000	5	$150	0%		Updated Assumption. Consistent with 2010 Update Incremental Cost
165	Pre-Rinse Spray Nozzle - 0.64 GPM (Limited)	Standard Pre-Rinse Spray Nozzle (3.0 GPM)	base	339	-	66,400	5	$150	0%		Updated Assumption. Consistent with 2010 Update Incremental Cost
166	Pre-Rinse Spray Nozzle - 0.64 GPM (Other)	Standard Pre-Rinse Spray Nozzle (3.0 GPM)	base	318	-	62,200	5	$150	0%		Updated Assumption. Consistent with 2010 Update Incremental Cost
167	Pre-Rinse Spray Nozzle - 0.64 GPM (Full Service)	Standard Pre-Rinse Spray Nozzle (1.6 GPM)	base	457	-	97,292	5	$150	0%		
168	Pre-Rinse Spray Nozzle - 0.64 GPM (Limited)	Standard Pre-Rinse Spray Nozzle (1.6 GPM)	base	90	-	19,197	5	$150	0%		
169	Pre-Rinse Spray Nozzle - 0.64 GPM (Other)	Standard Pre-Rinse Spray Nozzle (1.6 GPM)	base	109	-	23,166	5	$150	0%		
170	Prescriptive Higher Efficiency Boiler - DWH (300-1500 MBH, 83-84% Efficient)	DWH Boiler (80% Combustion Efficiency)	base	1,075-4,317	-	-	25	$3900 -$5900	10/12/20%		
171	Prescriptive Higher Efficiency Boiler - DWH (300-1500 MBH, 85-88% Efficient)	DWH Boiler (80% Combustion Efficiency)	base	1,766-7,095	-	-	25	$4500-$7400	10/12/20%		
172	Prescriptive Higher Efficiency Boiler - Space (300-2000 MBH, 83-84% Efficient)	Space Heating Boiler (80% Combustion Efficiency)	weather	2,105-16,452	-	-	25	$3900-$4950	10/12/20%		
173	Prescriptive Higher Efficiency Boiler - Space (300-2000 MBH, 85-88% Efficient)	Space Heating Boiler (80% Combustion Efficiency)	weather	3,125-24,431	-	-	25	$4500-$7050	10/12/20%		
174	Prescriptive School Boilers (Elementary)	Space Heating, Hydronic Boiler with Comb. Eff. Of 80%-82%.	weather	10,830	-	-	25	$8,646.00	12%		
175	Prescriptive School Boilers (Secondary)	Space Heating, Hydronic Boiler with Comb. Eff. Of 80%-82%.	weather	43,859	-	-	25	$14,470.00	12%		
176	Programmable Thermostats (Educational - School)	Standard thermostat	weather	65	8		15	$110	20%		Updated Assumption
177	Programmable Thermostats (Food Service - Restaurant/Tavern)	Standard thermostat	weather	69	77	-	15	$110	20%		Updated Assumption
178	Programmable Thermostats (Hotel/Motel)	Standard thermostat	weather	10	11	-	-	$110	20%		Updated Assumption

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179	Programmable Thermostats (Large Hotel)	Standard thermostat	weather	10	14	-	-	$110	20%		Updated Assumption
180	Programmable Thermostats (Small Office)	Standard thermostat	weather	39	43	-	-	$110	20%		Updated Assumption
181	Programmable Thermostats (Recreation - Small Fitness / Spa)	Standard thermostat	weather	35	87	-	15	$110	20%		Updated Assumption
182	Programmable Thermostats (Retail - Mall)	Standard thermostat	weather	14	19	-	15	$110	20%		Updated Assumption
183	Programmable Thermostats (Retail - Strip Mall)	Standard thermostat	weather	11	19	-	15	$110	20%		Updated Assumption
184	Programmable Thermostats (Retail - Food)	Standard thermostat	weather	22	16	-	15	$110	20%		Updated Assumption
185	Programmable Thermostats (Educational - University/College)	Standard thermostat	weather	58	57	-	-	$110	20%		Updated Assumption
186	Programmable Thermostats (Warehouse / Wholesale)	Standard thermostat	weather	132	9	-	15	$110	20%		Updated Assumption
187	Programmable Thermostats - Multi Family	Standard thermostat	weather	15	13	-	15	$80	20%		Updated Assumption
188	Rooftop Unit	Standard Rooftop Unit	weather	255	-	-	15	$375.00	5%		
189	Tankless Water Heater 100 USG/day, 84% thermal efficiency	Conventional Storage Tank Water Heater, 80% thermal efficiency	base	154	-	-	18	-$1,102.00	2%		
	COMMERCIAL/INDUSTRIAL CUSTOM PROJECTS										
190	Custom Projects			Actual	Actual	Actual	Actual	Actual			
191	Agriculture								40%		
192	Industrial								50%		
193	Commercial								12%		
194	Multi-Residential								20%		
195	New construction								26%		
	OTHER MEASURES										
196	CFL (13W)	60W Incandescent	n/a	0	45	0	8	$0.00	24%		
197	CFL (23W)	75W Incandescent	n/a	0	49.7	0	8	$0.00	24%		