uniongas
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March 14, 2011

Ontario Energy Board
2300 Yonge Street, Suite 2700
Toronto, Ontario
M4P 1E4

ATTN: Ms. Kirsten Walli, Board Secretary

RE: EB-2009-0166 – Union Gas Limited – 2010 Demand Side Management Plan Revised 2010 DSM Measure - Post the Audit of Union's 2009 DSM Annual Report

Dear Ms. Walli:

Union requests the Ontario Energy Board's (the "Board") approval for certain 2010 revised DSM measures for its 2010 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). Union followed the approved process to establish the 2010 DSM input assumptions. Union consulted with the 2010 Evaluation and Audit Committee ("EAC") on all the measures and achieved complete consensus on all the input assumptions. On June 22, 2010, the Board issued its EB-2010-0182 Decision approving the 2010 DSM input assumptions.

Attachment A contains revised 2010 DSM input assumptions in response to the Audit of Union's 2009 DSM Annual Report. Specifically, changes were made to the following technology substantiation documents: Energy Recovery Ventilators (ERVs), Heat Recovery Ventilators (HRVs), Infrared Heaters and Low-Flow Showerheads for both the Residential and Low-Income Markets.

Attachment B reflects the updates for 2010 SSM calculations. In addition, Union's updated Custom Program Free Rider rates are included on the last page.

Union followed the Board's process established in EB-2006-0021 and achieved consensus from its EAC for all of the enclosed revised 2010 measures. Union requests the Board's approval of the revised 2010 DSM measures.

If you have any questions, please contact me at 519-436-4521.

Sincerely,

[original signed by]

Marian Redford
Manager, Regulatory Initiatives

Cc: Crawford Smith (Torys)
EB-2009-0166 Intervenors

Revised 2010 DSM Measures – Post Audit of Union's 2009 DSM Annual Report

Energy Recovery Ventilator (ERV)

Heat Recovery Ventilator (HRV)

Infrared Heaters

Low Flow Showerheads

36. Energy Recovery Ventilator (ERV) – Existing Commercial

Revision #	Description/Comment	Date Revised
		September 16, 2010

Efficient Equipment and Technologies Description
Ventilation with an Energy Recovery Ventilator (ERV)
Base Equipment and Technologies Description
Ventilation without an Energy Recovery Ventilator (ERV)

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

Codes, Standards, and Regulations

N/A

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)	Water (L)	($/CFM)	($)
1	2.17 – 6.12	0	0	3.18	0
2	2.17 – 6.12	0	0	0	0
3	2.17 – 6.12	0	0	0	0
4	2.17 – 6.12	0	0	0	0
5	2.17 – 6.12	0	0	0	0
6	2.17 – 6.12	0	0	0	0
7	2.17 – 6.12	0	0	0	0
8	2.17 – 6.12	0	0	0	0
9	2.17 – 6.12	0	0	0	0
10	2.17 – 6.12	0	0	0	0
11	2.17 – 6.12	0	0	0	0
12	2.17 – 6.12	0	0	0	0
13	2.17 – 6.12	0	0	0	0
14	2.17 – 6.12	0	0	0	0
TOTALS	**30.4 – 85.7**	**0**	**0**	**3.18**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	2.17 – 6.12 m^3/CFM

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	ERV Capacity	UG
B	Exhaust air flow (cfm)	ERV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	67	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

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

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

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

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

Example below:

			Existing Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	3058	6.12
Medium Use	Hotel Restaurant Retail	500	1699	3.40
Low Use	Office Warehouse School	500	1086	2.17

Annual Electricity Savings	**0 kWh**

N/A

Annual Water Savings	**0 L/CFM**

N/A

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[2]	
Incremental Costs	**$3.18/CFM**
The incremental costs are based on relative scaling of incremental costs $2,500 / 1000 CFM[3]. Based on communication with local contractors, the incremental costs are $3/CFM. Nexant recommends increasing the incremental cost by inflation, to $3.18/CFM.[4]	

[2] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32

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

[4] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

37. Energy Recovery Ventilator (ERV) – New Commercial

Revision #	Description/Comment	Date Revised
		September 16, 2010

Efficient Equipment and Technologies Description
Ventilation with ERV
Base Equipment and Technologies Description
Ventilation without ERV

Decision Type	Target Market(s)	End Use
New	New Commercial	Space Heating

Codes, Standards, and Regulations

1) Restriction for new building construction: This measure is not applicable to system ≥5,000 CFM with ≥70% OA ratio because energy recovery is required by Ontario Building Code 2006.
2) Restriction for new building construction: This measure is not applicable to systems serving health care spaces indicated in **Table 1** because heat recovery is required by CSA Z317.2-01

Table 1 - Health Care Spaces Not Eligible		
Anaesthetic gas scavenging	Cart and can washers	Areas using hazardous gases
Animal facilities	Chemical storage	Isolation rooms
Autopsy suite	Cooking facilities	Perchloric hoods
Biohazard and fume hoods	Ethylene oxide	Radioisotope hoods

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)	Water (L)	($/CFM)	($)
1	2.05 – 5.77	0	0	3.18	0
2	2.05 – 5.77	0	0	0	0
3	2.05 – 5.77	0	0	0	0
4	2.05 – 5.77	0	0	0	0
5	2.05 – 5.77	0	0	0	0
6	2.05 – 5.77	0	0	0	0
7	2.05 – 5.77	0	0	0	0
8	2.05 – 5.77	0	0	0	0
9	2.05 – 5.77	0	0	0	0
10	2.05 – 5.77	0	0	0	0
11	2.05 – 5.77	0	0	0	0
12	2.05 – 5.77	0	0	0	0
13	2.05 – 5.77	0	0	0	0
14	2.05 – 5.77	0	0	0	0
TOTALS	**28.7 – 80.8**	**0**	**0**	**3.18**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	2.05 – 5.77 m^3/CFM

- ERV gas savings in new buildings is determined in the same way as in the ERV gas savings in existing buildings except the balance point temperature of a building. The balance point temperature of a building is selected based on building's thermal characteristics (internal & solar heat gains, infiltration rates and indoor temperature settings). Generally, older buildings (pre-1970's) or buildings with low internal heat gains (residences, motels, supermarkets, warehouses) should consider using a base HDD65^{o}F or HDD60^{o}F value. New buildings built to current OBC standards or buildings with high internal heat gains (retail, restaurants, offices) should consider using base HDD55^{o}F, HDD50^{o}F or even lower balance point temperature.
- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	ERV Capacity	UG
B	Exhaust air flow (cfm)	ERV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	67	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

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

- 168 hour = 7 days/week x 24hours/day

Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[1] %) **(B)**

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

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

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- New buildings and existing buildings mainly differ in the enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

			New Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	2885	5.77
Medium Use	Hotel Restaurant Retail	500	1603	3.21
Low Use	Office Warehouse School	500	1025	2.05

Annual Electricity Savings — 0 kWh

N/A

Annual Water Savings — 0 L

N/A

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[2]	
Incremental Costs	**$3.18 / CFM**
The incremental costs are based on relative scaling of incremental costs $2,500 / 1000 CFM[3]. Based on communication with local contractors, the incremental costs are $3/CFM. Nexant recommends increasing the incremental cost by inflation, to $3.18/CFM.[4]	

[2] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32

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

[4] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

40. Heat Recovery Ventilator (HRV) – Existing Commercial

Revision #	Description/Comment	Date Revised
		September 16, 2010

Efficient Equipment and Technologies Description
Ventilation with HRV
Base Equipment and Technologies Description
Ventilation without HRV

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

Codes, Standards, and Regulations

N/A

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)	Water (L)	($/CFM)	($)
1	1.67 – 4.70	0	0	3.61	0
2	1.67 – 4.70	0	0	0	0
3	1.67 – 4.70	0	0	0	0
4	1.67 – 4.70	0	0	0	0
5	1.67 – 4.70	0	0	0	0
6	1.67 – 4.70	0	0	0	0
7	1.67 – 4.70	0	0	0	0
8	1.67 – 4.70	0	0	0	0
9	1.67 – 4.70	0	0	0	0
10	1.67 – 4.70	0	0	0	0
11	1.67 – 4.70	0	0	0	0
12	1.67 – 4.70	0	0	0	0
13	1.67 – 4.70	0	0	0	0
14	1.67 – 4.70	0	0	0	0
TOTALS	**23.4 – 65.8**	**0**	**0**	**3.61**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	1.67 – 4.70 m^3 / CFM

- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	HRV Capacity	UG
B	Exhaust air flow (cfm)	HRV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	61	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**
  - 168 hour = 7 days/week x 24hours/day
  - Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[5] %) **(B)**

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

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

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- New buildings and existing buildings mainly differ in enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

Example below:

			Existing Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	2352	4.70
Medium Use	Hotel Restaurant Retail	500	1307	2.61
Low Use	Office Warehouse School	500	835	1.67

Annual Electricity Savings

0 kWh

N/A

Annual Water Savings

0 L / CFM

N/A

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[6]	
Incremental Costs	**$3.61 / CFM**
The incremental costs are based on relative scaling of incremental costs $1,700 / 500 CFM[7]. Nexant recommends increasing the incremental cost by inflation, to $3.61/CFM.[8]	

[6] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32)

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

[8] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

41. Heat Recovery Ventilator (HRV) – New Commercial

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Ventilation with HRV
Base Equipment and Technologies Description
Ventilation without HRV

Decision Type	Target Market(s)	End Use
New	Commercial	Space Heating

Codes, Standards, and Regulations

- Restriction for New Building Construction: This measure is not applicable to system ≥5,000 CFM in an application requiring ≥70% OA ratio according to Ontario Building Code 2006, because energy recovery is required.
- Restriction for New Building Construction: This measure is not applicable to systems serving health care spaces indicated in **Table 1** because heat recovery is required by CSA Z317.2-01

Table 1 - Health Care Spaces Not Eligible		
Anaesthetic gas scavenging	Cart and can washers	Areas using hazardous gases
Animal facilities	Chemical storage	Isolation rooms
Autopsy suite	Cooking facilities	Perchloric hoods
Biohazard and fume hoods	Ethylene oxide	Radioisotope hoods

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)	Water (L)	($/CFM)	($)
1	1.52 – 4.28	0	0	3.61	0
2	1.52 – 4.28	0	0	0	0
3	1.52 – 4.28	0	0	0	0
4	1.52 – 4.28	0	0	0	0
5	1.52 – 4.28	0	0	0	0
6	1.52 – 4.28	0	0	0	0
7	1.52 – 4.28	0	0	0	0
8	1.52 – 4.28	0	0	0	0
9	1.52 – 4.28	0	0	0	0
10	1.52 – 4.28	0	0	0	0
11	1.52 – 4.28	0	0	0	0
12	1.52 – 4.28	0	0	0	0
13	1.52 – 4.28	0	0	0	0
14	1.52 – 4.28	0	0	0	0
TOTALS	**21.3 – 59.9**	**0**	**0**	**3.61**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	1.52 – 4.28 m^3/CFM

- HRV gas savings in new buildings is determined in the same way as in the HRV gas savings in existing buildings except the balance point temperature of a building. The balance point temperature of a building is selected based on building's thermal characteristics (internal & solar heat gains, infiltration rates and indoor temperature settings). Generally, older buildings (pre-1970's) or buildings with low internal heat gains (residences, motels, supermarkets, warehouses) should consider using a base HDD65oF or HDD60oF value. New buildings built to current OBC standards or buildings with high internal heat gains (retail, restaurants, offices) should consider using base HDD55oF, HDD50oF or even lower balance point temperature. The balance point values listed represent climate data for the London area.
- Natural gas savings are determined from engineering calculations utilizing inputs such as air flow, indoor/outdoor temperatures, indoor/outdoor and relative humidity.

Symbols	Variable Names	Values	Source
A	Supply air flow (cfm)	HRV Capacity	UG
B	Exhaust air flow (cfm)	HRV Capacity	UG
C	Average Indoor Air Temperature (°F)	70	UG
D	Average Indoor Relative Humidity (%)	30	UG
E	Average Outside Air Temperature (°F)	Adjust Based On District	N
F	Average Outdoor Relative Humidity (%)	75	N
G	Atmospheric Pressure (psia)	14.25	UG
H	No. Of Hours in Heating Season (hrs)	Adjust Based On District	N
I2	No. Of Hours Of Operation Per Week	See Table Below	N
K	Effectiveness Of Heat Recovery Equipment (%)	61	N
L	Sensible Heat Recovery Only	no	UG
M	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Exhaust Air	Calculated	UG
N	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of INLET Supply Air	Calculated	UG
O	Enthalpy (Btu/lba) & Humidity Ratio (lbw/lba) Of OUTLET supply Air	Calculated	UG
P	Average Temperature of OUTLET Supply Air (°F)	Calculated	UG
Q	Average Hourly Moisture Addition (lb/hr)	Calculated	UG
R	Defrost Control Derating Factor (%)	5	UG
S	Average Hourly Heat Recovery (MBH)	Calculated	UG
T	Season Efficiency of Gas-Fired Equipment (%)	82	UG
U	Average Annual Gas Reduction (m^3)	Calculated	UG
V	Incremental Natural Gas Reduction ($/$m^3$)	0.3	UG
W	Average Annual Gas Savings ($)	Calculated	UG

UG - Union Gas

N - Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010

- **NG Savings** = # of Hours in Heating Season x (operating hours/168) x Average Hourly Heat Recovery / (35.3 m^3/MJ) / (Seasonal Efficiency / 100%) **(A)**
  - 168 hour = 7 days/week x 24hours/day
  - Average Hourly Heat Recovery = Supply air flow x 60 x (Supply air flow – Inlet supply air)/Specific Supply Air Conditions Volume x (1 – Defrost Control De-rating Factor[13] %) **(B)**
- Operating hours for each sectors being considered are as the following

Segment	Hours of Operation per Week
Multi-Family	168
Health Care	168
Nursing Home	168
Hotel	120
Restaurant	87
Retail	73
Office	64
Warehouse	61
School	54

- New buildings and existing buildings mainly differ in enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula **(B).**
- Based on the NG Savings formula (A) and input assumptions above, the natural gas savings for each of the commercial sectors are calculated. Gas savings for each district were combined using a 70/30 South/North split. Markets with similar gas savings were combined to reduce administration costs and to simplify the program.

			New Buildings	
Grouping	Segment	ERV Capacity (CFM)	Gas Savings (m^3)	Gas Savings per CFM (m^3/CFM)
High Use	Multi-Family Health Care Nursing Home	500	2142	4.28
Medium Use	Hotel Restaurant Retail	500	1190	2.38
Low Use	Office Warehouse School	500	761	1.52

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	0 L/CFM

N/A

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

Other Input Assumptions

Effective Useful Life (EUL)	14 Years
The 14 year life recommended by DEER is based on KEMA-XENERGY's *Retention Study of PG&Es 1996-1997 Energy Incentive Program* (50). This study tracked installed equipment over 6 years and used statistical analysis to calculate EUL.[14]	
Incremental Costs	**$3.61 / CFM**
The incremental costs are based on relative scaling of incremental costs $1,700 / 500 CFM[15]. Nexant recommends increasing the incremental cost by inflation, to $3.61/CFM.[16]	

[14] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-32
[15] "Prescriptive Incentives for Selected Natural Gas Technologies", Prepared for Enbridge Consumers Gas and Union Gas Ltd., by Jacques Whitford Environment Limited, Agviro Inc., and Engineering Interface Ltd., September 27, 2000.
[16] Nexant, Evaluation of Natural Gas DSM Measures: ERVs & HRVs, March 12 2010, page 6-34

43. Infrared Heaters

Revision #	Description/Comment	Date Revised

Efficient Equipment and Technologies Description
Infrared heater (up to 255,000 Btu/hour)
Base Equipment and Technologies Description
Regular unit heater

Decision Type	Target Market(s)	End Use
New/Retrofit	New/Existing Commercial buildings	Space Heating

Codes, Standards, and Regulations

The old code CAN 1-2.16-M81 (R1996) has been withdrawn.

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/Btu/hour)	Electricity (kWh)	Water (L)	($/Btu/hour)	($)
1	0.015	16 - 873	0	0.0122	0
2	0.015	16 - 873	0	0	0
3	0.015	16 - 873	0	0	0
4	0.015	16 - 873	0	0	0
5	0.015	16 - 873	0	0	0
6	0.015	16 - 873	0	0	0
7	0.015	16 - 873	0	0	0
8	0.015	16 - 873	0	0	0
9	0.015	16 - 873	0	0	0
10	0.015	16 - 873	0	0	0
11	0.015	16 - 873	0	0	0
12	0.015	16 - 873	0	0	0
13	0.015	16 - 873	0	0	0
14	0.015	16 - 873	0	0	0
15	0.015	16 - 873	0	0	0
16	0.015	16 - 873	0	0	0
17	0.015	16 - 873	0	0	0
18	0.015	16 - 873	0	0	0
19	0.015	16 - 873	0	0	0
20	0.015	16 - 873	0	0	0
TOTALS	**0.3**	**326 – 17,469**	**0**	**0.0122**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	0.015 m^3 / Btu/ h

The infrared heater gas savings were based on the analysis procedures previously created by Agviro Inc. for Union Gas[1].

Savings in the Agviro report are provided in three bins, corresponding to the input rating (Btu/hour) of the 0% over-sized conventional draft hood unit heater to be replaced. Agviro explicitly notes that over-sizing was not taken into account in the calculation of savings.

Agviro also notes that the efficient technology, the infrared heater "has been downsized by the infrared adjustment factor" and that "[when/if] the conventional system is 75,000 btu/h input... the infrared heater is [approximately] 64,000 Btu/h input...."

Put another way, an IR heater replacing a 0% over-sized conventional draft hood heater will have an input in btu/h that is 85% (the IR adjustment factor) that of the conventional unit.

Rather than using input range bins for the conventional draft hood heater, Navigant recommends using the corresponding input range bins for the efficient technology. This is for two reasons:

1. It will likely be much simpler to determine the input (btu/h) of the replacement/efficient technology than of the old conventional heater to be replaced.
2. The savings will not be overstated regardless of whether or not the conventional unit is over-sized, so long as the IR heater is appropriately sized for the heating load to be served. If in fact the conventional unit is over-sized the savings estimated will likely be understated given that an oversized draft hood heater operating at partial capacity is likely to consume more gas for a given heating load than a 0% oversized draft hood heater operating at optimal capacity.

In summary: the input heater range bins (and the attendant savings) shown below correspond to the input of *the efficient measure*.

Location	Heater Range (Btu/h)	Annual Gas Savings (m^3/year)		
		Single Stage	2-Stage	High Intensity
London	0 – 63,750	898	1,508	898
	64,600 – 127,500	1,786	3,017	1,786
	128,350 - 255,000	3,591	6,033	3,591
Sudbury	0 – 63,750	971	1,631	971
	64,600 – 127,500	1,942	3,262	1,942
	128,350 - 255,000	3,883	6,524	3,883

Annual gas savings were determined by taking the difference in the annual natural gas consumption of a conventional system and the annual natural gas consumption of the efficient technology as in equation (1) below.

$$\Delta GasUse = \left(\frac{AnnualHeatLoss_{Conv}}{Eff_{Conv}} - \frac{AnnuaHeatLoss_{EE}}{Eff_{EE}} \right) \times \frac{1}{35,300} \quad (1)$$

[1] Assessment of Average Infrared Heater Savings, Agviro, December 1, 2004

Where:

$AnnualHeatLoss =$	Annual heat loss of conventional heater and EE infrared heater (as defined by subscript).
Eff =	The combustion efficiency of the heater (%).
35,300 =	The energy value of natural gas (Btu/m^3)

The annual heat loss is calculated by Agviro as the sum of unit heat losses in a variety of outdoor temperature bins each of which is multiplied by the number of hours in which the temperature, on average falls into a given bin[2].

An average rate of savings of 0.015 m^3/Btu/hour was determined by taking a weighted average of the savings from both locations: 70% of Union Gas South (London) and 30% of Union Gas North (Sudbury) based on customer population distribution in Union Gas service territories. Navigant, in determining the average rate of savings from the information in the Agviro report has conservatively assumed that the Btu/h is the highest possible for a given range. For example, a single-stage infrared heater saves on average 920 m^3 of natural gas per year (see table directly below) for heaters in the 0 – 75,000 Btu/h range – the weighted average between Union's two territories. Assuming that the average Btu/h within this range is in fact the highest possible value in this range (in this case 75,000 Btu/h) this results in savings of 0.0123 m^3/Btu/hr/year as shown in the bottom half of the table directly below.

Weighted Average				
Heater Range (Btu/h)	Single Stage (m^3/year)	2-Stage (m^3/year)	High Intensity (m^3/year)	**Average (m^3/year)**
0 – 63,750	920	1,545	920	**1,128**
64,600 – 127,500	1,833	3,091	1,833	**2,252**
128,350 - 250,000	3,679	6,180	3,679	**4,513**
Heater Range (Btu/h)	Single Stage (m^3/Btu/hr/year)	2-Stage (m^3/Btu/hr/year)	High Intensity (m^3/Btu/hr/year)	**Average (m^3/Btu/h/year)**
0 – 63,750	0.0123	0.0206	0.0123	**0.015**
64,600 – 127,500	0.0122	0.0206	0.0122	**0.015**
128,350 - 250,000	0.0123	0.0206	0.0123	**0.015**

As noted above, the average savings, 0.015 m^3/Btu/h/year, should be applied to the input btu/h of the efficient, not the base, technology.

Baseline estimates of natural gas consumption[3]:

Heater Range (Btu/h)	Annual Gas Use (m^3/year)
0 – 63,750	6,131
64,600 – 127,500	12,262
128,350 - 250,000	24,525

[2] Ibid.
[3] Ibid.

Percentage of natural gas savings = Average Savings / Baseline Gas Consumption = 18.4%

Annual Electricity Savings — 16 - 873 kWh

Both infrared heaters and conventional draft-hood unit heaters require an electrically powered circulating fan. Infrared heaters typically use a fan of a much lower horse-power than those used by a conventional draft-hood heater.

Navigant has estimated the base measure's fan load by converting the average fan horse-power of a representative sample of conventional draft-hood heaters[4] into kilowatts. Fan loads for infrared heaters were obtained by Navigant by contacting several manufacturers by and requesting the horse-power of the fan/blower on the most popular units in a given btu/hr input range[5].

As with the natural gas savings shown above, the electricity savings correspond to the input range bin in which the input (btu/h) of the efficient technology falls, not the base technology.

	Fan load (kW)		Operating Hours per Year		
Heater Range (Btu/h)	Conventional draft-hood heater	Infrared Heater	Conventional draft-hood heater	Infrared Heater	**Electricity Savings**
< 50,000	0.02	0.02	2509	2133	**16**
50,000 - 165,000	0.19	0.04	2509	2133	**409**
> 165,000	0.43	0.09	2509	2133	**873**

Annual Water Savings — 0 L

N/A

Other Input Assumptions

Effective Useful Life (EUL) — 20 Years

Infrared heaters have an estimated service life of 20 years[6].

Base & Incremental Conservation Measure Equipment and O&M Costs — $ 0.0122 / Btu / h

An incremental cost of $350 was used based on past input assumptions filed by Union[7]. Local retailers reported an average of $0.009 / Btu/hr incremental cost. Navigant Consulting therefore is estimating an average of $0.0122 / Btu/hour.

Measure Assumptions Used by Other Jurisdictions

Source	Annual Natural Gas Savings	Effective Useful Life	Incremental Cost ($)	Penetration/Market Share

[4] Horse-powers are drawn from Trane's specifications sheet for that company's line of conventional draft-hood heaters: http://www.trane.com/Commercial/Uploads/Pdf/1024/uh-ts-1.pdf

[5] Navigant contacted Spaceray (www.spaceray.com) , Schwank (www.schwankgroup.com) and Calcana (www.Calcana.com) and also consulted the online specifications published by Solaronics (http://solaronics.thomasnet.com/Asset/SSTG-SSTU-GB_200010_Spec_Sheet.pdf). The infrared heaters produced by Solaronics, Schwank and Spaceray all use the same horse-power fan, regardless of btu/hr input, whereas the Calcana heater fan horse-power varies by input range. Navigant has conservatively assumed that the fan load of the 0 – 75,000 btu/hr range will be the average of all those reported to Navigant, whereas the fan-load for the other two buckets will be those reported by Calcana.

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

[7] EB-2005-0211, Union Gas Settlement Agreement, April 7, 2005

Low-Flow Showerhead (1.25 GPM, Residential, Distributed, per Household)

Revision #	Description/Comment	Date Revised
		October 28, 2010

Efficient Equipment and Technologies Description

Low-flow Showerhead (1.25 GPM) – distributed to participants under Union Gas' ESK program. One showerhead distributed per ESK Kit.

Base Equipment and Technologies Description

Average existing stock (2.21 GPM)[1].

Decision Type	Target Market(s)	End Use
New/Retrofit	Residential	Water heating

Codes, Standards, and Regulations

Ontario Building Code (2006)[2] requires shower heads to have a maximum flow of 2.5 GPM (9.5 L/min)

Resource Savings Table

Year (EUL=)	Electricity and Other Resource Savings			Equipment & O&M Costs of Conservation Measure	Equipment & O&M Costs of Base Measure
	Natural Gas (m^3)	Electricity (kWh)	Water (L)	($)	($)
1	44	0	13,885	3.69	0
2	44	0	13,885	0	0
3	44	0	13,885	0	0
4	44	0	13,885	0	0
5	44	0	13,885	0	0
6	44	0	13,885	0	0
7	44	0	13,885	0	0
8	44	0	13,885	0	0
9	44	0	13,885	0	0
10	44	0	13,885	0	0
TOTALS	440	**0**	**138,850**	**3.69**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings — 44 m^3

Enbridge Gas commissioned a study by the SAS Institute (Canada)[3] 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.

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[1] Shower-heads distributed under Union Gas's ESK program are installed by homeowners rather than Union contractors. No observation is made of the base equipment's GPM. It is therefore assumed to be the full-on flow rate corresponding to the as-used flow from York Region monitoring study calculated using the equation cited below. Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007. Cited by: Summit Blue, *Resource Savings Values in Selected Residential DSM Prescriptive Programs*, June 2008.

[2] Ontario Regulations 350/06, 2006 Building Code

[3] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010

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[4] 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.[5]

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:

Baseline Flow rate (GPM)	Energy Efficient Flow Rate (GPM)	Change in GPM	Annual Natural Gas Savings (m^3)	Annual Natural Gas Savings (m^3 per GPM)
2.25[6]	1.25	1.0	46	46
3[7]	1.25	1.75	88	50

For base flow/efficient flow showerhead types not explicitly tested in the SAS study, gas savings have been extrapolated in the following manner:

1. The results of the SAS institute study indicate that gas savings increase at an increasing rate as the difference between efficient and base GPM increases.
2. Fitting a polynomial function with no intercept (no change in GPM = no gas savings) delivers the following function (where ΔGPM = Base GPM – Efficient GPM):

$$\text{Annual Gas Savings } (m^3) = 40.29 * \Delta GPM + 5.71 * \Delta GPM^2$$
$$= 40.29*(2.21-1.25) + 5.71*(2.21-1.25)^2$$
$$= 44$$

These savings values assume that 100% of household showering is reduced to 1.25 gpm. A survey determining the percentage of showering affected by the program should be used to adjust the year end program results.

Annual Electricity Savings	**0 kWh**
N/A	

Annual Water Savings	**13,885 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 equipment: 1.89 GPM[8]
- Average household size: 3.1 persons[9]
- Showers per capita per day: 0.75[10]
- Average showering time per capita per day with base equipment: 7.32 minutes
- Average showering time per capita per day with new technology: 7.61 minutes[11]

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[4] where no low-flow showerheads were ever installed

[5] 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).

[6] Average of 2.0 GPM and 2.5 GPM

[7] Assumed average low flow showerhead which is greater than 2.5 GPM.

[8] As-used flow is calculated as a function of "full-on" or label flow: as-used flow = min{ 0.691+0.542*full-on flow, full-on flow}. Proctor, J. Gavelis, B. and Miller, B. *Savings and Showers: It's All in the Head*, (PGE) Home Energy Magazine, July/Aug 1994. Cited in Summit Blue (2008). .

[9] Summit Blue (2008).

[10] Ibid, based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007

[11] 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)

Annual water savings calculated as follows:

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

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)

Savings = 3,668 gallons or 13,885 litres

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	**$3.69**
As per utility program costs, bulk purchase of showerheads.	
Free-Ridership	**10%**
Free Ridership rate recommended by Summit Blue Consulting.[12]	

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

Low-Flow Showerhead (1.25 GPM, Residential, Installed, per Household)

Revision #	Description/Comment	Date Revised
		October 28, 2010

Efficient Equipment and Technologies Description
One Low-flow Showerhead (1.25 GPM) – Installed by Union-designated contractors.
Base Equipment and Technologies Description
Average existing stock within one of three ranges. Range mid-points used as point estimates: • Scenario A – 2.25 GPM • Scenario B – 3.0 GPM When new showerheads are installed contractors use a bag-test to determine base equipment flow-rate.

Decision Type	Target Market(s)	End Use
Retrofit	Residential (Existing)	Water heating

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	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	3.69	0
2	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
3	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
4	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
5	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
6	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
7	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
8	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
9	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
10	**A:**46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
TOTALS	**A: 460 B: 880**	**0**	**A: 142,940 B: 225,800**	**3.69**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	A: 46 m^3 B: 88 m^3

Enbridge Gas commissioned a study by the SAS Institute (Canada)[13] 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

[13] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010

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[14] 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.[15]

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:

Baseline Flow rate (GPM)	Energy Efficient Flow Rate (GPM)	Change in GPM	Annual Natural Gas Savings (m^3)	Annual Natural Gas Savings (m^3 per GPM)
2.25[16]	1.25	1.0	46	46
3[17]	1.25	1.75	88	50

For base flow/efficient flow showerhead types not explicitly tested in the SAS study, gas savings have been extrapolated in the following manner:

1. The results of the SAS institute study indicate that gas savings increase at an increasing rate as the difference between efficient and base GPM increases.
2. Fitting a polynomial function with no intercept (no change in GPM = no gas savings) delivers the following function (where ΔGPM = Base GPM – Efficient GPM):

$$\text{Annual Gas Savings } (m^3) = 40.29^* \Delta GPM + 5.71^* \Delta GPM^2$$
$$= 40.29^*(2.25-1.25) + 5.71^*(2.25-1.25)^2$$
$$= 46$$

$$\text{Annual Gas Savings } (m^3) = 40.29^* \Delta GPM + 5.71^* \Delta GPM^2$$
$$= 40.29^*(3.0-1.25) + 5.71^*(3.0-1.25)^2$$
$$= 88$$

These savings values assume that 100% of household showering is reduced to 1.25 gpm. A survey determining the percentage of showering affected by the program should be used to adjust the year end program results.

Annual Electricity Savings	0 kWh

N/A

Annual Water Savings	A: 14,294 L B: 22,580 L

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

[14] where no low-flow showerheads were ever installed
[15] 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).
[16] Average of 2.0 GPM and 2.5 GPM
[17] Assumed average low flow showerhead which is greater than 2.5 GPM.

Assumptions and inputs:

- As-used flow rate with base equipment[18]:
  Scenario **A:** 1.91 GPM
  Scenario **B:** 2.32 GPM
- Average household size: 3.1 persons[19]
- Showers per capita per day: 0.75[20]
- Average showering time per capita per day with base equipment:
  Scenario **A:** 7.31 minutes
  Scenario **B:** 7.13 minutes
- Average showering time per capita per day with new technology: 7.61 minutes[21]

Annual water savings calculated as follows:

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

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)

Scenario **A:** Savings = 3,776 gallons or 14,294 litres
Scenario **B:** Savings = 5,965 gallons or 22,580 litres

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	**$3.69**
As per utility program costs, bulk purchase of showerheads.	
Free-Ridership	**10%**
Free Ridership rate recommended by Summit Blue Consulting.[22]	

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[18] As-used flow is calculated as a function of "full-on" or label flow: as-used flow = min{ 0.691+0.542*full-on flow, full-on flow}. Proctor, J. Gavelis, B. and Miller, B. *Savings and Showers: It's All in the Head*, (PGE) Home Energy Magazine, July/Aug 1994. Cited in Summit Blue (2008)..

[19] Summit Blue (2008).

[20] Ibid, based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007

[21] 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)

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

Low-Flow Showerhead (1.25 Gpm, Low Income, Installed, per Household)

Revision #	Description/Comment	Date Revised
		October 28, 2010

Efficient Equipment and Technologies Description

Low-flow Showerhead (1.25 Gpm) – One or more showerheads are installed by Union-designated contractors.

Base Equipment and Technologies Description

Average existing stock within one of three ranges.

Range mid-points used as point estimates:

- Scenario **A** – 2.25 GPM
- Scenario **B** – 3.0 GPM

When new showerheads are installed contractors use a bag-test to determine base equipment flow-rate.

Decision Type	Target Market(s)	End Use
Retrofit	Low Income Residential (Existing)	Water heating

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	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	3.69	0
2	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
3	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
4	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
5	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
6	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
7	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
8	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
9	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
10	**A:** 46 **B:** 88	0	**A:** 14,294 **B:** 22,580	0	0
TOTALS	**A: 460** **B: 880**	**0**	**A:** 142,940 **B:** 225,800	**3.69**	**0**

Resource Savings Assumptions

Annual Natural Gas Savings	**A: 46 m^3** **B: 88 m^3**

Enbridge Gas commissioned a study by the SAS Institute (Canada)[23] 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

[23] Rothman, Lorne, SAS® PHASE II Analysis for Enbridge Gas Distribution Inc.: Estimating the Impact of Low-Flow Showerhead Installation; April 5, 2010

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[24] 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.[25]

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:

Baseline Flow rate (GPM)	Energy Efficient Flow Rate (GPM)	Change in GPM	Annual Natural Gas Savings (m^3)	Annual Natural Gas Savings (m^3 per GPM)
2.25[26]	1.25	1.0	46	46
3[27]	1.25	1.75	88	50

For base flow/efficient flow showerhead types not explicitly tested in the SAS study, gas savings have been extrapolated in the following manner:

1. The results of the SAS institute study indicate that gas savings increase at an increasing rate as the difference between efficient and base GPM increases.
2. Fitting a polynomial function with no intercept (no change in GPM = no gas savings) delivers the following function (where ΔGPM = Base GPM – Efficient GPM):

$$\text{Annual Gas Savings } (m^3) = 40.29 * \Delta GPM + 5.71 * \Delta GPM^2$$
$$= 40.29*(2.25-1.25) + 5.71*(2.25-1.25)^2$$
$$= 46$$

$$\text{Annual Gas Savings } (m^3) = 40.29 * \Delta GPM + 5.71 * \Delta GPM^2$$
$$= 40.29*(3.0-1.25) + 5.71*(3.0-1.25)^2$$
$$= 88$$

These savings values assume that 100% of household showering is reduced to 1.25 gpm. A survey determining the percentage of showering affected by the program should be used to adjust the year end program results.

Annual Electricity Savings	**0 kWh**

N/A

Annual Water Savings	**A: 14,294 L** **B: 22,580 L**

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

[24] where no low-flow showerheads were ever installed
[25] 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).
[26] Average of 2.0 GPM and 2.5 GPM
[27] Assumed average low flow showerhead which is greater than 2.5 GPM.

Assumptions and inputs:

- As-used flow rate with base equipment[28]:
  - Scenario **A:** 1.91 GPM
  - Scenario **B:** 2.32 GPM
- Average household size: 3.1 persons[29]
- Showers per capita per day: 0.75[30]
- Average showering time per capita per day with base equipment:
  - Scenario **A:** 7.31 minutes
  - Scenario **B:** 7.13 minutes
- Average showering time per capita per day with new technology: 7.61 minutes[31]

Annual water savings calculated as follows:

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

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)

Scenario **A:** Savings = 3,776 gallons or 14,294 litres
Scenario **B:** Savings = 5,965 gallons or 22,580 litres

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	**$3.69**
As per utility program costs, bulk purchase of showerheads.	
Free-Ridership	**1%**
Free Ridership rate recommended by Summit Blue Consulting.[32]	

[28] As-used flow is calculated as a function of "full-on" or label flow: as-used flow = min{ 0.691+0.542*full-on flow, full-on flow}. Proctor, J. Gavelis, B. and Miller, B. *Savings and Showers: It's All in the Head*, (PGE) Home Energy Magazine, July/Aug 1994. Cited in Summit Blue (2008).
[29] Summit Blue (2008).
[30] Ibid, based on data from: Resource Management Strategies, Inc., Regional Municipality of York Water Efficiency Master Plan Update, April 2007
[31] 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)
[32] "Residential Measure Free Ridership And Inside Spillover Study - Final Report", Summit Blue Consulting, June 2008.

	(m3)	(Years)		
Questar Gas[8]	32.64	17	1,391	N/A

Comments
Specifications for infrared heaters are not provided in the report or the baseline assumptions.

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

Attachment B

Revised 2010 SSM Calculations and Updated Program Free Rider Rates

(white)	As per EB-2010-0055
(blue)	Indicates changes from EB-2010-0055

Target Market		Equipment Details				Annual Resource Savings			Other			
Sector	New/Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Reference
Residential Space Heating												
Residential	Existing	Reflector Panels		No reflector panels		143	0	0	18	$229	0%	
Residential	Existing	Programmable Thermostat		Standard Thermostat		53	54	0	15	$25	43%	
Residential	New	Programmable Thermostat		Standard Thermostat		53	54	0	15	$25	10%	Substantiation document provided in Appendix B.
Residential	New/Existing	High efficiency fireplace with intermittent ignition	EnerGuide efficiency rating 5% above base equipment efficiency*	Natural gas fireplace with a pilot	EnerGuide median efficiency rating*	108 - 122*	(-) 31	0	20	$135	17%	Substantiation document provided in Appendix B.
Residential	Existing	Fireplace intermittent ignition control retrofit		Natural gas fireplace with a pilot		104	(-) 31	0	8	$150	1%	Substantiation document provided in Appendix B.
Residential Water Heating												
Residential	New/Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,004	10	$0.55	33%	Costs as per utility program costs, bulk purchase.
Residential	New	Faucet Aerator	Kitchen, 1.5 GPM	Ontario Building Code 2006	2.2 GPM	19	0	6,201	10	$1.39	33%	Base case adjusted to Ontario Building Code (2006). Costs as per utility program costs, bulk purchase. Substantiation document provided in Appendix B.
Residential	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	23	0	7,797	10	$1.39	33%	Costs as per utility program costs, bulk purchase.
Residential	New	Faucet Aerator	Bathroom, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	10	0	3,435	10	$0.55	33%	Substantiation document provided in Appendix B.
Residential	Existing	Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	10	0	3,435	10	$0.55	33%	Substantiation document provided in Appendix B.
Residential	New	Faucet Aerator	Kitchen, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	32	0	10,631	10	$1.59	33%	Substantiation document provided in Appendix B.
Residential	Existing	Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	35	0	11,694	10	$1.59	33%	Substantiation document provided in Appendix B.
Residential	Existing	Low flow showerhead (Distributed)	1.5 GPM	Average existing stock	2.2 GPM	46	0	6,334	10	$6	10%	
Residential	New/Existing	Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	44	0	13,885	10	$3.69	10%	Substantiation document provided in Appendix B.
Residential	Existing	Low-flow showerhead (Contractor Installed)	1.25 GPM	Average existing stock	2.25 GPM	46	0	14294	10	$3.69	10%	Substantiation document provided in Appendix B.
Residential	Existing	Low-flow showerhead (Contractor Installed)	1.25 GPM	Average existing stock	3.0 GPM	88	0	22580	10	$3.69	10%	Substantiation document provided in Appendix B.
Residential	Existing	Pipe Wrap (R-4)	Insulation for DWH outlet pipe	Uninsulated DHW outlet pipes	R-1	18	0	0	10	$0.98	4%	Costs as per utility program costs, bulk purchase.
Residential	Existing	Solar Pool Heaters		Natural gas pool heater		1,116	-57	0	20	$1,450	10%	Substantiation document provided in Appendix B.
Low-Income Space Heating												
Low-Income	Existing	Programmable Thermostat		Standard manual thermostat		53	54	0	15	$26.95	1%	Costs as per utility program costs, bulk purchase.
Low Income Water Heating												
Low-Income	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	6	0	2,004	10	$0.55	1%	Costs as per utility program costs, bulk purchase.
Low-Income	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	23	0	7,797	10	$1.39	1%	Costs as per utility program costs, bulk purchase.
Low-Income	Existing	Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	10	0	3,435	10	$0.55	1%	Costs as per utility program costs, bulk purchase.
Low-Income	Existing	Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	35	0	11,694	10	$1.59	1%	Costs as per utility program costs, bulk purchase.
Low-Income	Existing	Low-flow showerhead (Distributed)	1.5 GPM	Average existing stock	2.2 GPM	46	0	6,334	10	$6	1%	
Low-Income	Existing	Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	63	0	10,570	10	$3.69	1%	Costs as per utility program costs, bulk purchase.
Low-Income	Existing	Low-flow showerhead (Contractor installed)	1.25 GPM	Average existing stock	2.5 GPM	46	0	14,294	10	$3.69	1%	Substantiation document provided in Appendix B.
Low-Income	Existing	Low-flow showerhead (Contractor installed)	1.25 GPM	Average existing stock	3.0 GPM	88	0	22,580	10	$3.69	1%	Substantiation document provided in Appendix B.
Low-Income	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes (R-1)	R-1	18	0	0	10	$0.98	1%	Costs as per utility program costs, bulk purchase.
Commercial Cooking												
Commercial	New/Existing	Energy Star Fryer	50% cooking efficiency	Standard fryer	35% cooking efficiency	913	0	0	12	$2,648	30%	
Commercial Space Heating												
Commercial	Existing	Air Curtains	Single door	Non-air curtain doors		667	172	0	15	$1,650	5%	
Commercial	Existing	Air Curtains	Double door	Non-air curtain doors		1,529	1,023	0	15	$2,500	5%	
Commercial	Existing	Condensing Boilers	88% seasonal efficiency (est.)	Non-condensing boiler	76% estimated seasonal efficiency	0.0104 / Btu/hr	0	0	25	$12/Kbtu/hr	5%	
Commercial	New/Existing	Demand Control Kitchen Ventilation	0 - 4,999 CFM	Kitchen ventilation without DCKV		4,801	13,521	0	15	$10,000	5%	

	As per EB-2010-0055
(shaded)	Indicates changes from EB-2010-0055

Target Market		Equipment Details				Annual Resource Savings			Other			
Sector	New/Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Reference
Commercial	New/Existing	Demand Control Kitchen Ventilation	5,000 - 9,999 CFM	Kitchen ventilation without DCKV		11,486	30,901	0	15	$15,000	5%	
Commercial	New/Existing	Demand Control Kitchen Ventilation	10,000 - 15,000 CFM	Kitchen ventilation without DCKV		18,924	49,102	0	15	$20,000	5%	
Commercial	New/Existing	Destratification Fans		No destratification fans		0.5/ft^2	(-)0.0034 /ft^2	0	15	$7,021	10%	
Commercial	Existing	Energy Recovery Ventilator	Ventilation with ERV	Ventilation without ERV		2.17 - 6.12/CFM**	0	0	14	$3.18/CFM	5%	Substantiation document provided in Appendix B.
Commercial	New	Energy Recovery Ventilator	Ventilation with ERV	Ventilation without ERV		2.05 - 5.77/CFM**	0	0	14	$3.18/CFM	5%	Substantiation document provided in Appendix B.
Commercial	Existing	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		1.67 - 4.70/CFM**	0	0	14	$3.61/CFM	5%	Substantiation document provided in Appendix B.
Commercial	New	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		1.52 - 4.28/CFM**	0	0	14	$3.61/CFM	5%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Infrared Heaters	0 - 49,999 BTU/hr	Regular Unit Heater		0.015 /Btu/hr	16	0	20	$0.0122/Btu/hr	33%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Infrared Heaters	50,000 - 164,999 BTU/hr	Regular Unit Heater		0.015 /Btu/hr	409	0	20	$0.0122/Btu/hr	33%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Infrared Heaters	165,000 - 300,000 BTU/hr	Regular Unit Heater		0.015 /Btu/hr	873	0	20	$0.0122/Btu/hr	33%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Rooftop Unit	Two-stage rooftop unit	Single stage rooftop unit		255	0	0	15	$375	5%	
Commercial	Existing	Programmable Thermostat		Standard thermostat		82 - 538**	63 - 266**	0	15	$40	20%	Costs as per utility program costs, bulk purchase.
Commercial	Existing	Prescriptive Schools - Elementary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80%-82% efficiency		10,830	0	0	25	$8,646	27%	
Commercial	Existing	Prescriptive Schools - Secondary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80%-82% efficiency		43,859	0	0	25	$14,470	27%	
Commercial	New/Existing	Condensing Unit Heater		% Sales Weighted Average model	Equivalent in efficiency to a power vented or separated combustion unit heater (78% Annually Efficient)	0.00631 /Btu/hr	(-)0.00186 /Btu/hr	0	18	$0.0129 /Btu/hr	0%	Substantiation document provided in Appendix B.
Commercial Water Heating												
Commercial	New/Existing	Condensing Gas Water Heater (100gal/day)	95% thermal efficiency	Conventional water heater	80% efficiency, 91gal. tank.	332	0	0	13	$2,230	5%	
Commercial	New/Existing	Condensing Gas Water Heater (500gal/day)	95% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	873	0	0	13	$2,230	5%	
Commercial	New/Existing	Condensing Gas Water Heater (1,000gal/day)	95% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	1,551	0	0	13	$2,230	5%	
Commercial	Existing	Pre-Rinse Spray Nozzle	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	190 - 886**	0	36,484 - 170,326**	5	$60	12.4%	
Commercial	Existing	Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Pre-rinse spray nozzel	1.6 GPM	457	0	97,292	5	$150	0%	Substantiation document provided in Appendix B.
Commercial	Existing	Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Pre-rinse spray nozzel	1.6 GPM	90	0	19,197	5	$150	0%	Substantiation document provided in Appendix B.
Commercial	Existing	Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Pre-rinse spray nozzle	1.6 GPM	109	0	23,166	5	$150	0%	Substantiation document provided in Appendix B.
Commercial	Existing	Pre-Rinse Spray Nozzle (Full Service)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	1,286	0	252,000	5	$150	0%	Costs as per utility program costs, bulk purchase.
Commercial	Existing	Pre-Rinse Spray Nozzle (Limited)	0.64 GPM	Standard pre-rinse spray nozzle	3.0 GPM	339	0	66,400	5	$150	0%	Costs as per utility program costs, bulk purchase.
Commercial	Existing	Pre-Rinse Spray Nozzle (Other)	0.64 GPM	Standard pre-rinse spray nozzel	3.0 GPM	318	0	62,200	5	$150	0%	Costs as per utility program costs, bulk purchase.
Commercial	New/Existing	Energy Star Dishwasher	Undercounter – High Temperature	Non-Energy Star Dishwasher		801	3,754	112,795	10	(-)$13	40%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Energy Star Dishwasher	Undercounter – Low Temperature	Non-Energy Star Dishwasher		326	559	45,891	10	(-)$13	40%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Energy Star Dishwasher	Stationary Rack, (Door type, or Single rack) – High Temperature	Non-Energy Star Dishwasher		619	3,553	87,119	15	(-)$350	20%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Energy Star Dishwasher	Stationary Rack, (Door type, or Single rack) – Low Temperature	Non-Energy Star Dishwasher		841	855	118,369	15	(-)$350	20%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Energy Star Dishwasher	Rack Conveyor, Single (Tank) – High Temperature	Non-Energy Star Dishwasher		2,203	9,811	310,271	20	$2,375	27%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Energy Star Dishwasher	Rack Conveyor, Multi (Tank) – High Temperature	Non-Energy Star Dishwasher		3,708	15,822	522,192	20	$288	27%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Commercial Laundry Washing Equipment with Ozone	Washer extractor – 60 lbs	Commercial Laundry Washing Equipment without Ozone		0.0328 /lbs/yr	0.00219 /lbs/yr	2.01 /lbs/yr	15	$10,970	8%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Commercial Laundry Washing Equipment with Ozone	Washer extractor – 500 lbs	Commercial Laundry Washing Equipment without Ozone		0.0328 /lbs/yr	0.00219 /lbs/yr	2.01 L/lbs/yr	15	$30,270	8%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Commercial Laundry Washing Equipment with Ozone	Tunnel Washer – 120 lbs	Commercial Laundry Washing Equipment without Ozone		0.0240 /lbs/yr	0.00152 /lbs/yr	1.22 /lbs/yr	15	$49,667	8%	Substantiation document provided in Appendix B.
Commercial	New/Existing	Commercial Laundry Washing Equipment with Ozone	Tunnel Washer – 500 lbs	Commercial Laundry Washing Equipment without Ozone		0.0240 /lbs/yr	0.00152 /lbs/yr	1.22 /lbs/yr	15	$160,065	8%	Substantiation document provided in Appendix B.
Multi-Family Water Heating												
Multi-Family	New/Existing	CEE Tier 2 Front-Loading Clothes Washer	MEF=2.20, WF=5.1	Conventional top-loading, vertical axis clothes washer	MEF=1.26, WF=9.5	117	396	58,121	11	$600	10%	

	As per EB-2010-0055
(shaded)	Indicates changes from EB-2010-0055

Target Market		Equipment Details				Annual Resource Savings			Other			
Sector	New/Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m3)	Electricity (kWh)	Water (L)	EUL	Incremental Cost ($)	Free Rider (%)	Reference
Multi-Family	New/Existing	Energy Star Front-Loading Clothes Washer	MEF=1.72 ,WF=8.0	Conventional top loading vertical axis washers	MEF = 1.26, WF=9.5	76	201	19,814	11	$150	48%	Substantiation document provided in Appendix B.
Multi-Family	New	Faucet Aerator	Bathroom, 1.5 GPM	Ontario Building Code 2006	2.2 GPM	4	0	1,382	10	$0.55	10%	Substantiation document provided in Appendix B.
Multi-Family	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	4	0	1,382	10	$0.55	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	New	Faucet Aerator	Kitchen 1.5 GPM	Ontario Building Code 2006	2.2 GPM	13	0	4,280	10	$1.39	10%	Substantiation document provided in Appendix B.
Multi-Family	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	16	0	5,377	10	$1.39	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	New	Faucet Aerator	Bathroom, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	7	0	2,371	10	$0.55	10%	Substantiation document provided in Appendix B.
Multi-Family	Existing	Faucet Aerator	Bathroom, 1.0 GPM	Average existing stock	2.2 GPM	7	0	2,371	10	$0.55	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	New	Faucet Aerator	Kitchen, 1.0 GPM	Ontario Building Code 2006	2.2 GPM	22		7,337	10	$1.59	10%	Substantiation document provided in Appendix B.
Multi-Family	Existing	Faucet Aerator	Kitchen, 1.0 GPM	Average existing stock	2.5 GPM	24	0	8,072	10	$1.59	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	New	Low-flow showerhead (Distributed)	1.5 GPM		2.2 GPM	33	0	5,228	10	$6	10%	Substantiation document provided in Appendix B.
Multi-Family	Existing	Low-flow showerhead (Distributed)	1.5 GPM	Average existing stock	2.2 GPM	33	0	5,228	10	$6	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	New	Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	45	0	8824	10	$3.69	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing	Low-flow showerhead (Distributed)	1.25 GPM	Average existing stock	2.2 GPM	45	0	8824	10	$3.69	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing	Low-flow showerhead (Contractor Installed)	1.25 GPM	Average stock	2.25 GPM	48	0	9,088	10	$3.69	10%	Costs as per utility program costs, bulk purchase.
Multi-Family	Existing	Low-flow showerhead (Contractor Installed)	1.25 GPM	Average stock	3.0 GPM	84	0	14,333	10	$3.69	10%	Costs as per utility program costs, bulk purchase.

* Efficiency ratings and natural gas savings will vary by fireplace type. Please see substantiation sheet for type specific efficiency ratings and savings.

** Savings will vary for different segments. Please see substantiation sheet for segment specific savings.

Union Gas Custom Projects		
Sector	Free Rider (%)	Measure Life (Years)
Agriculture	54%	
Industrial	54%	
Commercial	54%	
Multi-Residential	54%	
New Construction	54%	
Low-Income - Weatherization	0%	23