Haris Ginis
Technical Manager
Regulatory Applications
Regulatory Affairs

tel 416-495-5827
haris.ginis@enbridge.com
EGIRegulatoryProceedings@enbridge.com

Enbridge Gas Inc.
500 Consumers Road
North York, Ontario
M2J 1P8

VIA EMAIL and RESS

September 10, 2024

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

Dear Nancy Marconi:

Re: Enbridge Gas Inc. (Enbridge Gas)
Ontario Energy Board (OEB) File No.: EB-2022-0335
Integrated Resource Planning Pilot Projects
Technical Conference Undertaking Responses

Consistent with the OEB's Procedural Order No. 4, enclosed are Enbridge Gas's written responses to undertakings received during the Technical Conference held on August 27, 2024.

If you have any questions, please contact the undersigned.

Sincerely,

Haris Ginis

Haris Ginis
Technical Manager, Regulatory Applications

c.c. David Stevens (Aird & Berlis LLP, Enbridge Gas Counsel)
Lawren Murray (OEB Counsel)
Stephanie Cheng (OEB Staff)
Intervenors (EB-2022-0335)

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 16

To advise as to where the previously incurred IRP pilot development costs are currently recorded

Response:

Enbridge Gas understands this undertaking as to advise where the costs already incurred associated with the Parry Sound and Southern Lake Huron Pilot Projects (as noted in the response at Exhibit I.PP-17 part a) are currently recorded.

The capital costs (which includes cost incurred for Hourly Metering Installations as noted in the interrogatory response at Exhibit I.PP-17part a) are currently recorded in Capital Assets - In-service (2024) accounts. For clarity, revenue requirement for 2024 will be calculated based on this balance and will be brought forward in the IRP Capital Costs Deferral Account as part of Enbridge Gas's 2024 Utility Earnings and Disposition of Deferral and Variance Account Balances Application.

The operating and maintenance costs (which includes costs incurred for CNG, Stakeholdering, Administrative/Legal, and Data Collection & Analysis as noted in the response at Exhibit I.PP-17 part a) are currently recorded in the IRP Operating Costs Deferral Account (2024) which will be brought forward for disposition in Enbridge Gas's 2024 Utility Earnings and Disposition of Deferral and Variance Account Balances Application.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 22

To advise as to what percentage of customers within the Southern Lake Huron project area have installed ERTS.

Response:

Approximately 93% of customers within the Southern Lake Huron Pilot Project area have encoder receiver transmitters (ERT) installed.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 31

To provide the two Vicot gue curve specifications that are referenced on page 4 of the response to ED 6.

Response:

See Attachment 1 to this response for the Vicot V20 gas heat pump catalogue, including product specifications.

See Attachment 2 to this response for the Vicot V20 gas heat pump performance curve.

See Attachment 3 to this response for the Vicot V65 gas heat pump catalogue, including product specifications.

See Attachment 4 to this response for the Vicot V65 gas heat pump performance curve.

VICOT 奇威特

HEATING & DHW

Gas Fired Absorption Heat Pump (GAP)

V20

AIR SOURCE GAS FIRED ABSORPTION HEAT PUMP (GAP)

VICOT SOLAR TECHNOLOGY CO., LTD.

Add：Hongdu Road, Dezhou Economic Development Zone, Shandong, China

Tel：+86 531 8235 5568/5566/5752

Fax：+86 531 8235 7911

Email: export@vicot.com.cn

www.vicot.com.cn

CORPORATE CULTURE

MISSION:

ONE DREAM ONE TEAM

FOR STAFF FOR SOCIETY

VISION:

THE SAME BREATH

ENERGY SAVING TOGETHER

KEY CAPABILITY:

SATISFY THE CLIENTS'

DEMAND OF VALUE

CREATIVITY QUALITY SERVICE

SOCIAL RESPONSIBILITY

MESSAGE FROM PRESIDENT

To make our private life be meaningful, make products and service good for society and benefiting our staff & society is Vicot founders common sense in our mission and honor at the beginning of Vicot establishment. Vicot has been having many supports from friends and clients and growing up in the market, basing on the pursuit of life meaning and enterprise value. With those precious supports, we deeply understand a person or a team who is striving for dream is not alone in the process of adventure. The gas and/or solar fired air source absorption heat pump (GAP) and solar boiler as Vicot R & D achievement from many years' of intelligence, vigor and capital input, perfectly express Vicot's pursuit of value.

GAP represents the most advanced productivity, broke the limit of solar and air source energy industry, combines three types of clean energy in the commercial and industrial application in the same time, extends the application field of clean energy in a milestone way and proves Vicot capability of creating industry benchmark with its technology patent achievements. GAP also stands for the clean energy's increasing powerful impact to human daily life, the earth is for us and for our next generations also, clean energy will become the prevailing main energy with its incomparable advantage of environment protection and serve more people, more districts and benefit the planet environment.

There were many difficulties in the process of the R&D and manufacturing of new products, but we remained in firm confidence. We are sure that we will win a better tomorrow no matter how painful is the process, because we have the industry technology and production experience accumulated in many years and the pursuit of product value. Now, the era creating product is right here, it stands for bigger market, more harmonious relation between human and nature and more magnificent behavior. Those new products in the clean energy industry will bring the true sense of honor to their innovator, manufacturer, distributor and user. We are striving for a better earth!

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06 2013 Vicot participates the Solar Cooling Research of "The 12th Five Year Plan" National Science and Technology Support Scheme

07 2013~2014 150 nos. of national invention patent and utility patent approved

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GAP PATENT LIST

No.	Description	Patent No.
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SHORTNESS
Efficiency is only around 90%

GAS BOILER

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- Driven by secondary energy, electricity, the energy cost is high and consumption is huge.
- Not able to start normally when ambient temperature is low
- Adopts HFC refrigerant, harmful to environment.

ELECTRIC COMPRESSOR
TYPE AIR SOURCE HEAT PUMP

ADVANTAGE
Driven by primary clean energy natural gas, energy cost is lower

ADVANTAGE
Adopts heat pump technology, gets air source energy freely

Natural gas + Air source energy

Perfect combination of two technologies' advantage

GAP–V20

V20

V20 PERFORMANCE AND APPLICATION

V20

HEATING

DHW

Radiator

Floor heating

Fan coil unit

Feature:

1、Optional built in high efficient water pump.
2、Built in weather compensation control mode, unit operation with higher efficiency.
3、Built in anti–freezing function.

V20 ADVANTAGES

UTILIZATION OF NATURAL GAS AND AIR SOURCE ENERGY, GOOD FOR ENVIRONMENT PROTECTION

>> Good for environment protection

- Each V20 GAP unit can annually save 19.345 tons of standard coal,
  Reduces 47.782 tons of CO_2 emission,
  in equivalence of planting 2611 trees.

- Vicot produces 12,000 sets of V20 GAP unit,
  It can save 232,140 tons of standard coal,
  reduces 573,384 tons of CO_2 emission,
  in equivalence of planting 31,332,000 trees.

01 Low operation cost

02 Low emission

03 Remote control, worry free operation

V20 ADVANTAGES

04 "Frost free" heat pump

05 Operation in ambient –30 ℃

06 Intelligent control, stepless capacity adjustment

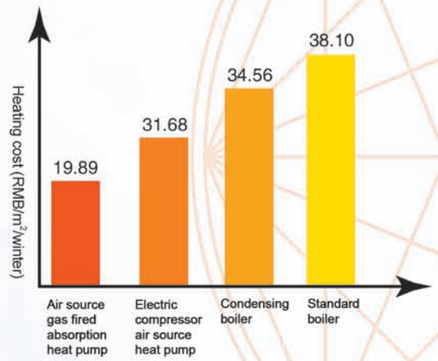
07 Super quiet operation, the quietest heat pump in market

08 Total heat recovery, higher efficiency

THE ADVANTAGES OF V20

V20 ADVANTAGES

LOW OPERATION COST



Item	Air source gas fired absorption heat pump	Electric compressor air source heat pump	Condensing boiler	Standard boiler
Renewable energy	Air	Air	No	No
Heating cost (RMB/m²/winter)	19.89	31.68	34.56	38.10

Remark: The above data is based on the heating in Beijing, design load: 50 W/m², supply water temp. 50℃, electricity cost: RMB0.55/kWh, natural gas cost: RMB3/m³.

LOW EMISSION

(1) GAP adopts heat pump principle, natural gas consumption amount is 45% of conventional boiler, and emission is reduced by 55%.

(2) GAP adopts advanced premixing combustion technology, the nitrogen oxide emission is in international leading level.

(3) SO_2 emission concentration 9 mg/m³, NO_x emission concentration 27 mg/m³, particle concentration 2.3 mg/m³, smoke blackness <1 Ringelmann.

REMOTE CONTROL, WORRY FREE OPERATION

There is an intelligent built in CPU in each GAP before leaving factory, the operation status of GAP can be monitored and operation parameter can be set through internet in our headquarter, to ensure the unit operation performance and in economic consumption status and save the operation cost; it is optional to check the maintenance at site and keep the client away from worry of operation; the unit self-diagnosis function can be controlled and unit will have self-diagnosis after operation of certain period and adjust the problem occurs during operation.

V20 ADVANTAGES

"FROST FREE" HEAT PUMP

Heavy frost on electric air source heat pump

V20

(1) Adopts brand new anti-frost technology, prevent the formation of frost and effectively extend the frost interval up to more than 3 hours.

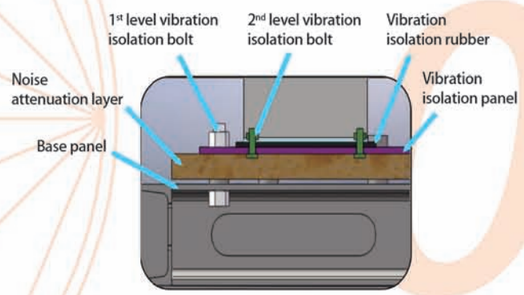
(2) Defrost energy consumption is reduced to below 5%.

SUPER QUIET OPERATION, THE QUIETEST HEAT PUMP IN MARKET

(1) No compressor is used, much quieter than electric air source heat pump.

(2) Adopts optimized fan blades, dramatically reduces operation noise.

(3) Adopts vibration isolator at base, suitable for installation on ground and rooftop.



CAPABLE OF OPERATION IN AMBIENT -30 ℃

Unit operation ambient temperature range is from -30 ℃ to 43 ℃, not afraid of low ambient temp.

INTELLIGENT CONTROL, STEPLESS CAPACITY ADJUSTMENT

The unit starts in low frequency and operates in high frequency to reach the set temperature quickly.The unit will operate in low frequency to maintain the room temp. when the set temp. reached, the room temp. is constant and more comfortable.

TOTAL HEAT RECOVERY, HIGHER EFFICIENCY

(1) System thermal energy utilization at high efficiency and more energy saving.

(2) Unique insulation design of heat exchanger, more safety.

GAS FIRED ABSORPTION HEAT PUMP (GAP) VGAHR020 (V20)

Item		Unit	Specification
Nominal heating capacity		kW	19.2
Water flow rate		m^3/h	⩾1.6
Water side pressure drop		kPa	⩽20
Minimum water inlet temp.		℃	9
Maximum water outlet temp.		℃	65
Ambient temp.	Max. temp.	℃	43
	Min. temp.	℃	−30
Rated thermal input		kW	9.4
Thermal input adjustment range		kW	3.8−11.3
Rated natural gas consumption		m^3/h	1.0
Natural gas consumption adjustment range		m^3/h	0.4~1.2
Power supply			220V / 1Ph / 50 Hz
Electricity power input		kW	0.35
Unit weight		kg	540
Noise		dB(A)	40
Pipe size	Water pipe (threaded)	In	DN25
	Gas pipe (threaded)	In	DN15
Unit dimension	Length	mm	1600
	Width	mm	950
	Height	mm	1710

Notes:

1. Nominal heating capacity: ambient dry bulb temperature 7℃, ambient wet bulb temperature 6 ℃， water outlet temperature 45℃, there will be certain change of heating capacity in different ambient temperature;

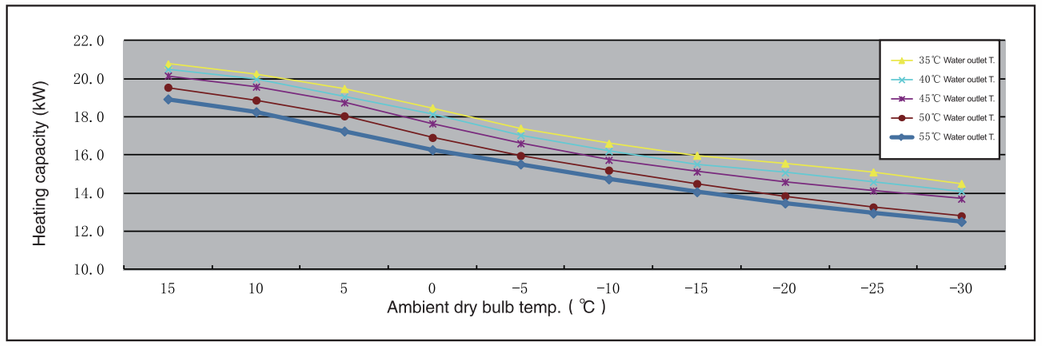
2. Natural gas lower heating value 34.02 MJ;

3. Test condition: natural gas static pressure 2.5 kPa;

4. The noise value is the average value in 5 meters away from the unit;

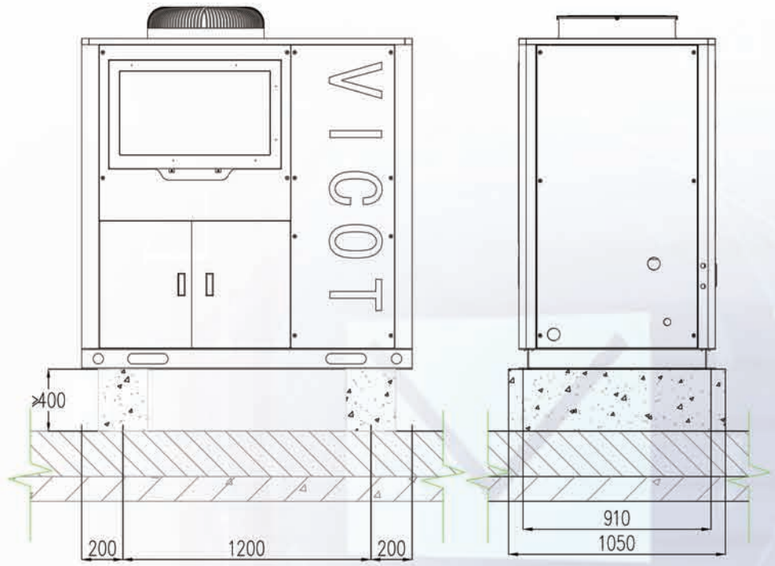
5. The specification is subject to the value in rating label, and no prior notice before any change.

V20 heating performance curve



INSTALLATION INSTRUCTION

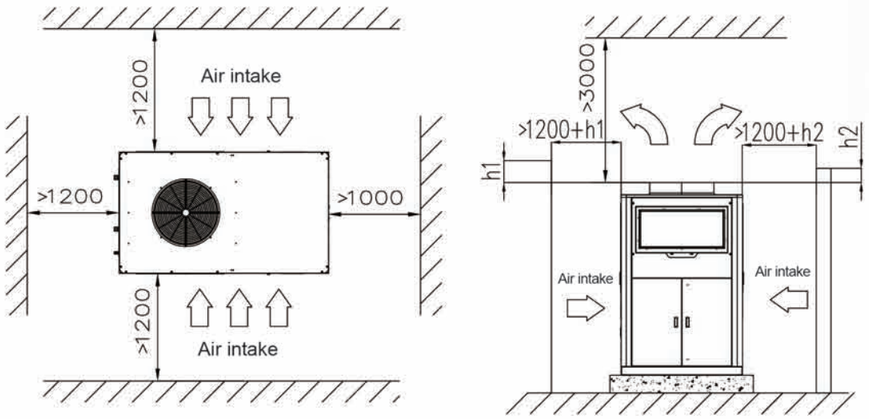
Foundation



Notes:

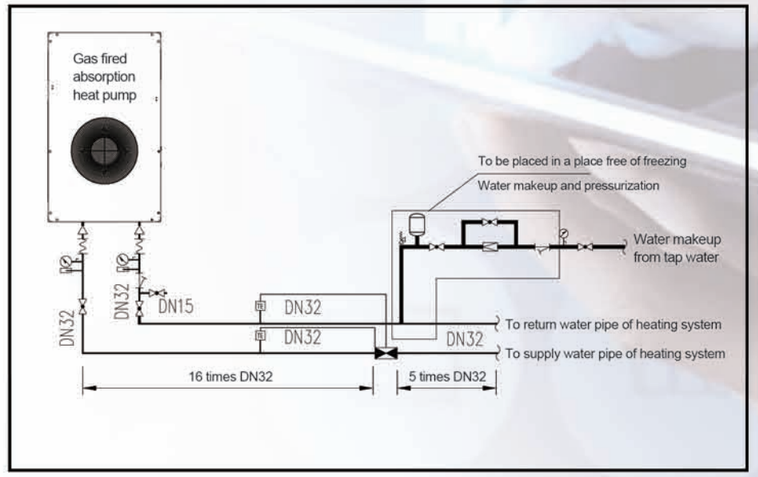
1. Foundation must be qualified for the unit weight.
2. Foundation height should be more than 400 mm, so as to keep snow accumulation away from unit in winter.
3. Foundation levelness should be ＜2 mm/m.
4. Ensure rain water and condensed water drainage around the unit.
5. No barrier placed in the ventilation area.
6. Avoid unit noise and smoke impact to resident.

Installation space requirement



Minimum surrounding space diagram

System principle diagram



PIPING INSTRUCTION

The following principle should be followed during water piping installation:

1) Water pipe length should be as short as possible;

2) The piping accessories should be installed strictly as per drawing;

3) The water pipe should not be less than DN32 at the connection part to unit, the system total water piping system resistance should be less than 7 meters;

4) Keep the elbow nos. as less as possible, and have elbow radius as big as possible;

5) The insulation thickness should not be less than 30 mm for pipe installed at outdoor.

Water circuit installation steps:

1) Install the water pipe and accessories.

2) Leakage test with pressure: Carry out water pressure test after pipe installation, the testing pressure should be 1.5 times of that of working pressure and no less than 0.6 MPa.

3) Inspection method: The water pressure drop no less than 0.05 MPa with testing pressure in 10 minutes, then reduce working pressure and no leakage in working pressure. Flush the system repeatedly till there is no sand, no scratch in water and water is clear after the leakage test. All the strainer should be removed before flushing and installed again after flushing.

4) The outlet water should be same as inlet water in the water color and transparent degree.

5) Have auto airvent valve at the highest point of the system.

6) Have flexible connector, pressure gauge, thermometer, valve at the water inlet and outlet pipe of the unit, pressure gauge accuracy 1.6 class and measurement range 0–1.0 MPa, and install T–cock valve there to keep the water pressure gauge away from freezing. Select thermometer with 0~70 ℃ measuring range and division value 1 ℃, upper part length 220 mm, lower part length 40 mm. Have strainer with mesh of 30~40 at the water inlet and outlet pipe of the unit.

7) Install water make up and pressurization unit as per system diagram and have it installed at indoor for anti–freezing.

8) Drain valve or drain pipe should be installed at the lowest position of water inlet pipe, drain water should flow to drain groove.

Electric wiring:

Unit power supply is 220 V，50 Hz (60 Hz optional)

All wiring and earthing must be in compliance with local electric regulation.

Warning

- Check the electric parameter on rating label and ensure the wiring is carried out as per local regulation.
- The unit should have independent power supply with current breaker and electric leakage protection device.
- Installer should select the power supply according to the unit power input and current.
- All the unit must be earthed.
- The manufacturer is not liable for the problem caused by the wiring change inside of the unit without authorization.
- Earthing must be properly fixed.
- Not to connect the power supply before all the wiring is done to avoid injuries and deaths.
- The power supply voltage fluctuation should be within +7%, –10%.

REFERENCE PROJECTS

>>PROJECT IN HUAIROU, BEIJING

- Installation site: A villager’ s house in Huairou, Beijing
- Equipment selected: 2 nos. of V20
- Actual heating area: 300 m²

ABOUT VICOT GROUP

Vicot Group is a high–tech corporation specialized in R&D, production, sales and service of new energy products;

Our production base locates in Solar City, Dezhou, China, has RMB600 million asset, designed annual production value reaches RMB5 billion;

Vicot main products are gas fired absorption heat pump (heating/hot water), solar boiler, solar absorption chiller, solar central heating system, solar central hot water system etc;

Vicot is awarded for many honors such as National Energy Progress 3rd Prize, China Huaxia Construction Science Technology Prize and National Construction Committee Science Progress Prize.

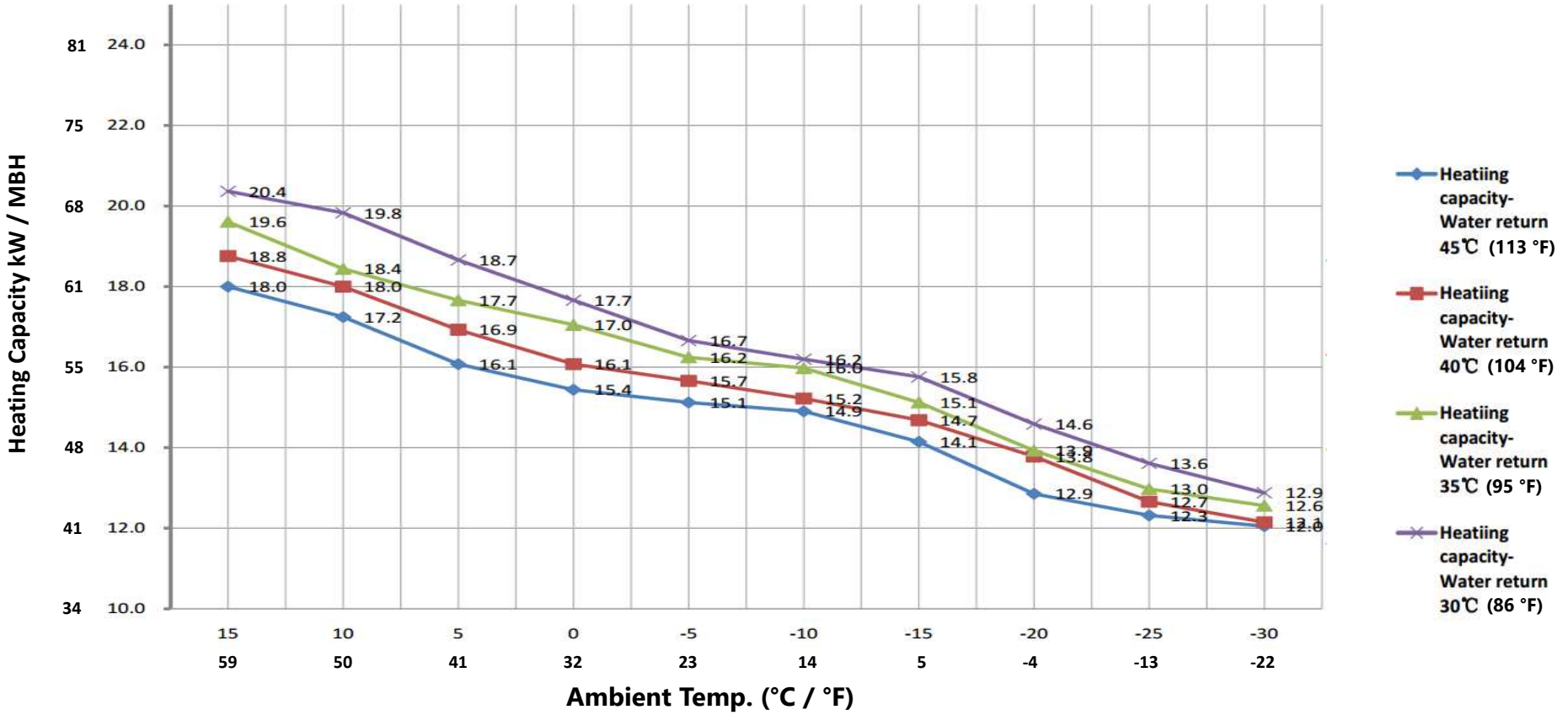
Vicot has 150 nos. of national invention patent and utility patent approved or in the process of approval, and certificates of ISO9001 quality management system and ISO14001 environment management system. The product with international level quality is ensured with strict process control and complete quality management system;

With the vision of “one world, one blue sky”, the corporate focuses on effective utilization of solar energy, air source energy and other renewable energies in construction energy saving heating and industrial energy saving thermal application, strives for technology creation achievement of international new energy application industry.

In accordance with the mission “One Dream, One Team, For Staff, For Society”, Vicot group will make continuous progress in the new energy field and sincerely cooperate and make progress with all the social sectors with quality product, perfect service with a broad mind in a great and firm spirit, and dedicates to creating a happier and richer future for partners, clients and our earth.

V20 HEATING CAPACITY CURVE

Working data and curve of ambient temperature and water temperature change – **V20**



V20 GUE RUNNING CURVE

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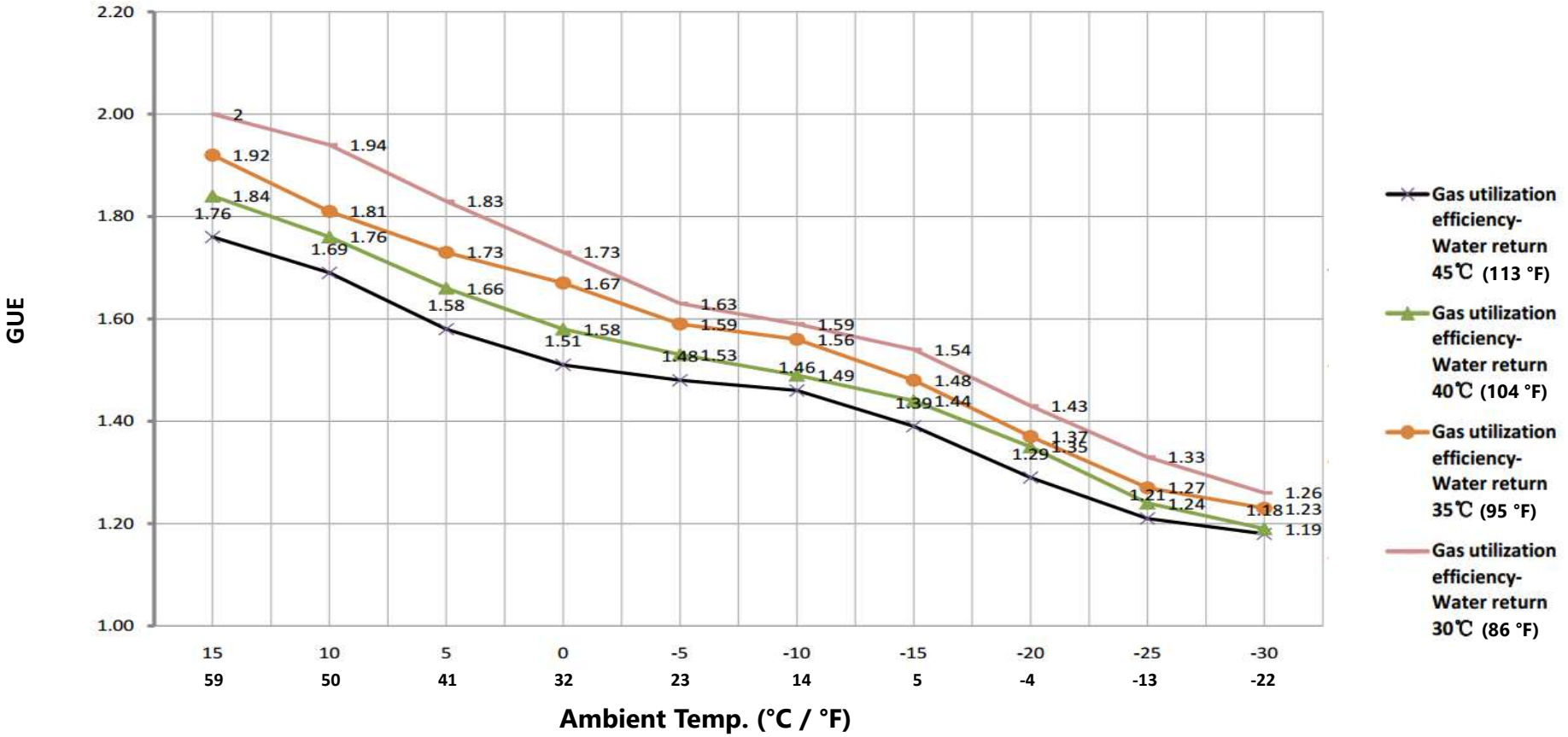

VICOT

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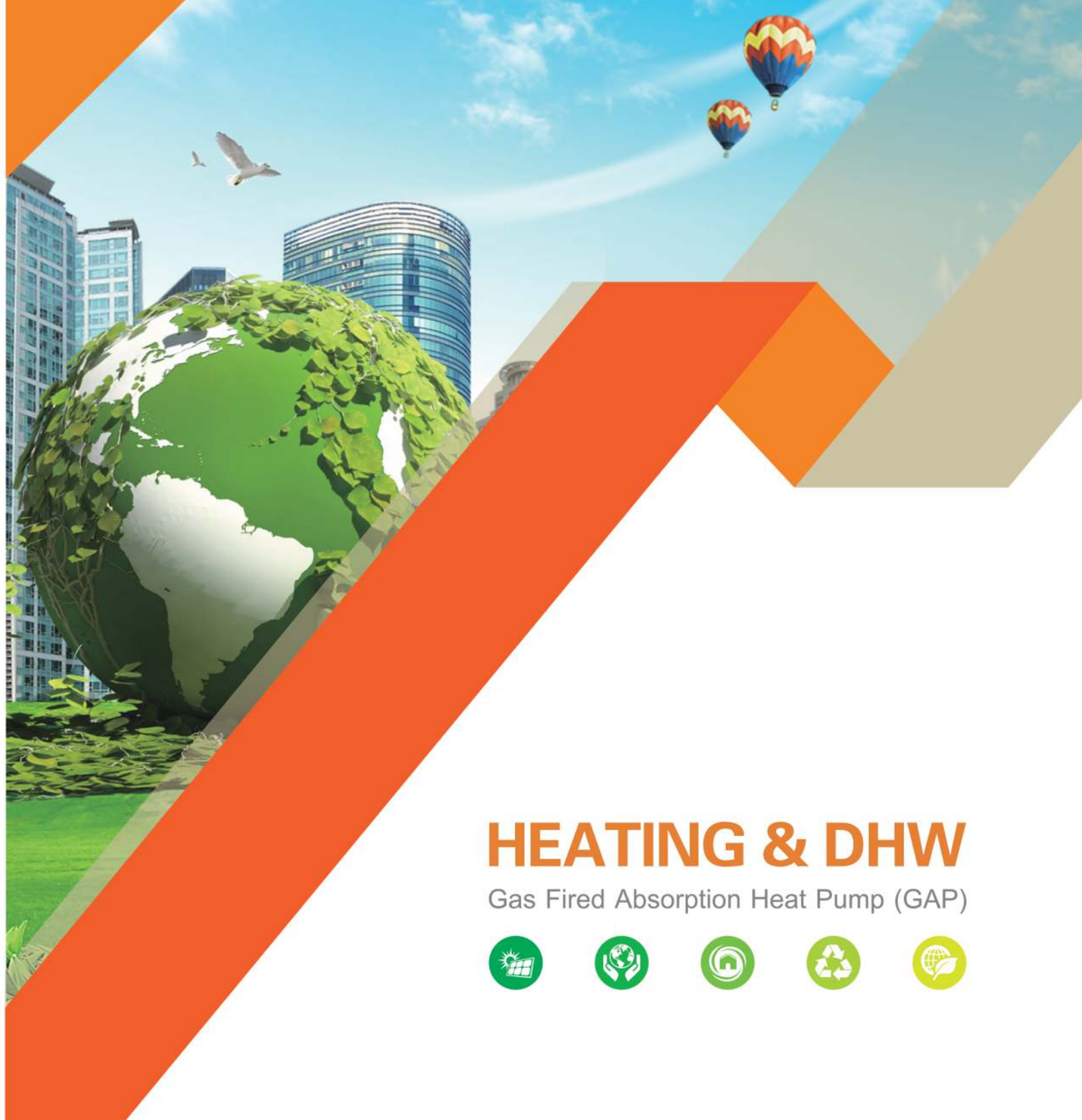

HEATING & DHW

Gas Fired Absorption Heat Pump (GAP)

HEATING & DHW

Gas Fired Absorption Heat Pump

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ELECTRIC COMPRESSOR TYPE AIR SOURCE HEAT PUMP

ADVANTAGE
Adopts heat pump technology, gets air source energy freely

Natural gas + Air source energy

Perfect combination of two technologies' advantage

GAP + Solar energy

Solar energy

Renewable energy input Solar energy 50%

Solar energy + Air source energy

Total heating capacity 65.8 kW

Total energy 100%

Air source energy

Renewable energy input Air source energy 50%

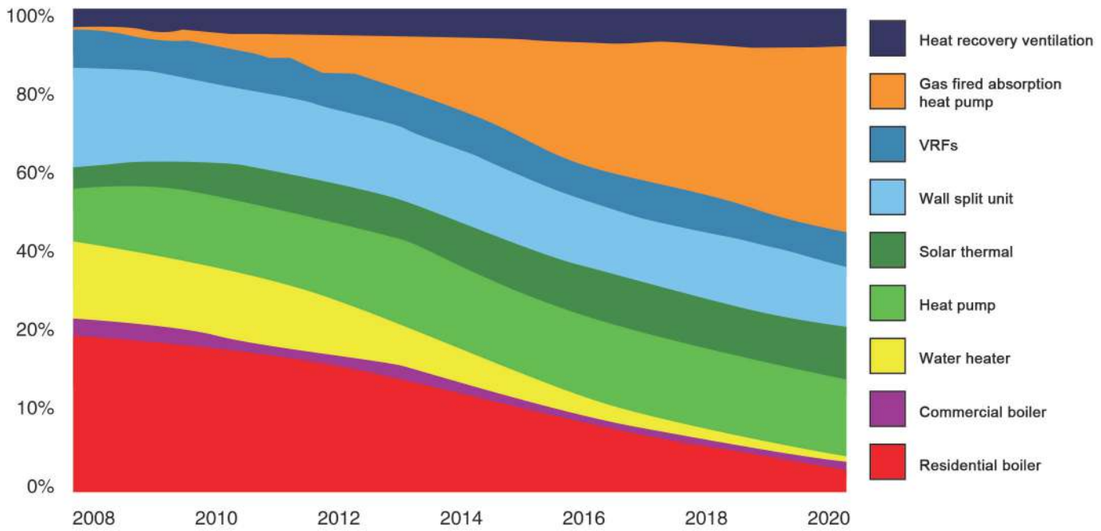
VICOT GAP efficiency and the application of renewable energy

HEATING & DHW

Gas Fired Absorption Heat Pump

GAP Market Analysis

Vicot chooses to develop the absorption heat pump technology in HVAC market in the be–ginning of 21st century. This choice is based on the forecast and confirmation of the HVAC market of next 10 years.



Absorption technology efficiency development history

1850
French engineer Ferdinand P. E. Carre made the 1st R717 absorption cooling unit that works intermittently in 1850.

1920
C. Munters and B. Von Platen made R717 absorption refrig-erator in 1920.

1969
The small size R717 absorption chiller started to enter market in 1969, unit efficiency is less than 30%, R717 ab-sorption technology development is slow while the compressor type air conditioning unit got the market with high efficiency.

1998
High efficiency gas fired R717 absorption unit was born, unit efficiency was increased to 62% in 1998.

2008
Vicot started to develop the high efficiency gas fired R717 ab-sorption chiller with cooperation of an American organization, unit efficiency 80%.

2009
Vicot 85% efficiency solar R717 absorption chiller en-tered the market in 2009.

2011
Vicot dual energy, gas / solar, R717 absorption heat pump entered the market in 2011.

2012
Vicot 180% gas fired R717 absorption heat pump was launched in market in 2012.

2017
Vicot "Frost Free" heat pump was launched into market in 2017.

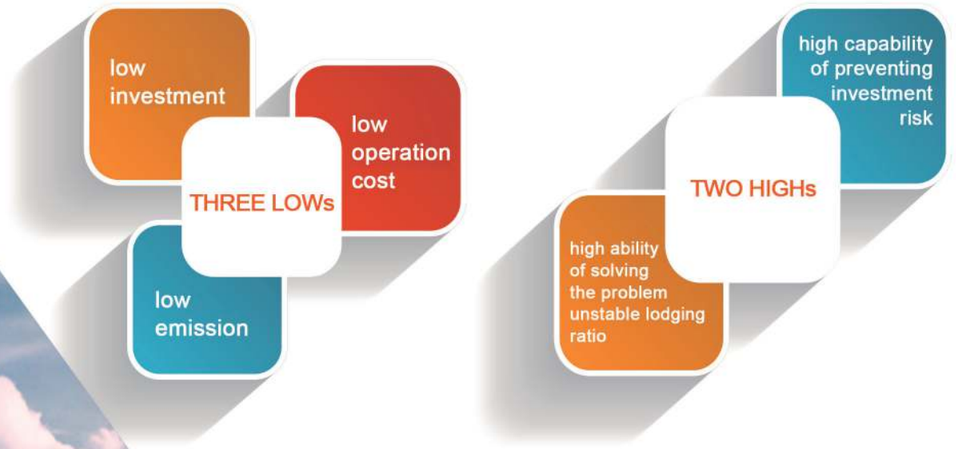
HEATING & DHW

Gas Fired Absorption Heat Pump

Utilization of natural gas and air source energy, good for environment protection

- Each GAP unit can annually save 55.434 Tons of standard coal, Reduces 136.922 tons of CO_2 emission, in equivalence of planting 19,528 trees.
- Vicot annually produces 12000 sets of GAP, it can save 665208 tons of standard coal and save 665208 tons of standard coal, reduces 1643064 tons of CO_2 emission, in equivalence of planting 234336000 trees,
- SO_2 emission concentration 9 mg/m³, NO_x emission concentration 27 mg/m³, particle concentration 2.3 mg/m³, smoke blackness <1 Ringelmann.

VOCT GAP FEATURE



检 验 报 告

TEST REPORT

国空质检（委）字（2013）第A071号

产品名称 Name of Product 太阳能/燃气型 GAX 高效吸收式（热泵）机组

委托单位 Client 山东威特人工环境有限公司

生产单位 Manufacturer 山东威特人工环境有限公司

检验类别 Test Category 委 托 检 验

国 家 空 调 设 备 质 量 监 督 检 验 中 心

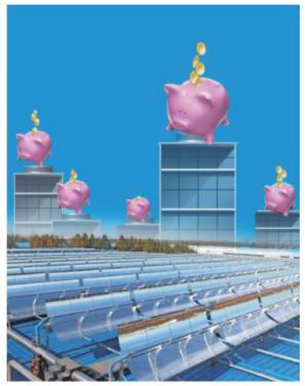
National Center of Quality Supervision and Inspection and Testing For Air Conditioning Equipment

国家空调设备质量监督检验中心

检 验 报 告

国家空调设备质量监督检验中心

检 验 报 告



HEATING & DHW

Gas Fired Absorption Heat Pump

LOW INVESTMENT

- **Durable in low ambient temperature, less capacity attenuation**
  VICOT GAP can operate durably in - 30 ℃, less capacity attenuation, high output capacity, the total equipment quantity is less for same load and investment is less.

- **Frost free, no attenuation**
  Vicot GAP adopts frost free technology, there is almost no frost in the most severe condition of 0 ℃ 95%. No frost attenuation and the total equipment quantity is less for same load and investment is less.

- **No secondary network**
  It can directly installed on the roof of the building for heating, no secondary network is required and low investment.

- **Modular combination, stepless energy adjustment**
  single unit or multiple units can be applied, it effectively reduces investment.

LOW OPERATION COST

- Uses cheaper primary energy;
- Uses free air source energy, COP up to 1.8;
- No frost attenuation;
- GAP can be installed on the roof of the building for heating, no heat loss of large scale heating network and secondary network;
- GAP adopts frost free and low ambient durable technology, its capacity is improved to against low temp. and high humidity ambient, the natural gas consumption is dramatically reduced;
- GAP modular combination, stepless energy regulation, the unit number can be adjusted according to room heating load with stepless energy regulation, avoids the waste of heat.

LOW EMISSION

- GAP adopts heat pump principle, natural gas consumption amount is 45% of conventional boiler, and emission is reduced by 55%.
- GAP adopts advanced premixing combustion technology, the nitrogen oxide emission is in international leading level.

GAP EMISSION AMOUNT

Unit: mg/m³

Emission description	National boiler standard	National coal power plant standard	Emission standard of boiler in Beijing	Gas fired absorption heat pump
SO_2 emission concentration	50	35	10	9
NO_x emission concentration	150~200	100	30	27
particle concentration	20	5	5	2.3
smoke blackness	≤1	≤1	≤1	<1

Reference standard

GB13271-2014 Newly built boiler requirement in boiler emission standard

GB13223-2011 Coal fired power plant emission standard

DB11/139-2015 Emission standard of boiler in Beijing

监 测 报 告

编号：德环监字 2016 年 第 0427 号

项目名称：废气

监测类别：委托监测

委托单位：山东奇威特太阳能科技有限公司

委托单位地址：德州市经济开发区红都路

报告日期：2016 年 08 月 16 日

德州市环境保护监测中心站

德州市环境保护监测中心站

烟尘（生产性排尘）、烟气监测结果报告表

SAFE FROM INVESTMENT RISK

- Vicot GAP can be installed in steps after the building construction done, it can effectively increase the client's capacity against investment risk and reduce capital cost.

SAFE FROM OCCUPANCY INSTABILITY

- Occupancy instability is out of control of heating supply company, it is a business killer.
- VICOT GAP can work in single unit or multiple units, with stepless capacity adjustment, it fundamentally improves the heating supply company's capacity against occupancy instability, converts "out of control" into "under control" and increases stability of making profit.

HEATING & DHW

Gas Fired Absorption Heat Pump

REMOTE CONTROL, ACTIVE SERVICE

- Each GAP has intelligent CPU, the GAP operation status can be monitored through internet in Vicot headquarter;
- The unit operation can be set via remote control, the operation cost can be maintained in economic way;
- The unit operation status can be viewed via remote control;
- Remote system has automatic error alarm function, Vicot will solve the error through remote control network when there is error, or send our aftersales team to site for maintenance, and the customer will be worry free for operation.
- The unit self-diagnosis function can be controlled and unit will have self-diagnosis after operation of certain period and adjust the problem occurs during operation.

VGAHR065、VGAHR065 PARAMETER

Item		Unit	Specification
Nominal heating capacity		kW	65.8
Water flow rate		m^3/h	⩾4
Water side pressure drop		kPa	⩾60
Minimum water inlet temp.		℃	9
Maximum water outlet temp.		℃	65
Ambient temp.	Max. temp.	℃	43
	Min. temp.	℃	–30
Rated thermal input		kW	33.9
Thermal input adjustment range		kW	14~37.7
Rated natural gas consumption		m^3/h	3.6
Gas consumption range		m^3/h	1.5~4.0
Power supply			380V/3Ph/50Hz
Electricity power input		kW	1.25
Unit weight		kg	980
Noise		dB(A)	54
Pipe size	Water pipe (threaded)	In	Rc1 1/4
	Gas pipe (threaded)	In	Rc 1/2
Unit dimension	Length	mm	2380
	Width	mm	1380
	Height	mm	2200
Installation distance		mm	⩾1000

Notes:

① Nominal heating capacity: ambient dry bulb temperature 7 ℃/ ambient wet bulb temperature 6 ℃， water outlet temperature 45 ℃, there will be certain change of heating capacity in different ambient temperature;

② Natural gas lower heating value 34.02 MJ;

③ Test condition: natural gas static pressure 2.5 kPa;

④ The noise value is the average value in 5 meters away from the unit;

⑤ The specification is subject to the value in rating label, and no prior notice before any change.

REFERENCE PROJECTS

HEATING & DHW

Gas Fired Absorption Heat Pump

★ Xianfeng community, Beijing

- Building area: 34500 m²
- Terminal type: Floor heating
- GAP nos.: 24 sets
- Location: Changpingdong street No. 52, Beijing
- Heat source: GAP
- Date of operation: November 15 2017

Operation analysis:

The GAP system started on Nov. 15 2017 and switched off on March 19 2018, the heating period is 125 days, natural gas consumption is 146600Nm³, electricity consumption is 123400kW. It consumed natural gas 4.24Nm³ and electricity 3.57kW for each square meter in the heating season. And the room temperature was kept at 21~22 ℃ according to the remote temperature recording meter in four apartments of this community.

REFERENCE PROJECTS

★ Shuiandongfang community, Tangshan

- Building area: 140000 m²
- Terminal type: Floor heating
- GAP nos.: 67 sets
- Location: Hanqiao Road No. 8, South District, Tangshan, Hebei
- Heat source: GAP
- Date of operation: November 15 2017

Operation analysis:

The GAP system started on Nov. 15 2017 and switched off on March 24 2018, the heating period is 130 days, natural gas consumption is 457000 Nm³, electricity consumption is 405000 kW. It consumed natural gas 4.35 Nm³ and electricity 3.86 kW for each square meter in the heating season. And the room temperature was 21 ℃ according to measurement in the apartments.

★ Lingnanzhuangyuan

- Building area: 46000 m²
- Terminal type: Floor heating
- GAP nos.: 28 sets
- Location: Nansanhuan, Shijiazhuang
- Heat source: GAP
- Date of operation: November 25 2017

Operation analysis:

The GAP system started on Nov. 13 2017 and switched off on March 14 2018, the heating period is 121 days, natural gas consumption is 140300 Nm³, electricity consumption is 110400 kW. It consumed natural gas 4.01 Nm³ and electricity 3.1 kW for each square meter in the heating season. And the room temperature was above 20 ℃ and the heating was highly comfortable according to the feedback from the apartment owners.

REFERENCE PROJECTS

★ Hehemeijia community

- Building area: 122000 m²
- Terminal type: Floor heating
- GAP nos.: 47 sets
- Location: Tianshanda street, Shijiazhuang
- Heat source: GAP + gas boiler

★ Huanghua Press

- Building area: 18900 m²
- Terminal type: Radiator
- GAP nos.: 18 sets
- Location: Huazhong street, Huanghua, Hebei
- Heat source: GAP + gas boiler

★ Binhe Garden, Xinmi City

- Building area: 380000 m²
- Terminal type: Floor heating
- GAP nos.: 21 sets
- Location: Gegou village, Pingmo Town, Xinmi City, Henan
- Heat source: GAP

REFERENCE PROJECTS

★ Beidaihe Town, Vanke

- Building area: 35000 m²
- Terminal type: Floor heating
- GAP nos.: 10 sets
- Location: Nanda street, Beidaihe, Qinhuangdao, Hebei
- Heat source: GAP + gas boiler

★ Zhoujia community

- Building area: 52000 m²
- Terminal type: Floor heating
- GAP nos.: 28 sets
- Location: Zhoujia community, Shouguang, Weifang
- Heat source: GAP

HEATING & DHW

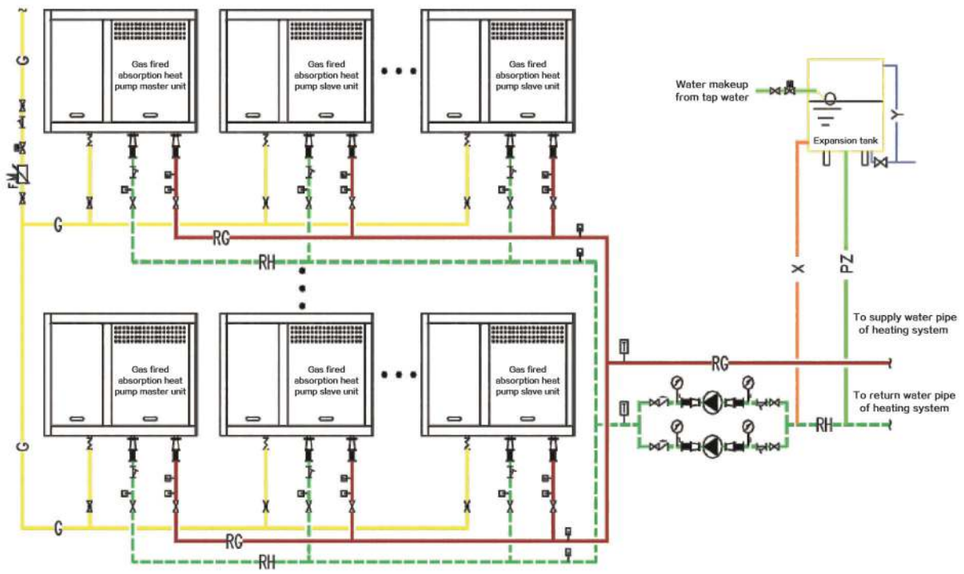
Gas Fired Absorption Heat Pump

PART OF REFERENCE PROJECTS

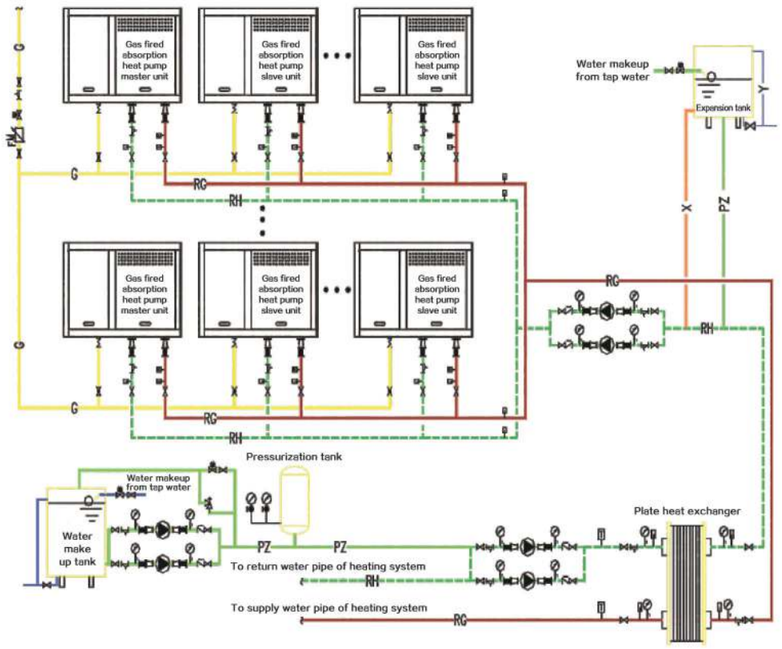
Community	Building area (m²)	Terminal type	Nos. of GAP (SETS)	Heating equipment
Yuanmingxinyuan	140000	Floor heating	97	GAP
Jinyulanwan	84000	Floor heating Radiator	48	GAP
Road Branch of Communication Bureau	30000	Radiator	28	GAP+gas boiler
No. 4 middle school of Huanghua	30000	Radiator	26	GAP+gas boiler
Living building of real estate bureau, Huanghua	20000	Radiator	16	GAP+gas boiler
Nursing home of Huanghua	18000	Floor heating	14	GAP+gas boiler
Living building of Food Bureau	24000	Radiator	20	GAP+gas boiler
Kangxinyuan	60000	Floor heating	38	GAP+gas boiler
Jingang Garden	40000	Floor heating	24	GAP
Medical company & its commercial building	12000	Radiator	10	GAP+gas boiler
Dormitory of Tgood industrial park	42000	Radiator	35	GAP
Wenxindasha	60000	Floor heating	45	GAP
Guojiaxin Village	12000	Floor heating	12	GAP
Sandu community	20000	Floor heating	15	GAP
Zhongchenguanjingyuan	25000	Floor heating	18	GAP+gas boiler

HEATING & DHW
Gas Fired Absorption Heat Pump

DIRECT HEATING SYSTEM PRINCIPLE DIAGRAM



INDIRECT HEATING SYSTEM PRINCIPLE DIAGRAM



DIRECT HEATING SYSTEM PRINCIPLE DIAGRAM -- APPLICABLE RANGE EXPLANATION

The direct heating system is suitable for:

1. GAP to be placed on ground or the roof of low-rise building;
2. The building with heating area divided into high and low area, GAP to be placed on the roof for direct heating to high area.

INDIRECT HEATING SYSTEM PRINCIPLE DIAGRAM -- APPLICABLE RANGE EXPLANATION

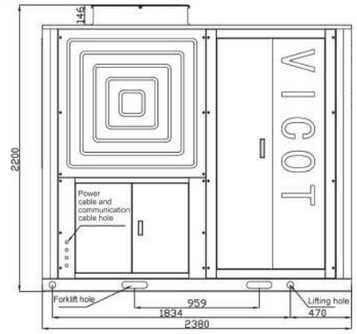
The indirect heating system is suitable for:

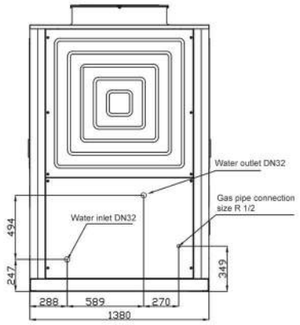
1. The building with heating area divided into high and low area, GAP to be placed on the roof for heating to low area where the indoor terminal is not suitable for direct heating due to pressure bearing.
2. When the GAP pressure bearing is above 1.6 MPa.

HEATING & DHW

Gas Fired Absorption Heat Pump

UNIT DIMENSION

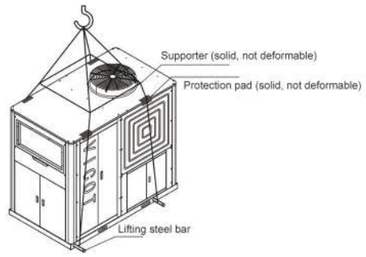




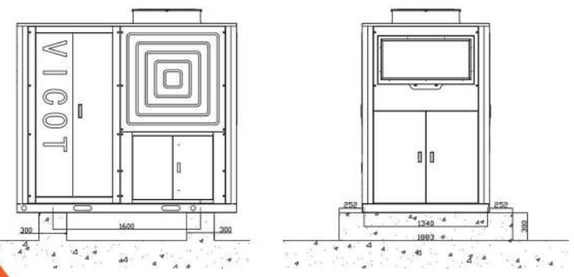
Installation instruction
——Unit lifting requirement

Unit is already R717 charged, transportation and handling should be careful to avoid unit damage due to improper operation. Expanding rod lifting, lifting rope, protection pad should be used, no direct contact of lifting rope on the unit panel and frame.

The unit should be kept in balance during handling.

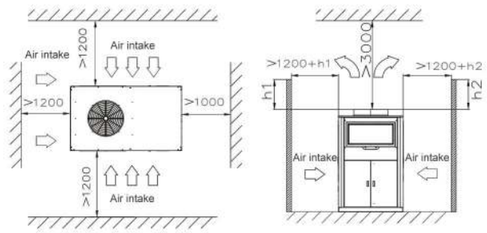


Lifting diagram



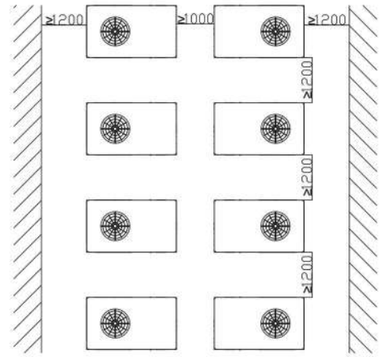
Installation requirement

A. Single unit installation diagram



Minimum surrounding space diagram

B. Modular units installation diagram



Minimum surrounding space diagram when modular installation

HEATING & DHW

Gas Fired Absorption Heat Pump

ABOUT VICOT GROUP

Vicot Group is a high–tech corporation specialized in R&D, production, sales and service of new energy products;

Our production base locates in Solar City, Dezhou, China, has RMB600 million asset, designed annual production value reaches RMB5 billion;

Vicot main products are gas fired absorption heat pump (heating/hot water), solar boiler, solar absorption chiller, solar central heating system, solar central hot water system etc;

Vicot is awarded for many honors such as National Energy Progress 3rd Prize, China Huaxia Construction Science Technology Prize and National Construction Committee Science Progress Prize.

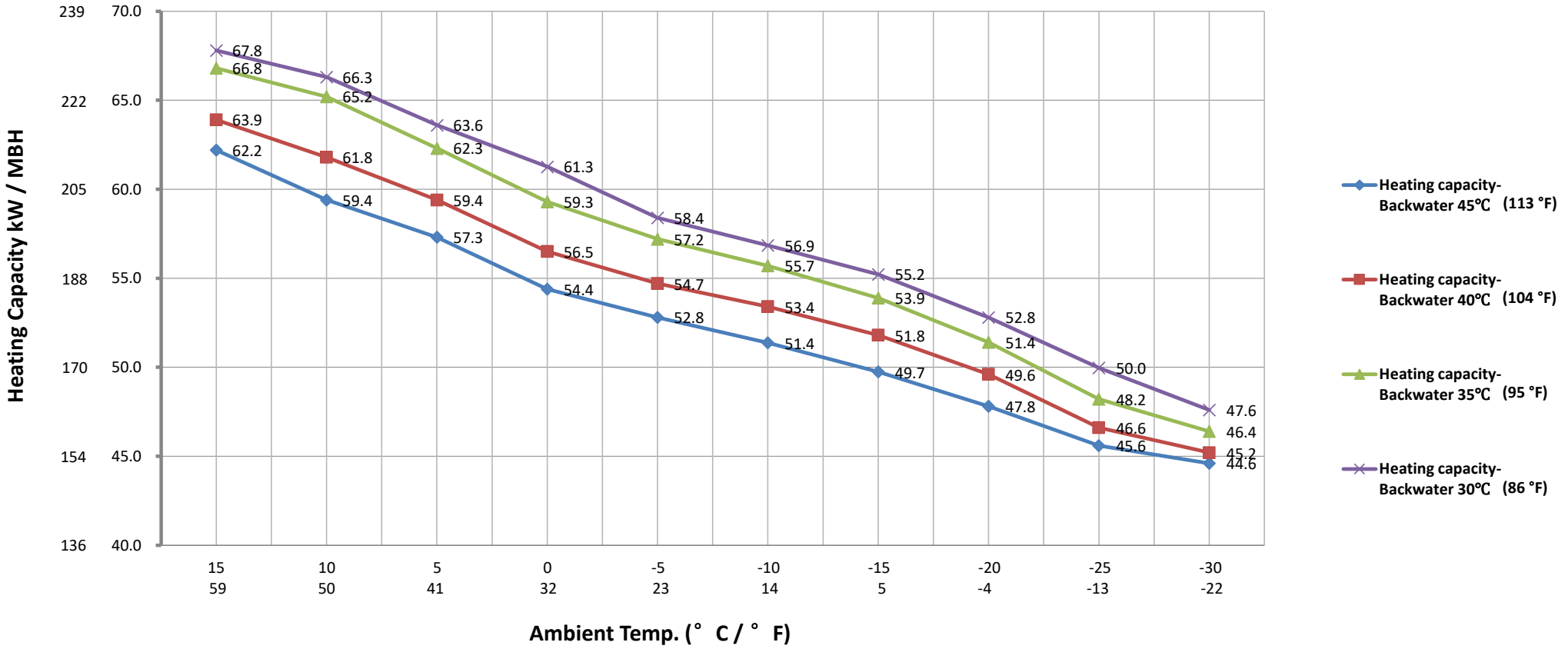
Vicot has 150 nos. of national invention patent and utility patent approved or in the process of approval, and certificates of ISO9001 quality management system and ISO14001 environment management system. The product with international level quality is ensured with strict process control and complete quality management system;

With the vision of “one world, one blue sky”, the corporate focuses on effective utilization of solar energy, air source energy and other renewable energies in construction energy saving heating and industrial energy saving thermal application, strives for technology creation achievement of international new energy application industry.

In accordance with the mission “One Dream, One Team, For Staff, For Society”, Vicot group will make continuous progress in the new energy field and sincerely cooperate and make progress with all the social sectors with quality product, perfect service with a broad mind in a great and firm spirit, and dedicates to creating a happier and richer future for partners, clients and our earth.

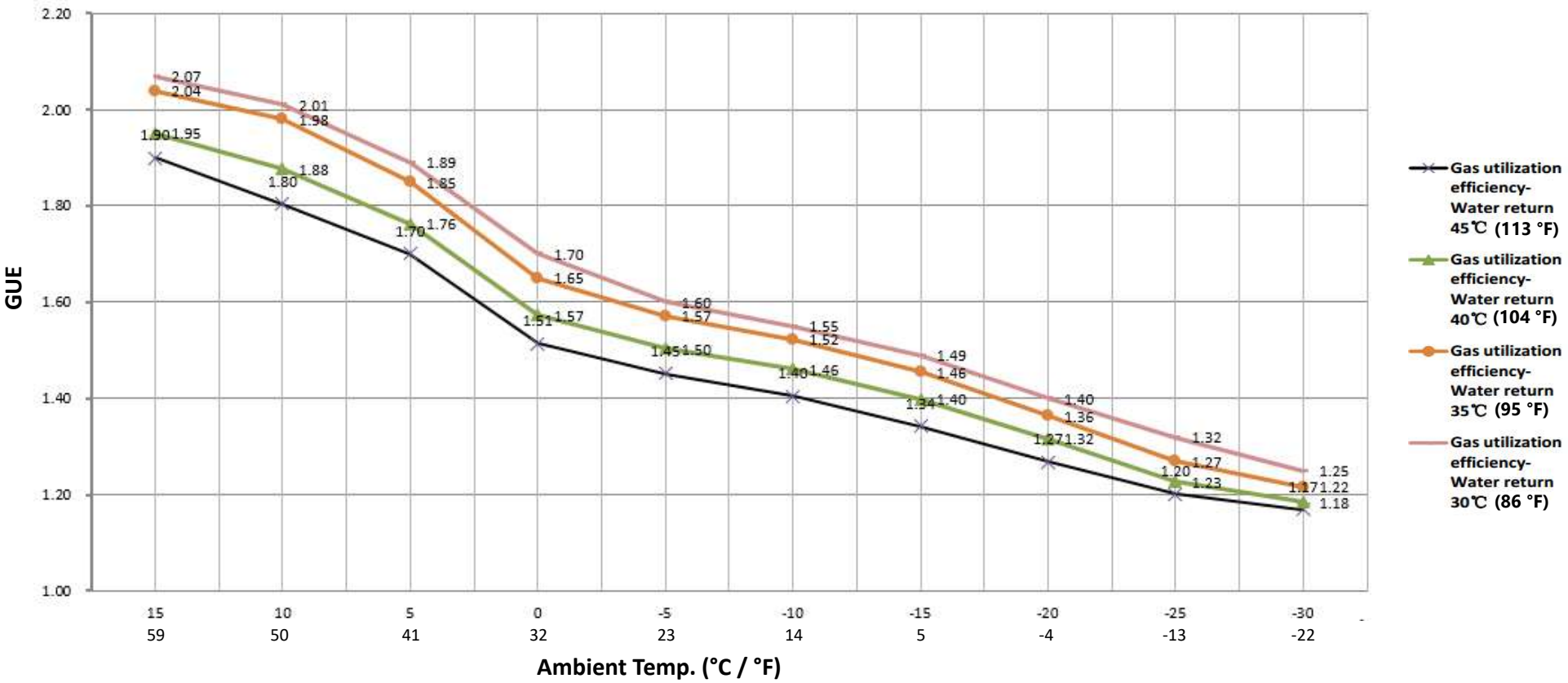
V65 HEATING CAPACITY CURVE

Working data and curve of ambient temperature and water temperature change – **V65**



V65 GUE RUNNING CURVE

Working data and curve of ambient temperature and water temperature change – **V65**



ENBRIDGE GAS INC.

Answer to Undertaking from
Federation of Rental-housing Providers of Ontario (FRPO)

Undertaking:

Tr: 37

To provide the peak reduction by participant for each of the rows in the table at ED number 6

Response:

Enbridge Gas interprets this undertaking as (1) a request to provide the peak reduction by participant for each of the rows in the table at Exhibit I.ED-6, page 2, and (2) a request to provide the assumptions associated with the table at Exhibit I.ED-6, page 2, to the extent that the assumptions are not already stated within Exhibit I.ED-6 and to the extent that is reasonable.

See Table 1 for the table provided at Exhibit I.ED-6, page 2, with a column added for average peak reduction per participant (m^3/hr). Please note, while developing the response for this undertaking Enbridge Gas identified an error that impacted four figures in the table provided at Exhibit I.ED-6, page 2. The four figures have been corrected in Table 1 below and are identified with Footnotes 2 to 5. Enbridge Gas also reviewed the evidence on the record and identified two other areas impacted by these corrections (in addition to the table provided at Exhibit I.ED-6, page 2):

- Exhibit D, Tab 1, Schedule 2, page 33, Table 14: The 2026 “Estimated Peak Reduction - Cumulative (m^3/hr)” figure for “ETEE - Advanced Technology - Gas Heat Pump” should be 13.4 m^3/hr (rather than 13.5 m^3/hr).

- Exhibit E, Tab 1, Schedule 1, page 4, Table 3: The “$ per m^3 Peak reduction ($/$m^3$/hr)” figure for “ETEE – Advanced Technologies (Gas Heat Pump)” should be $40,150 (rather than $39,950).

Enbridge Gas has not updated the affected evidence as the corrections are not material.

Table 1
Average Peak Reduction per Participant Added to Table Provided at Exhibit I.ED-6, page 2

Line No.		Cost per customer – total	Cost per customer – paid by Enbridge incentives	Cost per customer – paid by the customer	Net energy cost savings per customer	Average Peak Reduction per Participant (m3/hr)[1]	Cumulative peak reduction (m^3/hr)	Cumulative Annual reduction (m^3)
1	1) ETEE Existing DSM – Residential	~$12,80	$3,500	N/A	N/A	0.15	193.3	410,014
2	2) ETEE Existing DSM – Commercial / Industrial	N/A	~$3,200	N/A	N/A	0.74	170.8	367,969
3	3) Cold Climate Air Source Heat Pump	$12,300	$10,000	$2,300	N/A	0.82	16.3	34,655
4	4) Ground Source Heat Pump	$30,000	$10,000	$20,000	N/A	0.82	8.2	17,328
5	5) Simultaneous Hybrid Heating	$19,000	$11,400	$7,600	N/A	0.49	20.8	41,586
6	6) Gas Heat Pump - Residential	$17,000	$10,200	$6,800	N/A	0.23	4.7 [2]	16,894 [3]
7	7) Gas Heat Pump - Commercial	$50,000	$30,000	$20,000	N/A	1.74	8.7 [4]	26,287 [5]
8	8)Thermal energy Storage	$6,500	$3,900	$2,600	N/A	0.21	8.2	3,032

See below for additional assumptions associated with the table at Exhibit I.ED-6, page 2, which are not already included within Exhibit I.ED-6.

Regarding the "Average Peak Reduction per Participant (m^3/hr)" figures added to Table 1:

- Table 2 provides average peak demand per customer segment.
- The system wide peak hour demands were developed using the Design Hour Demand Process in EB-2022-0200 Exhibit 4, Tab 2, Schedule 3, as noted at Exhibit I.CCC-10.

[1] Figures may vary due to rounding.
[2] This figure is presented in the table provided at Exhibit I.ED-6, p.2 as 5.9. The correct figure is 4.7.
[3] This figure is presented in the table provided at Exhibit I.ED-6, p.2 as 15,595. The correct figure is 16,894.
[4] This figure is presented in the table provided at Exhibit I.ED-6, p.2 as 7.6. The correct figure is 8.7.
[5] This figure is presented in the table provided at Exhibit I.ED-6, p.2 as 25,064. The correct figure is 26,287.

Table 2
Average Peak Demand Per Customer

Line No.	Customer	Design Hour Demand (m^3/hr) [A]	Number of Customers [B]	Average Peak Demand per Customer (m^3/hr) [A/B]
1	Residential	25,989	25,452	1.0
2	Commercial	10,597	1,820	5.8
3	Multi-residential	2,632	547	4.8
4	Industrial	635	112	5.7

1) ETEE Existing DSM – Residential

- % peak load reduction per unit: A high-level estimate of percentage peak reduction was used, derived from historical projects from the DSM residential whole home offering.

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 1.0 x 15% = 0.15 m^3/hr

2) ETEE Existing DSM – Commercial / Industrial

- % peak load reduction per unit: A high-level estimate of percentage peak reduction was used, derived from historical projects from the DSM commercial and industrial offerings (includes multi-residential).

- Peak hour reduction for commercial = Average peak demand per commercial customer x % reduction per unit x budgeted participants

  = ~5.8 x 13% = ~0.8 m^3/hr x 160 budgeted participants

  =~121.1 m3/hr

- Peak hour reduction for multi-residential = Average peak demand per multi-residential customer x % reduction per unit x budgeted participants

  = 4.8 x 10% = 0.5 m^3/hr x 57 budgeted participants

  = ~27.4 m^3/hr

- Peak hour reduction for industrial = Average peak demand per industrial customer x % reduction per unit x budgeted participants

  = 5.7 x 30% = 1.7 m^3/hr x 13 budgeted participants

  = ~22.3 m^3/hr[6]

- Average C/I peak hour reduction per participant = C/I peak hour reduction / budgeted participants

  = 170.8 m^3/hr / 230 budgeted participants

  = 0.74 m^3/hr[7]

3) Cold Climate Air Source Heat Pump

- % peak load reduction per unit: Please see Exhibit I.SEC-8

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 1.0 x 80% = 0.8 m^3/hr

4) Ground Source Heat Pump

- % peak load reduction per unit: Please see Exhibit I.SEC-8

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 1.0 x 80% = 0.8 m^3/hr

5) Simultaneous Hybrid Heating

- % peak load reduction per unit: Please see the assumptions outlined at Exhibit I.ED-6 part b). In addition, it is noted at Exhibit I.ED-6 part b) that 16,000btu/hr of space heating would be provided during the peak hour by the heat pump. This assumption is based on the understanding that an example heat pump (such as the 2.5ton iFlow 70C3036CA described at Exhibit JT1.7) is known to be able to provide 27,000 btu/hr at –15C[8] however performance below that level is not

[6] Figures may vary due to rounding.
[7] Figures may vary due to rounding.
[8] https://www.iflowhvac.com/wp-content/uploads/2023/10/iFLOW-2.5T-30MBH-COLD-CLIMATE-AIR-SOURCE-HEAT-PUMP-20231002.pdf

published. The estimate of 16,000 btu/hr was taken to be a conservative amount of natural gas peak reduction, with the goal of the IRP Pilot Project being to further understand and quantify the heat output below –15C and natural gas peak reduction potential.

- Heat Pump Output at peak hour = 16,000 btu/hr x 1.05 kJ/btu = 16,881 kJ/hr

  Furnace Consumption Reduction = Heat pump output at peak hour/Higher Heating Value/Typical Furnace AFUE = 16,881kJ/hr/38,500kJ/m^3/0.9 = 0.487m^3/hr[9]

- % peak load reduction per unit = Furnace Consumption Reduction/Average peak Demand per Customer

  = 0.49m3/hr/1.0m^3/hr = 49%

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 1.0 x 49% = 0.49 m^3/hr[10]

6) <u>Gas Heat Pump - Residential</u>

- Base case efficiency assumptions: Please see Exhibit I.ED-6 part b).

- Peak hour condition gas heat pump (Vicot V20) efficiency:
  - Gas utilization efficiency at –25C (closest data point to the design temperature in Southern Lake Huron area): 1.27 (for performance curve please refer to Exhibit JT1.3, Attachment 2)
  - Adjusted gas heat pump efficiency for higher heating value since the V20 efficiency data was tested using lower calorific (heating) value of 34.0MJ/m^3

    = 1.27 x 0.9 = 1.14

- % peak load reduction per unit = 1- (Base case efficiency/Peak condition gas heat pump (Vicot V20) efficiency)

  = 1- (0.88/1.14) = 23%

[9] Figures may vary due to rounding.
[10] Figures may vary due to rounding.

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 1.0 x 23% = 0.23 m^3/hr

7) Gas Heat Pump -Commercial

- Base case efficiency assumptions: Please see Exhibit I.ED-6 part b).

- Peak hour condition gas heat pump (Vicot V65) efficiency:
  - Gas utilization efficiency at –25C (closest data point to the design temperature in Southern Lake Huron area): 1.27 (for performance curve please refer to Exhibit JT.1.3, Attachment 4)
  - Adjusted GHP efficiency for higher heating value since the V20 efficiency data was tested using lower calorific (heating) value of 34.0MJ/m3

    = 1.27 x 0.9 = 1.14

- % peak load reduction per unit = 1- (Base case efficiency/ Peak condition gas heat pump (Vicot V65) gas utilization efficiency)

  = 1- (0.8/1.14) = 30%

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 5.8 x 30% = 1.74 m^3/hr

8) Thermal Energy Storage

- % peak load reduction per unit: Please see Exhibit I.ED-6 part b).

- Average peak hour reduction per participant = Average peak demand per customer x % reduction per unit

  = 1.0 x 20% = 0.21 m^3/hr[11]

[11] Figures may vary due to rounding.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 43

To provide a copy of the posterity reporting on modelling for the Southern Lake Huron original pilot project proposal.

Response:

Please see Attachment 1 to this response for the report regarding Posterity's analysis related to the initial Southern Lake Huron Pilot Project proposal (i.e., related to the application and pre-filed evidence filed on July 19, 2023).

POSTERITY GROUP

IRP Analysis Project
Southern Lake Huron Analysis Modelling Findings

Project: Integrated Resource Planning Alternative Analysis (IRPA Analysis)
Re: Southern Lake Huron IRPA Analysis
Submitted by: Posterity Group (PG)
Date: March 31st, 2023

This memo presents information about the potential to reduce natural gas peak hour demand in the context of the Southern Lake Huron Analysis including the potential peak hour demand reduction in m^3/hr and the associated costs by 2042. The scope of the analysis focuses on demand side management (DSM) IRPAs (including energy efficiency and demand response measures). The analysis was performed using data from the current version of the Posterity 'mirror model' of the 2019 Achievable Potential Study (APS), which was centered around DSM and is being used as a proxy to demonstrate ETEE potential for the system of need.

This memo focuses on existing and future general service customers and the potential for these customers to reduce peak hour demand during the forecast period.

1 Profile of Customers Included in Analysis

The Southern Lake Huron region was divided into two sub-regions: Lakeshore and Sarnia Core. The results of the IRPA analysis present both sub-regions but scaling and calibration were performed for each region individually.

1. The following sectors and rate classes were included in the scope of the analysis:

Lakeshore Sub-Region		Sarnia Core Sub-Region	
Residential	M1	**Residential**	M1, M2
Commercial	M1, M2	**Commercial**	M1, M2
Industrial	M1, M2	**Industrial**	M1, M2

2. The reference peak hour demand is forecasted to increase from 47,955 m^3/hr in 2021 to 49,361 m^3/hr by 2042.
    - The total peak hour demand in 2021 is expected to be 47,955 m^3/hr, comprised of 1,811 m^3/hr in the industrial sector, 11,970 m^3/hr in the commercial sector, and 34,174 m^3/hr in the residential sector.
    - The total peak hour demand in 2042 is expected to be 49,361 m^3/hr, comprised of 2,014 m^3/hr in the industrial sector, 14,360 m^3/hr in the commercial sector, and 32,987 m^3/hr in the residential sector.

2 Peak Hour Reduction and Cost

This analysis has yielded the following insights on peak hour reductions and associated costs:

- By 2042, peak hour reduction potential from the ETEE program is estimated to be 7,710 m^3/hr, which corresponds to a 16 percent reduction in the total hourly peak demand.
- The total gross cost of the 7,710 m^3/hr of potential reduction that could be obtained by 2042 would be $55,939,662; or an average gross cost of $7,255 per m^3/hr reduction. [1]

3 Most Impactful Sectors and End Uses

In addition to the preliminary answers to these two questions, the following key observations were made for 2042:

- The residential sector accounts for 94 percent of the peak hour reduction while representing 67 percent of the total peak hour consumption before any savings. The main reason for this discrepancy is that measures in the residential sector were predominantly space heating measures:
    - Space heating measures account for 97 percent of peak hour reductions and the residential sector accounts for 97 percent of the space heating reduction.
    - Space heating measures were more likely to pass the TRC test, including in the residential sector.
    - A few key residential measures made up the majority of the total peak hour reductions: whole home building envelope (33%), air sealing (22%), condensing boilers (17%), and wall insulation (8%).
- The commercial sector makes up 29% of the total peak hour consumption but only accounts for 3% of the peak hour reductions. This effect is due to the dominance of the few residential space heating measures mentioned above over all other measures:
    - 100% percent of commercial peak hour reductions come from space heating.

[1] A Net-to-Gross ratio of 75 percent was used to estimate the gross costs of the program. The total gross costs presented do not include fixed portfolio overhead costs.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 46

To advise how Enbridge plans to use the outcomes of the IRP pilot project to update and improve its modelling for IRP evaluations, including any updates to the posterity approach for modelling.

Response:

The core objectives of the Southern Lake Huron Pilot Project are to develop an understanding of how ETEE and DR programs impact peak hour flow/demand and to develop an understanding of how to design, deploy, and evaluate ETEE and residential DR programs.

For the first objective, the baseline peak hour estimated savings are summarized at Exhibit D, Tab 1, Schedule 2, paragraph 72 and Table 14. Once actual data on changes in peak hour flow is available, it can be compared to the estimated savings determined from the modeling. This will serve to validate or highlight the differences between actual savings and modeled savings. If differences are found, this will serve as a basis to modify modeled assumptions accordingly. If such changes are required, the updates will serve to enhance the accuracy of future IRP assumptions and evaluations.

For the second objective, Enbridge Gas will monitor the progress and outcomes of the ETEE and residential DR programming regarding parameters such as uptake rates, and programming costs (e.g., incentives, promotion, delivery, administrative), and will look to incorporate that information into existing assumptions. For example, if Enbridge Gas sees a 1.5% annual uptake rate in residential ETEE programming across the duration of the pilot project, and the assumption the company currently uses is a 2.5% annual uptake, the Company will evaluate how best to incorporate these pilot insights into future IRP assumptions and evaluations.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 57

To (i) size the cold climate air source heat pumps for the full heating load in the context of the hybrid heating application that is part of this pilot project proposal; (ii) to provide the typical specs of the air source heat pump that you would use for these hybrid heating systems.

Response:

Enbridge Gas interprets part (i) of this undertaking as a request to confirm whether the Company will size the electric cold climate air source heat pump (ccASHP) for the full heating load in the context of the simultaneous hybrid heating (SHH) measure. Enbridge Gas interprets part (ii) of this undertaking as a request to provide specifications for electric ccASHPs that would be installed as part of the SHH measure.

Enbridge Gas's responses to part (i) is provided below:

For the SHH measure, the electric ccASHP will not be sized to meet the full heating demand since full electrification does not meet the definition of SHH. For the SHH measure, the electric ccASHP provides the primary heating load and a natural gas furnace provides supplemental load during colder periods, with a smart controller allowing the natural gas furnace to operate alongside the electric ccASHP to reduce peak natural gas demand. This operation is achieved by repositioning the electric ccASHP's A-coil from the supply duct to the return duct, altering the configuration of a conventional hybrid heating system. The electric ccASHP in the context of the SHH measure will follow NRCan's Air-Source Heat Pump Sizing and Selection Guide[1].

The installation of an electric ccASHP to heat the entire home is covered as a separate measure as explained at Exhibit D, Tab 1, Schedule 2, paragraphs 40-42. The SHH and electrification ccASHP measures serve unique purposes and are both important to gain learnings regarding peak load reduction that can be implemented across a variety of configurations and climate areas.

[1] Air-source Heat Pump Sizing and Selection Guide (canada.ca).

Enbridge Gas's responses to part (ii) is provided below:

An example of specifications that would be considered for electric ccASHPs installed as part of the SHH measure are provided in Table 1. These specifications correspond with an iFlow 2.5 ton/30,000 btu/h rated iFlow 70C3036CA.[2]

Table 1
Example of Electric ccASHP Specifications for the SHH Measure

Line No.	Specification	Value
1	Heating Capacity (Btu/h) @ 47F/8.3C	33,000
2	Heating Capacity (Btu/h) @ 5F/-15C	27,000
3	Cooling Capacity (Btu/h)	30,000
4	SEER2 (Btu/Wh)	15.5
5	HSPF2 Region 4 (Btu/Wh)	9.7
6	HSPF2 Region 5 (Btu/Wh)	7.7
7	COP @ 47F/8.3C	3.39
8	COP @ 5F/-15C	1.85

[2] https://www.iflowhvac.com/wp-content/uploads/2023/10/iFLOW-2.5T-30MBH-COLD-CLIMATE-AIR-SOURCE-HEAT-PUMP-20231002.pdf

ENBRIDGE GAS INC.

Answer to Undertaking from
School Energy Coalition (SEC)

Undertaking:

Tr: 58

To advise whether it plans to use the same switching mechanism or equipment for this hybrid heating proposal as is being used or proposed by Enbridge Sustain; whether the controller to be used in this situation is different and, if so, how.

Response:

Enbridge Gas is not in a position to confirm the switching mechanism being used or proposed by Enbridge Sustain. However, the Simultaneous Hybrid Heating (SHH) measure for the IRP Pilot Project uses a novel switching mechanism (controller) and system setup which, to the best of Enbridge Gas's knowledge, is not yet used in market.

Enbridge Gas understands that the conventional hybrid heating technology currently used in market includes a natural gas furnace, an electric air source heat pump, and a controller which switches between heating sources depending on a variety of factors but does not optimize for natural gas peak load reduction. The SHH measure is different from conventional hybrid heating in two aspects:

1) The electric ccASHP A-coil installed on the supply-side duct is moved to the return duct which enables the electric ccASHP and natural gas furnace to run at the same time; and,

2) When required, the controller will turn the natural gas furnace on and operate the electric ccASHP and the natural gas furnace simultaneously to meet heating needs and reduce natural gas peak load.

The description of the controller for the SHH measure for the IRP Pilot Project is provided in the response at Exhibit I.PP-25 part a):

> Enbridge Gas can confirm that the proposed Hybrid Heating System does not switch between gas equipment and electric equipment. The controller operates both the air source heat pump (primary heating source) and the gas furnace simultaneously to reduce the peak gas load.

Furthermore, the proposed heating system will operate the electric ccASHP when there is heating demand, including during peak load periods. When the electric ccASHP cannot meet the heating demand, the controller will turn the natural gas furnace on to supplement the heating load. The natural gas peak load is expected to be reduced because the electric ccASHP will continue to operate, along with the natural gas furnace, during peak load periods.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 60

To provide details of Clean Home Heating Initiative.

Response:

Please note that the Clean Home Heating Initiative was funded by the Government of Ontario and not by Enbridge Gas.

Please find attached to this response the following reports provided by Enbridge Gas to the Government of Ontario:

- Attachment 1 – Clean Home Heating Initiative Phase I Year 2 Report (August 2023), including Clean Home Heating Initiative Phase I Measurement and Verification Overview (June 2023)
- Attachment 2 – Clean Home Heating Initiative Phase II Year 2 Report (August 2024)
- Attachment 3 – Clean Home Heating Initiative Phase II Measurement and Verification Overview (August 2024)

Please note that final Measurement and Verification reports are not yet complete/available.

Clean Home Heating Initiative Phase I

Year 2 Report

August 2023

ENBRIDGE
Life Takes Energy

Table of Contents

Background and Intended Project Goals

The Clean Home Heating Initiative is a collaborative project delivered by Enbridge Gas and the Government of Ontario (GOO). The Initiative strives to help homeowners in select Ontario communities install an electric air source heat pump with smart controls. This is done through offering incentives for this equipment. The Initiative is funded by the Government of Ontario and serves as an expansion to the Hybrid Heating pilot that was completed in London, Ontario in 2021.

The participant incentives are designed to cover up to 100 per cent of the incremental cost of equipment and installation compared to a code-minimum air conditioner. Eligible heat pumps for this Initiative align with the Canada Greener Homes Grant product listing for ducted heat pumps with the exception that the furnace or air handler does not have to be a specified matching unit. This means that the existing furnace or air handler may be used if compatible with the heat pump. This Initiative includes both standard energy star air source heat pumps (referred to herein as ASHP) and cold climate air source heat pumps (referred to herein as ccASHP).

This report discusses the overall results of Phase I of this Initiative, which took place from September 2022 to March 2023 and was offered in 4 communities: London, Peterborough, Sault Ste. Marie and St. Catharine's. Phase I was an up to $4,518,020 allocation that included a target of up to 1000 homes (participants). An estimated 700 homes were projected to receive a standard energy star air source heat pump, and 300 homes were projected to receive a cold climate air source heat pump.

Phase I looked to accomplish a number of different goals. Firstly, it aimed to strengthen market readiness and diversify the supply chain for scaling up low-carbon heating options in Ontario. In doing so, it could support Ontario's economy by creating jobs and building capacity in the skilled trades, including the province's Heating, Ventilation, and Air Conditioning (HVAC) industry, and local Ontario-based suppliers. The Government of Ontario could learn from the hybrid heating model and inform decisions on offering the model more broadly in the future. The measurement and verification analysis could provide insights into the effect that hybrid heating system has on electricity peak demands on the coldest days compared to an all-electric heating system. In summary, the long-term goal is to support the GOO's efforts to reduce the impacts of climate change. Hybrid heating with smart controls reduces GHG emissions and decreases the consumption of natural gas in the residential sector cost-effectively.

Specific objectives of the Initiative include:

- Diversify market offerings with smart controls;
- Build capacity with HVAC manufacturers and contractors to sell, install and service hybrid heating systems with smart controls;
- Build support for, and awareness about the benefits of hybrid heating systems

Performance Metrics and Results

The table below summarizes and compares the assigned targets for the Initiative to the overall results. The comments section provides Enbridge's insights into the overall impact and effectiveness of the results.

Metric/Target	Results	Comments (Impact/Effectiveness)
Install hybrid heating with smart controls in up to 1000 existing homes across the 4 participating regions. The expected breakdown by unit type is: • **700 ASHP installations** • **300 ccASHP installations**	488 customers participated and installed hybrid heating systems with smart controls in their homes. The actual breakdown of these installations by unit type was: • 26 ASHP installations • 462 ccASHP installations	The Clean Home Heating Initiative achieved roughly 50% of its intended 1000 home target. This result is explained further in the rationale and challenges section below. Despite not meeting the overall intended target, the Initiative saw uptake of heat pumps in all four communities. It was expected that there would be a large uptake in London based on the results of the previous pilot, however there were also significant results in both Sault Ste. Marie and Peterborough respectively. This supports the overall assumption that customers in various areas of the province are looking to hybrid technology to support their home heating needs. Across all regions, the market was very receptive to ccASHP technology, and surpassed that of standard Energy Star ASHPs. The ccASHP installations made up roughly 95% of sales in the program, and greatly exceeded their intended target of 300 units. This was the opposite of the original predictions for the program (which expected a larger uptake of ASHPs) and provided great insight into market demands. The results of Phase I helped support the forecasting for cold climate units for Phase II. Overall, given the constraints and the timing of the Initiative, Enbridge feels that the program was successful in promoting hybrid heating installations in these four communities.
Build capacity with HVAC contractors to sell, install, and service hybrid heating systems with smart controls.	• 8 HVAC Manufacturers participated • 45 HVAC contractors were trained and participated	Overall, the Initiative had great participation from both HVAC manufacturers and contractors alike. The program saw eight of the largest HVAC manufacturers in the market participate and be actively engaged. Working with the manufacturers helped to re-enforce their need to focus on heat pump technology moving forward and invest in proper installation and service training amongst their contractor base. Nearly 45 contractors across the regions participated in Phase I and completed mandatory training sessions. Enbridge offered approximately 15 training sessions in total covering the 3 mandatory topics; Hybrid Heating Awareness and Sales Training, Smart Controls, and DropZone application portal training. The hybrid heating awareness and sales training provided insight into heat pump technology, sales challenges, and communicating benefits to potential customers. As part of our participant survey results, 1 in 4 participants heard about hybrid heating directly from their contractor which indicates that our participating contractor base was successful in promoting this technology on their own. Enbridge believes it was effective in this goal. In stakeholdering with the participating contractors and manufacturers, Enbridge received feedback regarding the impact the Initiative had on their organizations with respect to hybrid heating. The overall feedback was positive, with some key points from this feedback summarized as follows:

Metric/Target	Results	Comments (Impact/Effectiveness)
		• The Initiative helped to establish Ontario as a heat pump market by partnering with contractors to deploy a program that helps homeowners improve their carbon footprint. • The program helped our organization move faster into this space in Ontario and will only further help this objective. The program brings the technology to the forefront and does so in sustainable way. • The promotion of Heat Pumps and the use of an alternative fuel to decrease the use of gas has been a great topic of discussion in homes. This program gave us a tool to assist clients with alternative choices to heating and cooling. This incentive is proving to be the push the clients need to spend the dollar amount required for these systems.
Build support for, and awareness about the benefits of hybrid heating systems	Enbridge implemented an omni-channel marketing outreach strategy to generate awareness of the program and increase enrollment in each of the eligible communities. Marketing activities included digital and social media campaigns as well as 1-on-1 personalized tactics. Digital marketing leveraged Facebook, Responsive Search, and YouTube advertisements. The social media campaigns utilized Enbridge's organic social media channels. Personalized email marketing campaigns were also deployed to Enbridge customers in each of the 4 communities. The marketing content focused on highlighting the benefits of the technology to homeowners. Additionally, the content directed customers to the Initiative webpage which included details and graphics explaining how hybrid heating systems work as well as the benefits of the technology. Enbridge set up a dedicated email to field questions from contractors and customers regarding the program. Enbridge frequently communicated with the manufacturer and contractor base to have line of sight into the field and ensure customers were supported	The results of Enbridge's marketing efforts are summarized below. These results display the vast reach that these campaigns were able to achieve, highlighting Enbridge's strong effectiveness at increasing awareness of hybrid heating technology. In terms of program support, the dedicated hybrid heating email was heavily monitored to ensure quick turnaround to program inquiries. Enbridge also frequently communicated with the manufacturer and contractor base (at minimum on a monthly basis but often several times a month) regarding program updates and to capture feedback from the field. • The digital campaign delivered over 1.86 million impressions with 28,588 total clicks to the program landing page. Impressions are the number of times an ad is displayed or seen. On average, customers spent over 6 minutes on the webpage which shows that customers found the content very engaging. Google search and Facebook advertising provided the highest combination of traffic to the webpage, contributing to roughly 70% of the traffic. YouTube videos were watched 119,221 times with 35.93% of the videos being watched to completion. • Enbridge rolled out a targeted email campaign in October to Enbridge Gas customers in the 4 eligible communities. The average open rate for the emails in this campaign was around 40%. This is strong in comparison to the industry average open rate of 23%. The click rate was 6%, whereas industry average for a click rate is around 2.62%. The campaign also resulted in 11,445 clicks to the program webpage. Overall, this tactic was very cost effective and drove great engagement. • Based on the customer research survey conducted with program participants, most participants first heard of the

Metric/Target	Results	Comments (Impact/Effectiveness)
	properly in their transition to this technology.	program directly from Enbridge Gas. The Enbridge Gas email campaign was the most prevalent for reaching potential participants. Roughly, 55% of the responders of the customer survey recalled receiving an email from Enbridge Gas to first learn about the Clean Home Heating Initiative. About 60% of the responders visited the Enbridge Gas website to get a list of eligible contractors in their region. This highlights that majority of the customers reviewed all the information on the website before deciding to participate the program. In summary, Enbridge's marketing efforts helped generate over 1.8 million impressions and over 28, 000 campaign level clicks which highlight that customers engaged with our content and wanted to learn more about hybrid heating systems.
Diversify market offerings with smart controls	Enbridge worked with 2 different smart controls manufacturers as part of the program.	As part of the Initiative, Enbridge utilized two smart control manufacturers in the market which included BKR Energy and Napoleon. HVAC Manufacturers were provided with an option to utilize either smart controls manufacturer as part of their system installations. During the duration of the Initiative, we also saw some HVAC manufacturers utilizing their own proprietary thermostats and integrating the smart controls platform to them. This provided each of the HVAC manufacturers with a few different options when looking to integrate smart controls with the hybrid heating systems. Smart controls training sessions were also provided by our smart controls manufacturers to our participating contractors which educated them on the benefits of incorporating a smart controller into the hybrid heating system. In addition, our webpage and customer brochure included information and graphics on how the smart controller worked with the hybrid system to educate customers. Overall, Enbridge was successful in implementing smart controls within the Initiative.

Rationale for Variances in Projected Results

As mentioned above, the Initiative achieved approximately 50% of its intended overall target, installing just under 500 hybrid heating systems. Enbridge believes that this result can be attributed to several different factors which are described in more detail in the challenges section below. However, the biggest of these challenges was certainly the time period for which Phase I was offered. The program was launched in September 2022 with the sales deadline being the end of March 2023. Therefore, the heat pump sales occurred during the fall and winter months which posed some challenges. Although contractors were able to install systems until the end of June 2023, selling systems that would need to be installed at a much later date due to weather conditions (such as cold, snow, and ice) proved challenging. This is validated by consistent feedback from our participating contractors.

There were also variances in the expected uptake of both the standard Energy Star ASHPs and ccASHPs. Original predictions indicated that there would be a 70% uptake of the standard Energy Star ASHPs. However, the Initiative results showed greater market demand for cold climate units with roughly 95% of the Phase I units being cold climate air source heat pumps. The higher incentive levels offered in this Initiative, as well as the improved performance of these units in colder temperatures were key selling features that contributed to their success.

Summary of Challenges

The below table identifies the challenges faced in Phase I of the Clean Home Heating Initiative. Some of these challenges identified below can be attributed to the overall program results.

Challenge	Description	Effect
Competing Programs	Based on feedback from contractors, programs like CGHG/HER+ were very enticing as contractors looked to capitalize on the higher heat pump incentives for their customers.	Participation from some of the contractor base declined throughout the program as their interest turned to other incentive offers. This meant that a portion of contractors were no longer directing their efforts to securing participants for our program. This ultimately inhibited further sales in the program.
Seasonality	The sales season for the program was the fall and winter. Weather during these seasons can pose challenges for contractors when installing heat pumps during this time frame.	The installation constraint during the winter sales season impacted contractors' abilities to secure additional participants and affected the overall success of the program.
Supply Chain	For several months of the program, one of the manufacturers experienced a distribution issue that prevented their dealers from having approved product in stock to sell to customers as part of the Initiative.	This stock shortage prevented some participating contractors from having available units to sell to their eligible customer base (attributing to virtually 0 sales from these contractors).
Economic Conditions	Economic conditions including inflation pose challenges for customers, especially when it comes to investing in new technologies such as heat pumps. Customers have increased uncertainty on whether it makes sense to provide the upfront capital to install new HVAC equipment, especially when the technology is less familiar to them.	These economic challenges could have prevented potential sales in the program, as customers did not want to invest in unfamiliar technologies. To try to mitigate economic effects in the program, HVAC contractors were encouraged to utilize their financing tools, where applicable, as well as capitalize on their respective manufacturer's incentives to mitigate costs for customers.

Challenge	Description	Effect
Consumer Awareness	Preliminary market insights indicated that the term “heat pump” may be confusing to customers in terms of understanding how the technology works. The term suggests that this system can only provide heat, and therefore it is not a suitable option for replacing their air conditioner and providing year-round comfort.	The customer confusion around the industry term “heat-pump” may result in customers deciding not to pursue this technology, and therefore not participate in our program. Our survey of Phase I participants indicated that roughly 20% of the respondents thought the technology name made it difficult to understand how the technology operates. If it was confusing for participating customers to understand, we can expect that non-participating customers would experience the same confusion, probably in a greater percentage.
Contractor Hesitancy	Phase I sales results indicated that roughly 70% of sales in the program were completed by 20% of contractor base.	Heat pump technology is still new for contractors. Becoming knowledgeable in this technology requires education, training, and support from a number of parties, but primarily from their internal organizations and manufacturers. New technology creates hesitancy amongst those that are selling it. In this case, it is easier and more convenient for contractors to sell what they are most familiar with (which is air conditioners). Hesitancy by some contractors to sell the technology can slow down the progress of sales as well as prevent it.

Added or Modified Tasks

Throughout Phase I, several tasks were added or modified. This was either the result of market circumstances or to increase the overall effectiveness of the program.

Firstly, the TPA outlined a specific allotment of heat pumps per community. As the program progressed, the demand for heat pumps was far greater in certain communities compared to others, which was reflected in their sales. London, for example, was experiencing high sales volumes, whereas St. Catharine's was experiencing limited sales volumes. To assist in getting closer to the overall program target of 1000 units, it was decided that London would be allowed to exceed their original forecast of heat pumps.

Early on in the program, the procurement of the smart controllers was shifted to the contractors. This simplified the overall sales process. As a result, the smart controls budget was redistributed. The redistribution allowed for an increased number of cold climate units compared to the original allotment in the TPA. As mentioned in earlier sections, the demand for cold climate units proved to be greater than the demand for standard energy star units. The redistribution of this budget allowed for 166 more cold climate units for a total of 466 units compared to the original allotment of 300.

Lastly, modifications were also made to the detailed progress report. The original template provided for the progress report included a column for the HSPF 2 values. The latest NRCan report with this information was not released in time for the Phase I reports. The delayed release of this information by NRCan resulted in no reporting of the HSPF 2 values for the duration of the program. Additionally, the table originally requested the heat pump’s “Heating Capacity at –15 (if available)”. This column was changed to “Capacity Maintenance % (Max –15 C/5 F ÷ Rated 8.3 C/47 F) due to available manufacturer data. The “Total Heat Pump Installed Cost” column was changed to “Total Installed Cost” (this cost could include both the furnace and heat pump). The costing column was changed as a result of the way the information was captured in the DropZone application portal.

Participant Feedback

At the beginning of May, Enbridge deployed a survey to those customers who had fully completed installations under the program at that time. The survey was sent to 388 participants in total and yielded 163 responses. The goal of the survey was twofold. The first portion of the survey was aimed at collecting customer feedback on overall customer experience and satisfaction with the Initiative. The second portion of the survey was aimed at understanding the customer's overall electricity and natural gas usage patterns. The usage patterns would assist in the M&V study.

The participant feedback regarding their overall impressions of the Initiative are summarized as follows:

- Just over 40% of participants heard of the program through Enbridge marketing channels, 25% through their contractor and 11% from friends or family.
- The most influential factors to participation were incentives. Natural gas savings and reduction in greenhouse gas emissions were also influencers of program participation.
- The application and installation process met 89% of the participants' expectations. For nearly half of the participants, the process exceeded their expectations.
- Those that felt the application and installation process fell short of expectations cited equipment issues which mostly included setup and noise.
- Almost half of the participants would recommend the Clean Home Heating Initiative program to their friends and family due to positive experiences with the equipment, customer service and value of the program.

Lessons Learned

Phase I proved to be a great learning experience for the delivery team. Some of the key lessons learned are summarized in the table below.

Topic	Lessons Learned
Customer Marketing	• There is a need to further develop heat pump pre-education material for customers and collaborative partners. This includes providing a better explanation of the "heat pump" terminology in marketing materials so that customers understand that the system helps to provide year-round comfort • Providing additional customer testimonials and real-life installation examples would enhance marketing efforts and reduce the fear in homeowners often associated with trying new technology
Contractor Training & Retention	• Continuous communication is necessary to remind contractors of the benefits of CHHI compared to other programs in the marketplace (such as CGHG) • Removal of non-productive contractors in the program ensures that customers are only connected to contractors who are dedicated to installing hybrid heating systems and securing incentives for their customers • To ensure proper installations of systems, contractors could benefit from heat pump sizing and selection training. Reiterating the basics of sizing and selection and the tools that are available to contractors is important, while also stressing to their manufacturers the importance of providing this in-depth training and support for their contractor base

Topic	Lessons Learned
Smart Controls	• Continued communication with contractors is necessary to remind them to assist their customers in smart control registration and setup • Additional training sessions are necessary with updated content to clarify the pain points identified by contractors in Phase I • Implementing checkboxes in the application portal so that contractors can confirm that they have completed the requirements to properly register their customers for their smart controls
Application Portal Modifications	• Portal updates can be made to make the system more user-friendly for the contractor base. This is based on pain points expressed and identified throughout Phase I • Additional updates can be made to capture more information fields that would be useful to the Province including new heat pump size in relation to existing AC sizing, cost information, electrical upgrades, etc.
Additional Collaboration (Municipalities & LDCs)	• Marketing efforts could be further enhanced through leveraging additional collaboration opportunities between municipalities and LDCs • Getting traction on collaboration activities has proved challenging
ccASHP vs ASHP	• Market demand for cold climate air source heat pump technology is greater than standard energy star air source heat pumps

Required Next Steps

There are several ongoing milestones and activities required to fully meet the commitments of Phase I of the Initiative. The remaining activities left to complete are listed in the table below. To ensure that the success of Phase I is built upon, Enbridge will utilize the key findings and lessons learned to inform future phases and make necessary improvements.

Date	Activity
August 30th, 2023	Final M&V Plan to be provided to the Government of Ontario
September 30th 2024	Draft M&V Report to be provided to the Government of Ontario
November 29th 2024	Final M&V Report due to Government of Ontario
Continuous	Recruit strong candidates for Phase 1 customer testimonials

Co-Benefits:

Aside from lowering GHG emissions, the Initiative offered a number of other benefits to consumers and to the HVAC marketplace in general. Three key co-benefits that the Initiative supported can be summarized as awareness, accessibility, and affordability. In terms of awareness, the Initiative has helped to increase the awareness of hybrid heating technology amongst homeowners in the 4 eligible communities as well as its benefits. This was shown in the overall marketing results and the wide reach that the marketing efforts achieved.

The Initiative supported an increase in accessibility of this technology in the marketplace by working alongside a strong base of manufacturers and contractors in the eligible communities. Offering HVAC contractor training and participant incentives helped to stress the need for the HVAC community to become well versed in heat pumps and hybrid heating technology. It also encouraged the manufacturers to put additional internal support in place so that their contractors can deliver this technology effectively to homeowners. Additionally, our website included the list of participating contractors in each area. This helped to connect homeowners to contractors that could deliver this technology for them.

Lastly, the Initiative made this technology more widely available in the marketplace. Enbridge worked directly with the manufacturers on their stock availability to ensure that product was available as part of this program. This reiterated the need for manufacturers to continue supporting the production and supply of these units. Making technology more widely accessible helps to drive costs down and make it more affordable for consumers over the long term. In addition, this unintentionally applied to the availability and overall cost of cold climate air source heat pumps which were 95% of our overall results.

Average Costs

Enbridge further analyzed the invoices of 246 homes under this project to produce an additional cost analysis as shown below. Please note that this table offers a very high-level analysis as invoices are not always granularly itemized which can make dissecting cost breakdowns challenging. Additionally, there is a very limited data pool for ASHP installations which means that these values may not necessarily be reflective of a true average. This is likely one of the reasons why the average cost for jobs using standard energy star air source heat pumps appears higher compared to the jobs with cold climate units in the table below.

Install Type	Average Installed Cost (excl HST)	Range of Installed Costs (excl HST)
ccASHP	$8,203	$5,196 - $11,350
ccASHP + Furnace	$14,393	$11,299 - $19,300
ASHP	$10,656	$6,505 - $13,786
ASHP + Furnace	$19,312	$16,500 - $22,124

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End of Project Financial Statement

Item	2022/2023			
	March Actuals + Accruals	March Invoiced (80%)	March – July Actuals	July True-Up
Participant-Related Costs				
Air Source Heat Pump Incentives				
Sault Ste Marie	$3,000	$2,400	$6,000	$3,600
London	$9,000	$7,200	$15,000	$7,800
Peterborough	$6,000	$4,800	$15,000	$10,200
St. Catharines	$0	$0	$0	$0
Cold Climate Air Source Heat Pump Incentives				
Sault Ste Marie	$121,500	$97,200	$117,000	$19,800
London	$310,500	$248,400	$283,500	$35,100
Peterborough	$292,500	$234,000	$270,000	$36,000
St. Catharines	$45,000	$36,000	$45,000	$9,000
Smart Controls*	$0	$0	$0	$0
Sub-Total Participant Related Costs:	**$787,500**	**$630,000**	**$751,500**	**$121,500**
Project Delivery Costs				
Contractor Product and Sales Training	$0	$0	$0	$0
System Enhancements	$0	$0	$0	$0
Marketing Costs	$68,913.9	$55,131.12	$68,913.4	$13,782.28
Sub-Total Project Delivery Costs:	**$68,913.9**	**$55,131.12**	**$68,913.4**	**$13,782.28**
Measurement and Verification				
Measurement and Verification	$9,186	$7,348.8	$9,186	$1,837.2
O&M Salaries – Fully Allocated Costs				
O&M Salaries	$38,209.91	$30,567.93	$38,209.91	$7,641.98
O&M Salaries – *correction**				$60,119.47
Project Total:	**$903,809.81**	**723,047.85**	**$867,809.31**	**$204,880.93**

*Due to an internal accounting oversight, the O&M salaries did not include the fully allocated costs for the duration of Phase I. The O&M correction line is a lump sum value that represents what is owed by the Province after correcting the necessary Phase I salaries.

Municipal Overview

Participant	2022-2023	
	March – July Actuals	Final YTD Project Actuals
Air Source Heat Pump		
Sault Ste Marie	2	8
London	5	6
Peterborough	5	11
St. Catharines	-	1
Cold Climate Air Source Heat Pump		
Sault Ste Marie	26	93
London	63	206
Peterborough	60	115
St. Catharines	10	48
Cumulative Total	**171**	**488**

Detailed Progress Report

Please see the below link to access the detailed progress report. This report encompasses all projects completed under Phase I.

Year 2 Detailed Progress Report .xlsx

Qualified Product List

Please see the below link to access the qualified product list. This is the most recently updated version that was used in Phase I.

Phase I Qualified Product List.xlsx

Appendix

Please find the Draft M&V report attached for your review, including the aggregated survey results.

Clean Home Heating Initiative

Measurement and Verification Overview

Prepared By: The Sustainable Technologies Evaluation Program (STEP) of the Toronto and Region Conservation Authority (TRCA)

June 2023

Contact Information:

Prepared by: Erik Janssen, CMVP; Research Scientist, STEP/TRCA erik.janssen@trca.ca
Reviewed by: Gil Amdurski, CMVP; Project Coordinator, STEP/TRCA gil.amdurski@trca.ca

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Acronyms

- **ASHP:** air-source heat pump
- **CMVP**: Certified Measurement and Verification Professional
- **EEM**: energy efficiency measure
- **HDDs**: Heating degree days
- **IPMVP**: International Performance Measurement and Verification Protocol
- **M&V**: measurement and verification
- **TOU**: time-of-use

1 Introduction to IPMVP

Measurement and verification (M&V) describes the *"...process of planning, measuring, collecting and analyzing data to verify and report energy savings within a facility or facilities resulting from the implementation of energy efficiency measures (EEMs)."* [1]

The energy savings associated with an EEM are not directly measurable. Energy savings are the difference between the actual post-EEM energy consumption and the energy consumption that *would have occurred* had the EEM not been implemented. This necessarily means that savings is an estimate because the calculation procedure needs to make assumptions about something that did not actually happen. The framework within which these assumptions are made is described in the International Performance Measurement and Verification Protocol (IPMVP).

This framework was developed by the Efficiency Valuation Organization (EVO) in the 1990s. Since then, it has received international recognition and is the most widely used M&V protocol by facility energy managers, project developers, energy service companies (ESCOs), non-governmental organizations (NGOs), finance firms, government, and consultants. It is the primary M&V protocol used by the Independent Electricity System Operator (IESO) and is the basis of the Certified Energy Manager (CEM) and Certified Measurement and Verification Professional (CMVP) designations.

Within the IPMVP, energy savings is determined by comparing energy usage after an EEM has been implemented (this period of time is termed the reporting period) against baseline energy use prior to the retrofit (termed the baseline period) that has been adjusted to the reporting period conditions (Figure 1).[2] An additional adjustment term may add a further correction to make both the baseline and reporting periods truly comparable. This ensures that the calculated savings are a result of the EEM rather than other factors that may have affected energy usage.

Adjustments of baseline or reporting period energy data from one set of conditions to another is based on regression analysis. A suitable mathematical model is developed that describes the measured energy consumption as a function of one or more independent energy influencing variables. With a baseline energy model, it is possible to calculate the baseline energy consumption *that would have occurred* under the reporting period conditions. This would then be compared against the actual reporting period energy consumption to determine savings.

[1] Efficiency Valuation Organization. Core Concepts: International Performance Measurement and Verification Protocol. 2022.

[2] It is also possible to project the reporting period energy consumption to baseline conditions or, even project both the baseline and reporting period to a set of standard conditions.

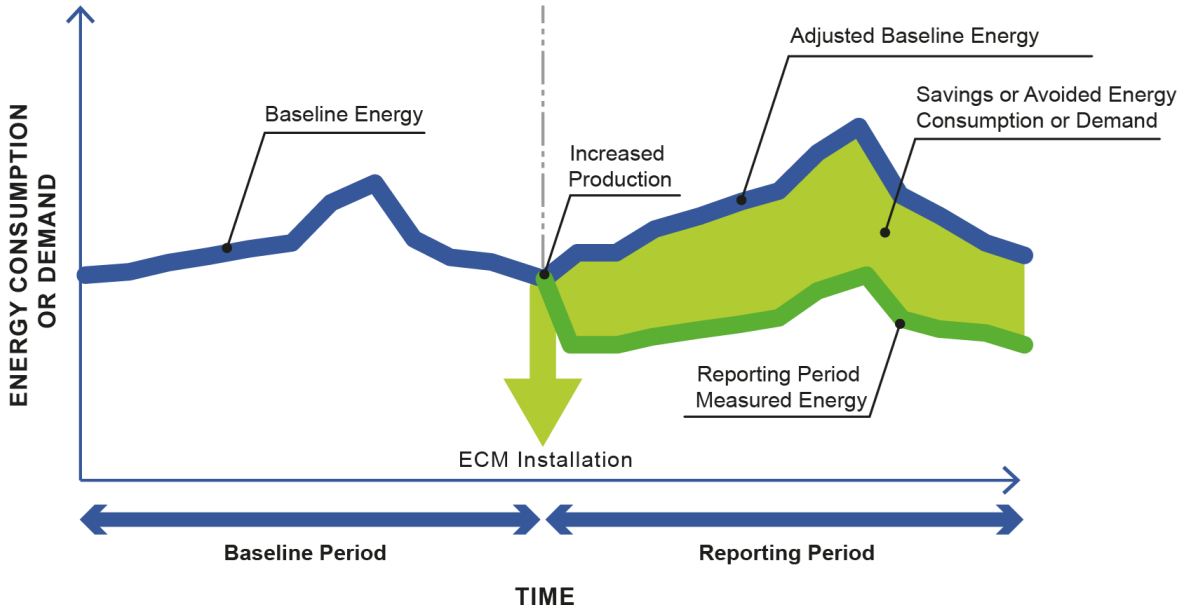


Figure 1. Baseline energy consumption data is projected to reporting period conditions to calculate the energy savings. Image from EVO.

Since the constraints on different M&V initiatives will vary, the IPMVP provides four different options. Different options may be selected depending primarily on the resources available for the evaluation and the EEM being studied, but in all cases, reporting period energy usage is compared against a baseline and the M&V is based on actual measurements.

This document is an M&V Overview rather than an IPMVP-adherent M&V Plan because an M&V Plan has defined requirements within the IPMVP, specifically, it requires both the baseline data and the baseline regression models. Due to the timelines of the reporting schedule, the baseline data could not be collected and analyzed in time for the submission of this document but will be provided at a later date. This M&V Overview will follow the format of an IPMVP-adherent M&V Plan insofar as is possible.

2 Project Overview

With funding support from the Government of Ontario, The Clean Home Heating Initiative (CHHI) that is delivered by Enbridge is offering an incentive to homeowners in select Ontario communities for the installation of smart hybrid heating systems. The Clean Home Heating Initiative was preceded by the successful 100-home smart hybrid heating pilot in London.

These systems pair an air-source heat pump (ASHP) with a forced-air natural gas furnace. The ASHP replaces an air-conditioner and provides all the cooling needs for a home. It is also able to provide heating and is typically able to manage a portion of the annual heating load for the home. This can reduce home energy consumption, carbon emissions, and operating costs for the homeowner.

Smart hybrid heating systems utilize a web-enabled smart controller that selects either the ASHP or the furnace for home heating based on whichever is the lowest cost, given factors like time-of-use (TOU) electricity rates, natural gas costs, outdoor temperature, ASHP efficiency and furnace efficiency.

Phase I of CHHI was launched in the market in September of 2022 and was intended to target a total of 1000 homes in Peterborough, London, St. Catharines, and Sault Ste Marie. At the conclusion of Phase I in March of 2023 there were approximately 500 customers that decided to participate in the program. In 2023, The Government of Ontario supported the launch CHHI Phase II which would expand the Initiative into 4 new communities Ajax, Barrie, Pickering, and Whitby with just over 1000 units.

As part of this analysis, only CHHI Phase I participants will be considered for review.

3 EEM Intent

ASHPs have efficiencies of up to 200-300% depending on unit type as well as outdoor air temperature and are much more efficient than some of the baseline technologies which include electric resistance and furnace heating. Even though, in Ontario, electricity can be more costly than natural gas per unit of energy, the high efficiency of an ASHP can allow it to be the lower cost option for much of the year. This is typically the case in non-peak time-of-use (TOU) brackets and/or in milder outdoor temperatures.

As per the IESO's Year End Data for 2022[3], ~90% of the Energy Output in Ontario was derived primarily from low-carbon sources, mainly through nuclear and hydro as well as wind and a small amount of solar. ASHPs can therefore reduce home carbon emissions because the energy source is lower carbon, and less energy is used overall due to their higher efficiency. It follows that the intent of the ASHP retrofits is to reduce home energy consumption, utility costs, and carbon emissions. The extent of the savings depends on many factors including:[4]

- the relative cost of electricity and natural gas (which fluctuates, particularly owing to variations in the natural gas rates, and also to new electricity rate structures);
- homeowner temperature setpoints;
- climate heating degree days;
- year-to-year variations in weather;
- the efficiency and cold-temperature capacity of the heat pump that was selected; and
- the relative sizing of the heat pump with respect to the home heating load.

Based on analysis from installations in Southern Ontario, it is expected that savings in the low hundreds of dollars may be feasible for many homes, with the ASHP typically handling a portion of the annual heating load. Given this analysis is being completed on installations in four diverse areas in Ontario, it will support better clarity on performance of hybrid systems with smart controls in different weather zones.

This analysis will only look to review savings and GHG emission reductions for the timeframe of M&V analysis. This is due to uncertainty with future utility rates and electricity marginal emissions factor.

[3] IESO 2022 Year In Review

[4] The carbon reductions are also impacted by the assumptions of the analysis. Marginal emissions factor will be utilized as part of this analysis from IESO's current Annual Planning Outlook.

4 Selected IPMVP Option and Measurement Boundary

IPMVP Option Used to Determine Savings

This M&V will use Option C - Whole Facility according to IPMVP 2022. Option C will be used in a sample of homes participating in the project. In May 2023, 388 participants who had their heat pumps installed at the time were selected to complete a M&V survey to determine existing operating conditions (more detail in Section 5.4) as well as overall satisfaction with the initiative. There was a successful response rate of ~50% which resulted in 163 survey results. Note that only 142 of the 163 participants wished to have their survey responses disaggregated and will be included as part of this M&V analysis. Based on the survey results, they will be sorted into different groups in relation to level of confidence in the savings estimate.

See below for distribution based on survey responses by City:

City	Utility Data Requests	Survey Responses
London	208	58
Peterborough	105	29
SSM	98	42
St.Catharines	47	13
Total:	**458**	**142**

** Note that all 458 participants who had their heat pumps installed at the time of the utility data request may be included as part of this analysis. Those that did not provide survey responses or did not approve disaggregation of their responses may be analyzed as part of an "indeterminant" group. In addition, given that the uptake of ASHP through the initiative was only ~5% of overall units this analysis will not differentiate between ccASHPs or ASHPs.*

Measurement Boundary

The existing electricity and natural gas utility meters encompass the full energy consumption of each home. The measurement boundary is therefore the full home for each home considered. Interactive effects (where energy may be saved within the measurement boundary, but then also increases or decreases outside of it) are not anticipated.[5]

[5] An example of an interactive effects is an LED lighting retrofit that increases the heat load (because internal heat gains are reduced) and similarly, decreases the cooling load.

5 Baseline: Period, Usage and Conditions

Identification of the Baseline Period

The baseline period will encompass utility bill data from at least 1 year prior to the retrofit, and up to two years when possible.

Baseline Utility Consumption Data

The baseline natural gas and electricity consumption has not yet been analyzed. It will be collected directly from the utilities, with homeowners having signed data-sharing agreements as a condition for participating in the pilot.

Natural gas utility meters are typically read bi-monthly, resulting in at least 6 data points for the baseline model (given that at least one year of baseline data will be collected). The lower number of data points is not anticipated to be an issue for the baseline natural gas consumption model because gas consumption is typically highly linear with heating degree days (home heat loss is linearly proportional to the temperature difference between the inside and outside).

The typical relationship between natural gas consumption and heating degree days is shown for an example home (from previous work) below in Figure 2. The y-intercept represents the gas usage for non-temperature dependent sources (hot water as well as potentially the dryer and stove) and the HDD temperature-dependence is from the furnace consumption. As it gets colder, HDDs increase, and more gas is consumed.

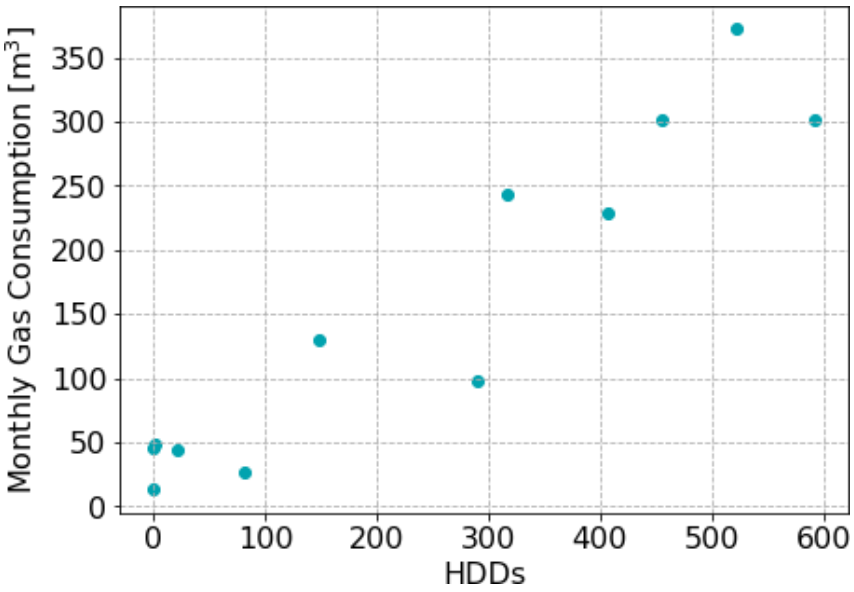


Figure 2. Example home gas consumption data from a previous project that illustrates the linear relationship between gas consumption and HDDs.

Electricity will be collected on an hourly basis when feasible and will be aggregated to higher timescales (likely monthly) for the energy savings analysis. The hourly data is needed for the electricity demand analysis. The homeowners are not charged based on maximum electricity demand but it is nonetheless an important variable for understanding the grid impacts of ASHPs. To determine the demand increase, the maximum electricity consumption for a 1-hour period in each month will be determined and then used to define a maximum electricity demand model.

To determine overall energy savings, the M&V only needs to evaluate the changes in total electricity and gas consumption. However, to determine the cost savings, it must also estimate the change in electricity reduction in each time-of-use bracket. This will likely involve creating separate linear regressions models for monthly electricity consumption in each TOU bracket, and separating the weekend TOU bracket from the weekday off-peak bracket since they cover different time periods of the day. The approach for aggregating the baseline data will be finalized once the data is received and reviewed.

Utility Influencing Variable Data

The primary independent variable influencing energy consumption is the outdoor temperature. In this M&V, outdoor temperature will be accounted for using heating degree days. Outdoor temperature data will be collected from the nearest Environment and Climate Change Canada weather station accessed through the weatherstats.ca portal.

Operating Conditions

The operating conditions of the home will be assessed using a survey of participants. The aggregated results are provided in Appendix 1 of all 163 respondents. The aim of the survey is to identify homes that are unlikely to require large non-routine adjustments within the M&V. These homes will be initially grouped within the M&V as having a high confidence in the savings estimates (explained below). Based on the results of the analysis, there may be the requirement to complete a second re-evaluation survey but this will be reviewed at a later date.

Non-routine adjustments incorporate other energy influencing factors in the M&V that are not accounted for by routine adjustments based on an energy influencing variables like heating degree days. There are many factors in a home that may require non-routine adjustments, for example, a change in occupancy, an addition, other concurrent energy retrofits alongside the heat pump, new large loads (like an electric vehicle, sauna, hot tub, fireplace, and similar), etc. M&V must take these into account because they may otherwise (incorrectly) reduce or increase the results of the savings calculation for reasons unrelated to the hybrid heating system.

To be able to estimate hybrid system energy savings as accurately as possible, it is ideal if the implementation of the hybrid system is the only significant energy-influencing factor that changes between the baseline period and the reporting period (aside from that which can be

accounted for with routine adjustments due to changes in weather). Quantitatively accounting for non-routine factors on a home-by-home basis would be onerous. Rather, the M&V will seek to group together any homes requiring significant non-routine adjustments as having a lower confidence in the savings estimates.

Using the survey responses, homes will be sorted into three categories based on the level of non-routine adjustment that may be required: (1) none, (2) a small adjustment, and (3) a medium or large-sized non-routine adjustment. For homes in Category 1, the energy consumption patterns of the home are expected to change only due to the hybrid heating installation and weather, aside from small random variations. Category 1 is ideal for M&V. Homes in Category 2 may have had other small factors impacting energy consumption; for example, a single small energy conservation measure (for example, a few windows or a door was replaced) or a small change in occupancy (an occupant moved out). Homes in Category 3 will have had a substantial change to the energy consumption of the home; for example, a *new* (i.e. concurrent with the hybrid heating install) electric vehicle with home charger that is replacing a gas vehicle, or multiple large home energy retrofits (for example, the homeowners replaced all the windows as well as did air-sealing and attic insulation).

An additional category will identify whether there are large variable energy loads whose usage may be inconsistent or difficult to model. Examples of these loads would include a hot tub, an electric sauna, a pool heater, or an electric car. This category would also include usage profiles that may be variable; for example, if the home is a secondary residence or if it includes a short- or long-term rental. The aim is, again, to limit the other things that have changed in the candidate homes or to flag any homes whose energy usage may be inconsistent.

It is important to note that, in all of these homes, the hybrid heating system installations may benefit all homes in the initiative and the purpose of sorting homes into categories is only to identify those homes where it is feasible to calculate the savings using the methods of IPMVP Option C, i.e. regression analysis of whole-home utility consumption. Table 1 summarizes the categories. Green represents high confidence that the savings are due to the hybrid system alone, red represents low-confidence, and yellow represents medium confidence.

Table 1. Homes will be sorted into categories based on the responses to Survey 1.

Category	**Description**	**(a) No large unpredictable or variable loads**	**(b) Has large unpredictable or variable loads**
1	No non-routine adjustments required	Selected 1st for M&V	Selected 3rd for M&V
2	A small non-routine adjustment may be required	Selected 2nd for M&V	Selected 4th for M&V
3	Would require a large non-routine adjustment	Excluded from the M&V	Excluded from the M&V

In summary, the steps for selecting final M&V candidates and placing them in their corresponding category are listed below:

1. Homeowners install heat pumps.
2. Homeowners fill out the survey.
3. Candidates are sorted into categories based on suitability for M&V.
4. Participants' baseline utility data is collected and analyzed.
5. Formal IPMVP-adherent M&V Plan is created including the utility data and baseline regression models.
6. Final placement of candidate homes in each category.
7. Final reporting period utility bill data collection.

After the final placement of candidate homes into each category, the baseline regression models will be used to project baseline energy consumption to reporting period conditions and savings will be determined. Results will be presented for each category, and this will also reflect the confidence in the results (homes in Category 1(a) or 2(a) having the highest confidence in the savings calculations).

6 Reporting Period

The reporting period will encompass (at least) May 2023 to May 2024.

7 Basis for Adjustment

Savings will be reported as avoided energy (discussed in Section 8). Baseline energy consumption will be projected to reporting period conditions using the baseline models.

8 Calculation Methodology and Analysis Procedure

13.5 Baseline Consumption Models

The final IPMVP-adherent M&V Plan will fully define the baseline utility consumption data for each candidate home included in the M&V, and will also define the baseline regression model and statistics. As an example, the data shown in Figure 3 can be represented by the line defined in Equation 1 with a coefficient of determination (R^2) of 0.89. Note that Equation 1 is just an example linear regression model, and it does not represent any home included in the M&V. Statistical parameters outlined in the IPMVP, like the standard error, help to further define the overall quality of the model.

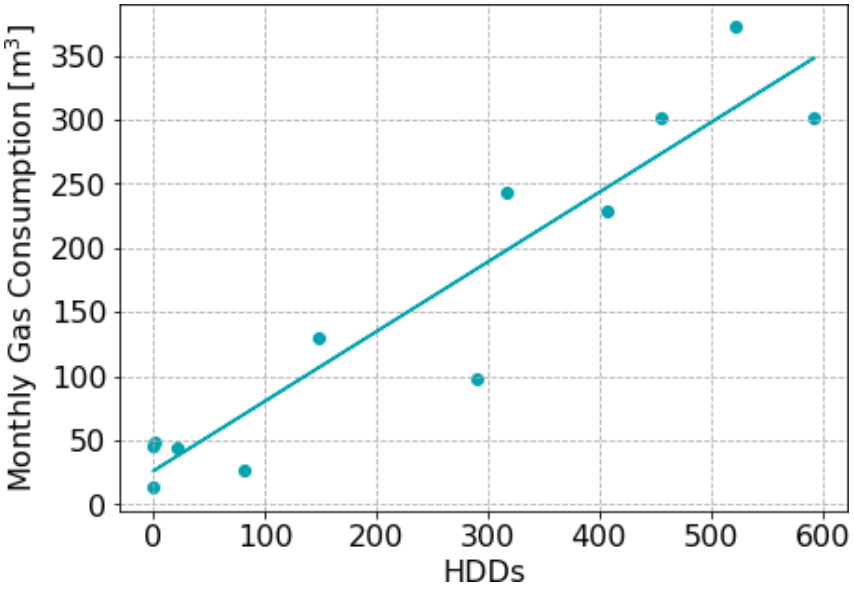


Figure 3. Baseline energy consumption can be represented using a linear regression model according to HDDs. The reporting period HDDs can be used in the baseline model to determine the projected baseline energy, against which the actual energy consumption can be compared.

$$Monthly\ Gas\ Consumption = (0.543\ \times HDDs) + 26.0 \qquad \text{Equation 1}$$

With a mathematical model of baseline gas consumption as a function of HDDs, it is then possible to determine the baseline energy consumption using the HDDs that occur for the reporting period. This allows for a fair “apples-to-apples” comparison against the actual energy consumption, with the savings being the difference in energy consumption between the projected baseline energy and the actual energy consumption. Baseline models will be determined both for the gas consumption and the electricity consumption, with the electricity consumption models (likely) to be further broken down according to TOU.

13.5 Avoided Energy Consumption

The avoided energy consumption will be calculated using Equation 2. Separate calculations will be done for gas and electricity, with electricity likely to be further broken down into TOU. In each case, baseline models will be projected to reporting period conditions using heating degree days. This is the “Adjusted Baseline Energy” term. The term for “Non-routine Adjustments” will be zero because the surveys will be used to identify candidate homes where non-routine adjustments are not required or are very small.

$$Avoided\ Energy\ Consumption = \begin{matrix} Adjusted\ Baseline\ Energy \\ -Reporting\ Period\ Energy \\ \pm\ Non-routine\ Adjustments\ to\ Repo\ Period\ Conditions \end{matrix} \quad \text{Equation 2}$$

13.5 Electricity Demand Increase

The electricity demand increase will be evaluated for those included in the M&V where hourly electricity consumption data is provided from the electricity utility. The demand will therefore be an hourly demand, rather than a truly instantaneous demand. Subsequent work (outside of this M&V) may use the maximum hourly demand and further estimate a maximum demand at a finer timescale. Avoided demand will be calculated monthly using Equation 3. Note that “Avoided Demand” is the terminology used in the IPMVP, but here it will be negative because electricity demand will increase. “Adjusted Baseline Demand” is the baseline model projected to reporting periods conditions based on HDDs. “Reporting Period Demand” is the actual demand that occurred during the reporting period.

$$Avoided\ Demand = \begin{matrix} Adjusted\ Baseline\ Demand \\ -Reporting\ Period\ Demand \end{matrix} \quad \text{Equation 3}$$

13.5 Avoided Cost

Avoided cost will be calculated monthly using Equation 4 and totaled for the reporting period. In this calculation, the “Avoided Elec Consumption” is negative since there will be an increase. The increases will be determined separately, and rates applied separately, for each TOU (as indicated by the summation in Equation 4).

$$Avoided\ Cost = (Avoided\ Gas\ Consumption \times Gas\ Rate) + \left(\sum_{i}^{All\ TOUs} Elec\ Rate_i \times Avoided\ Elec\ Consumption_i \right) \quad \text{Equation 4}$$

13.5 Avoided Greenhouse Gas (GHG) Emissions

Avoided GHGs will be calculated monthly using Equation 5 and totaled for the reporting period. In this calculation, the “Avoided Elec Consumption” is negative since there will be an increase. Unless otherwise stipulated by Enbridge Gas Inc. (or the Province of Ontario), GHG savings will be calculated using the most recent federal National Inventory Report values associated with Ontario electricity and natural gas.

$$Avoided\ GHGs = (Avoided\ Gas\ Consumption \times Gas\ Emission\ Factor) + (Avoided\ Elec\ Consumption \times Elec\ Emission\ Factor)$$

Equation 5

9 Energy Rates

Utility bills can be complicated and have many line items. In this M&V, *marginal* utility rates for electricity consumption and natural gas consumption will be used to calculate savings. The marginal utility rates include all utility bill line items that are linearly dependent on consumption (including tax) and ignores any line items that are fixed and do not vary with consumption. As an example, for natural gas consumption, the Customer Charge is fixed, but all other line items vary linearly with consumption.

The M&V will determine the marginal gas and electricity rates for each home at the time of final reporting using the Ontario Energy Board Bill Calculator (https://www.oeb.ca/consumer-information-and-protection/bill-calculator). Using the calculator, the marginal rates can be determined for each geographical region by calculating two sample bills for different levels of energy consumption. The change in cost divided by the change in consumption is equal to the marginal rate that will be used for savings calculations.

As an example, two sample bills are calculated below. On the left, is a bill for 200 m^3 consumption and on the right is one for 100m^3. The reduction in cost is $47.13 and the reduction in consumption is 100 m^3. The marginal utility rate is therefore $0.471 $/m^3$. This marginal rate is the same regardless of the magnitude of the reduction. A similar exercise can be done for each electricity time of use bracket to determine marginal electricity rates.

SAMPLE MONTHLY BILL STATEMENT

Enbridge Gas - All

Account Number: 000 000 000 0000
Meter Number: 0000000

Your Natural Gas Charges

Customer Charge	$22.88
Delivery	$20.90
Gas Supply Charge	$26.46
Cost Adjustment	$4.08
Transportation Charges	$8.51
Federal Carbon Charge	$24.78
Total Natural Gas Charges	**$107.61**
HST	$13.99
Total Amount	**$121.60**

SAMPLE MONTHLY BILL STATEMENT

Enbridge Gas - All

Account Number: 000 000 000 0000
Meter Number: 0000000

Your Natural Gas Charges

Customer Charge	$22.88
Delivery	$10.84
Gas Supply Charge	$13.23
Cost Adjustment	$2.04
Transportation Charges	$4.25
Federal Carbon Charge	$12.39
Total Natural Gas Charges	**$65.63**
HST	$8.53
Total Amount	**$74.17**

Figure 4. Example invoices from the Ontario Energy Board bill calculator for 200 m^3 consumption (right) and 100 m^3 consumption (left).

10 Meter Specifications

Utility meters will be used for gas and electricity consumption/demand. Since these are the meters upon which the homeowners are charged for their consumption, the measurement uncertainties of the meters will not be taken into account within the M&V.

11 Monitoring Responsibilities

The baseline and reporting period utility data for the participating homes will be collected by Enbridge Gas Inc. and provided to STEP for analysis. Surveys will be created jointly by STEP and Enbridge Gas Inc. but they will be administered by Enbridge Gas Inc. and provided to STEP. Data will be provided in two batches. The first batch will cover the baseline period for 1 to 2 years pre-retrofit. The second batch will cover the reporting period.

12 Expected Accuracy

Without the baseline data and regression models, the expected accuracy cannot be provided in this M&V Overview. The final IPMVP-adherent M&V Plan will estimate the typical expected accuracy.

13 Report Format

In addition to this overview, three additional documents will be provided as part of the M&V:

1. An IPMVP-adherent Plan, containing regression analysis of baseline utility data and survey analysis, to be provided to Enbridge after the baseline utility data and survey data is received from Enbridge.
2. A draft Final M&V Report which will be provided after the final reporting period data and survey data is provided by Enbridge Gas Inc. This document will be provided to the Province by September 30th, 2024.
3. The Final M&V Report will be provided after comments have been provided by Enbridge Gas Inc. and the Ontario Government. This document will be provided by November 29th, 2024.

The Final M&V Report will include all required sections outlined in Section 13.3 of IPMVP Core Concepts 2022. It will include, at minimum:

- Definitions or terminology.
- Overview of M&V objectives and goals.
- Detailed description of the approach for data collection, measurement, and verification.
- For the selected sample, the results of applicable performance metrics measuring the impact and effectiveness. At minimum, the following performance metrics are to be included: (i) natural gas savings in cubic metres or GJ and as percentage of change; (ii) electricity increases in kWh as a percentage of change; (iii) natural gas bill savings in $ and as a percentage of change; (iv) electricity bill increases in $ and a percentage of change; (v) net utility bill impact in $ and as a percentage of change; (vi) greenhouse gas emissions in tCO_2e.
- A comparison of the performance metrics of a regular ASHP and a ccASHP as outlined in the above bullet (provided there is sufficient data on regular ASHPs).
- If the requested data from Local Distribution Companies is provided, an analysis of peak demand increases.
- Description of and rationale for any variances in relation to intended or programed results.
- Identification and description of any challenges with achieving M&V objectives, if applicable.
- Description of and rationale for any added or modified tasks.

- Summary of lessons learned from M&V, including participant behavioral insights based on the questionnaire results (e.g. tendencies to or likelihood for changing the set temperatures).
- Conclusions and recommendations.
- Appendices with sample questionnaire, the M&V Plan, and any relevant datasets.

14 Quality Assurance

- A survey will be used to identify the candidate homes best suited to M&V, they will be used to exclude any homes not well-suited to M&V. Homes not well-suited to M&V are those where energy consumption patterns are significantly influenced by changes in other factors aside from the hybrid system installation. By isolating the most suitable homes, confidence in the results will increase.
- For energy measurements, this M&V will only use utility meter data. These are the meters upon which the homeowners are charged for their consumption. It follows that measurement errors from submeters will not be a factor in this M&V.
- The analysis will be completed by an individual with the CMVP designation and reviewed by another individual with the CMVP designation.

15 Appendix 1: Aggregated Survey Results

Clean Home Heating Initiative - Report

Background:

Enbridge Gas and the Ontario government collaborated to launch the Clean Home Heating Initiative in 2022. The program aims to bring hybrid heating technology to households in St. Catharines, London, Peterborough, and Sault Ste. Marie. The initiative will support the installation of electric heat pumps with smart controls by providing homeowners with incentives of up to $4,500.

Enbridge Gas and the Sustainable Technologies Evaluation Program (STEP) are interested in ascertaining additional information about current participants' energy usage behavior and energy sources of household appliances they may have in the home. The survey was administered by Enbridge Gas through Qualtrics (an online survey platform) on May 1, 2023. A total of 163 competed surveys were collected between May 1, 2023 and May 15, 2023. This represents a 45% responses rate with a margin of error of +/- 5.8%.

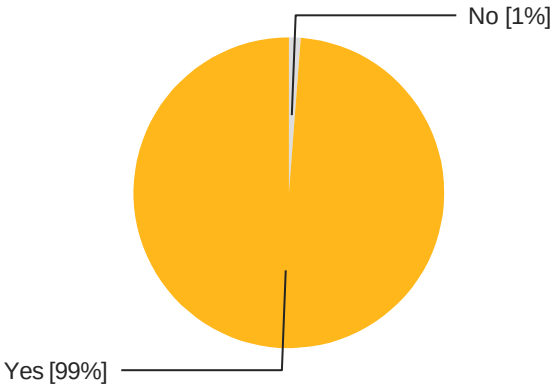
Finding Summary:

- Nearly all hybrid heating systems were installed in the participants' primary home.
- The majority of households are occupied by two residents, while the average household size is about three.
- Almost all participants (96%) have a natural gas furnace and 79% also have a natural gas water heater. Stoves/cooktops, air conditioning, and clothes dryers are predominantly electric. The Clean Home Heating Initiative requires all participants to have a natural gas furnace. Enbridge attributes the 96% furnace result to the margin of error mentioned in the paragraph above as human error exists when participants are completing surveys.
- A small proportion of participants have recently replaced the furnace and water heater within the last 12 months, while upgrading windows, doors, or more energy efficient appliances are the most likely to have occurred.
- Over 9-in10 participants typically set the thermostat between 18-24 degree Celsius. About the same proportion of program participants continue to have the same temperature setting for the house. A small proportion (4%) of participants "decreased" the temperature setting on the thermostat.
- Hot water consumption patterns have not changed for the majority of participants. Only a handful of participants have indicated a decrease in hot water consumption over the past 12 months.
- Nearly 3-in-4 participants reported the hybrid heating system as the only heating system the home.

Household Composition

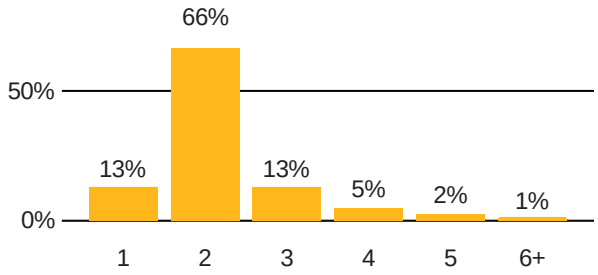
Is the home your primary residence?

163 Responses



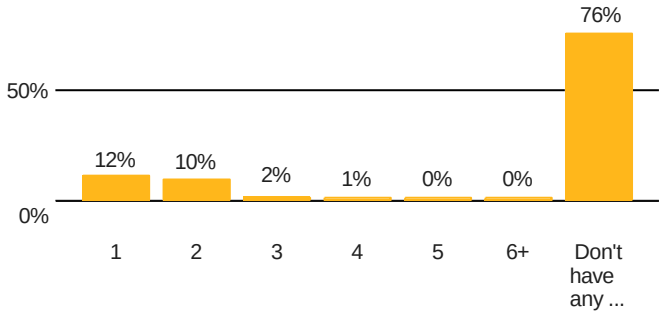
Including yourself, how many adults (18 years or older) currently live in the home?

163 Responses



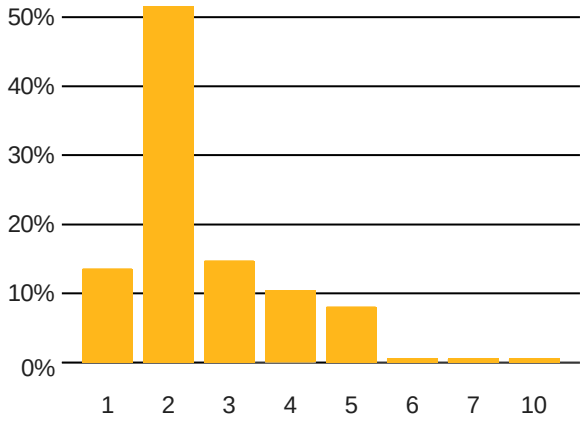
How many children (17 years or younger) currently live in the home?

163 Responses



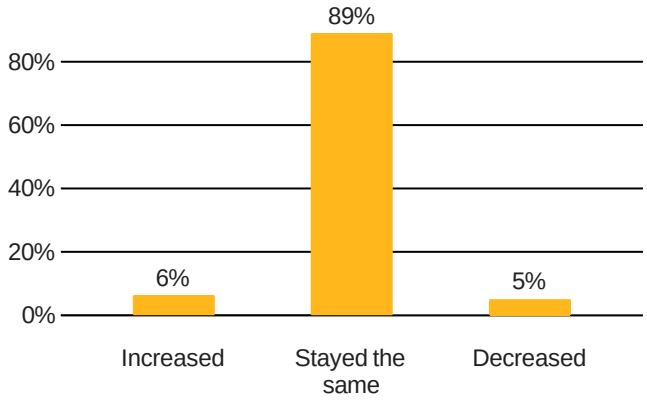
of People is Household (Derived)

163 Responses



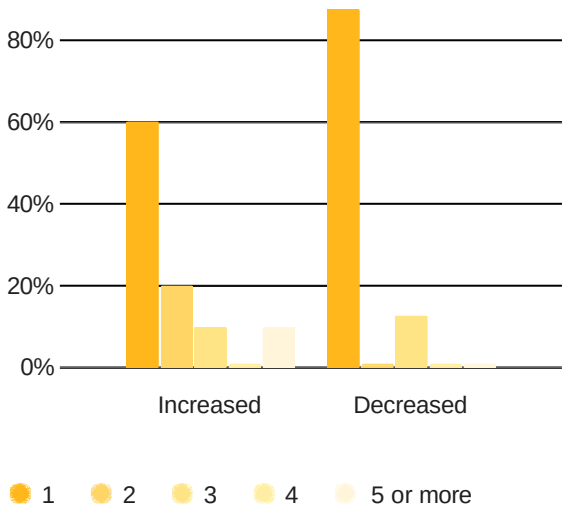
Within the last year, has the number of people living in the home...

163 Responses



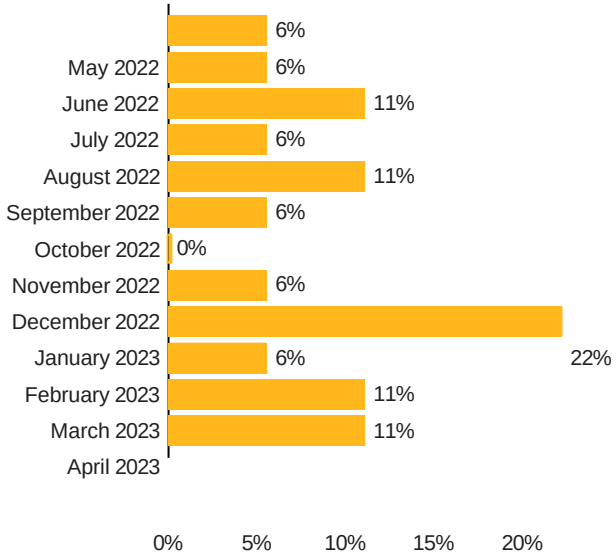
By how many people has it changed?

18 Responses



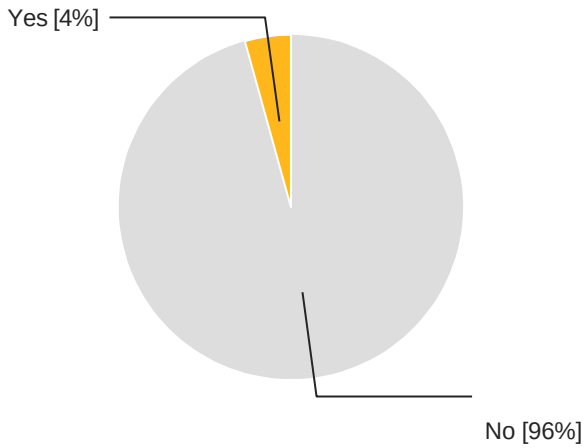
During which month did this occur?

18 Responses



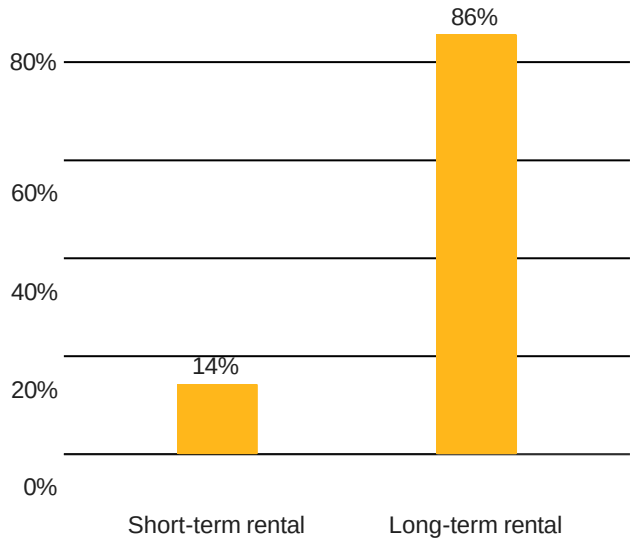
Is any part of the home used for rental?

163 Responses



Is the rental a...

7 Responses



Appliances and Energy Source

Please indicate the energy source of the following appliances you may have...

163 Responses

Field	Natural Gas	Electric	Other	N/A
Furnace	96%	2%	1%	1%
Water heater	79%	20%	1%	0%
Stove/Cooktop	32%	65%	1%	2%
Clothes dryer	13%	84%	0%	2%
Barbeque	34%	1%	49%	16%
Fireplace	52%	6%	11%	31%
Pool heater	6%	2%	1%	91%
Hot tub heater	0%	10%	1%	89%
Sauna	0%	2%	1%	97%
Central air-conditioner	9%	71%	4%	16%
Other	1%	7%	2%	89%

Other (Please specify)

18 Responses

Electric

Mini freezer
DW
Washing machine
Heat Pump
clothes washer and dishwasher
EV charger
Heat pump
Heat pump
Oven
Pool pump
Steam shower
Dehumidifier

Other

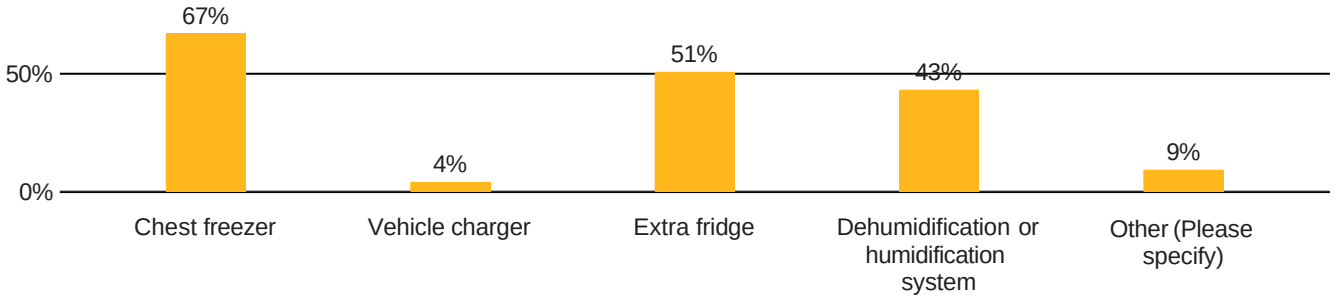
propane bbq
Propane
wood burning stove (unused)
Heat Pump

Natural Gas

Rennai space geater
Air handler/ heat /tankless

Which of the following electrical applications were in the home prior to the heat pump installation? (Please select all that apply)

154 Responses



Please indicate whether you have added, removed or replaced any of the following...

163 Responses

Field	Add	Remove	Replace	N/A
Furnace	2%	1%	14%	83%
Fireplace	2%	1%	1%	96%
Barbeque	4%	1%	2%	93%
Water heater	1%	0%	10%	90%
Clothes dryer	2%	0%	7%	91%
Pool heater	0%	0%	1%	99%
Hot tub heater	1%	1%	0%	98%
Heating for an outbuilding or garage	1%	0%	0%	99%
Stove/Cooktop	2%	0%	8%	90%
Secondary fridge/freezer	4%	0%	3%	93%
Sauna	0%	0%	0%	100%
Other (Please specify)	1%	1%	2%	95%

Other (Please specify)

9 Responses

Replace

- A/C
- A/C unit
- Dish washer
- Fridge

Remove

- Air conditioner
- Hot tub

Add

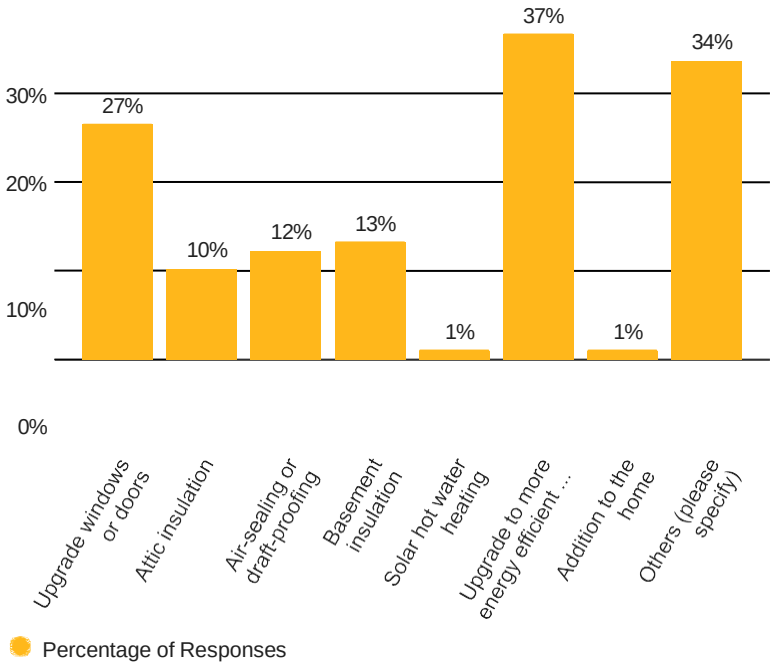
- EV Charger
- exterior fire tablr

N/A

- N/A

Which of the following upgrades or improvements have you completed within the last 12 months? (Select all that apply)

98 Responses



Others (please specify)

13 Responses

heat pump/furnace

New back storm door installed

Replacement of insulation with foam R20

Renovated 2 Bathrooms with new shower faucets

Solar panels

No changes other than hybrid system

Just the furnace and heat pump

Furnace Heat Pump

I haven't completed any.

Wall insulation

2 bathrooms, kitchen renovations

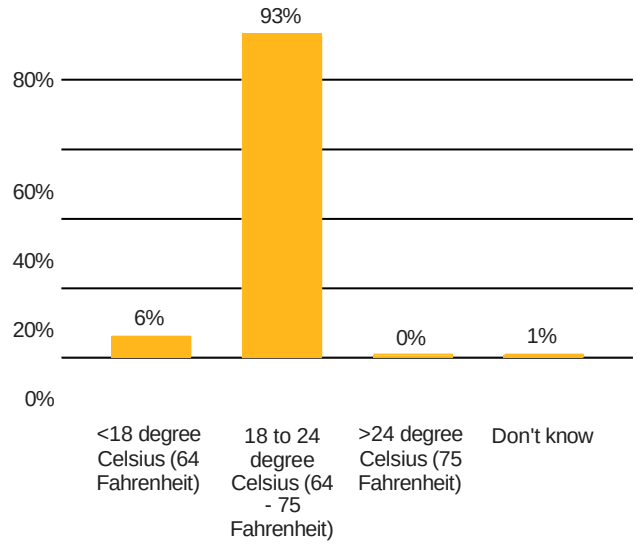
No upgrades in last 12 months

None in last 12 months

Energy Use Behaviours

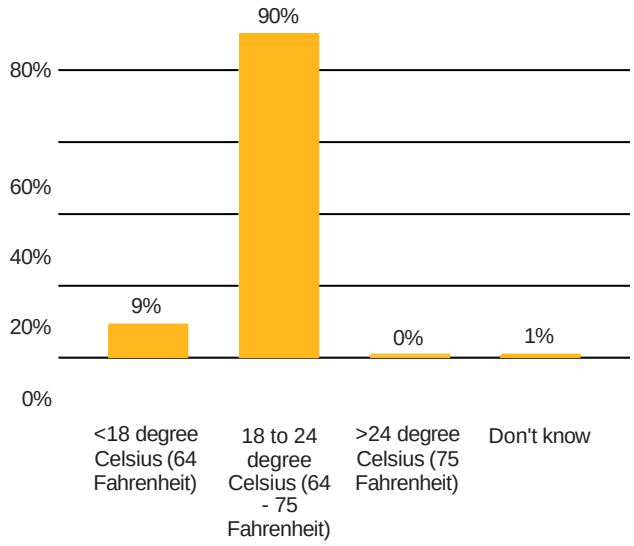
At what temperature range do you typically set your thermostat?

163 Responses



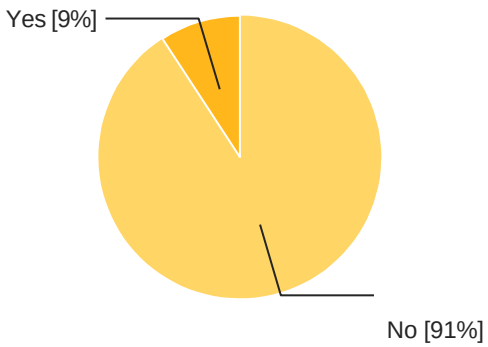
At what temperature range is the thermostat currently set at?

163 Responses



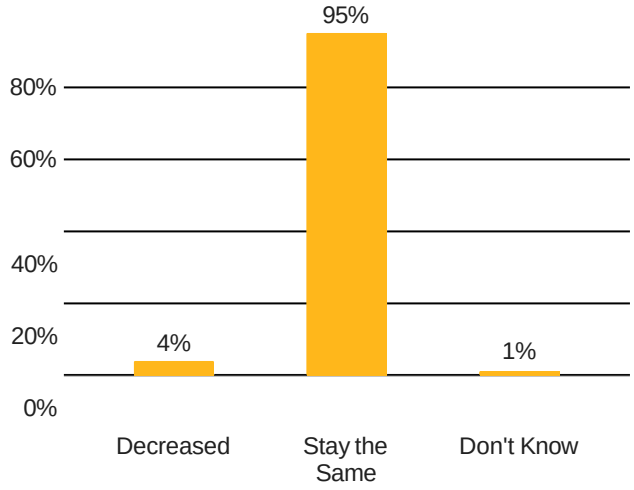
After the heat pump installation, have you changed the thermostat set-point temperature?

152 Responses



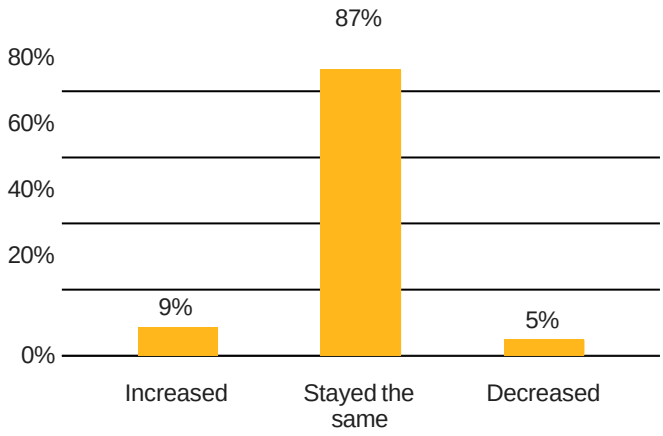
Temperature Setting

163 Responses



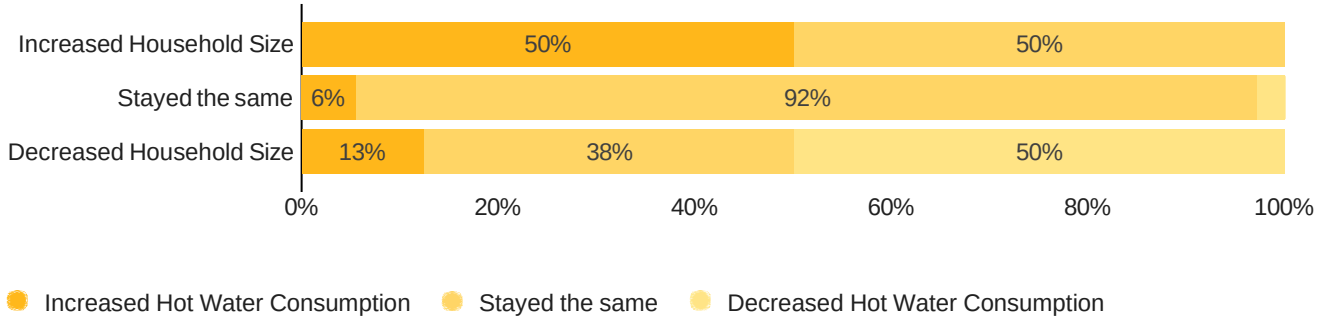
Within the past year, has the hot water consumption patterns of your home changed?

163 Responses



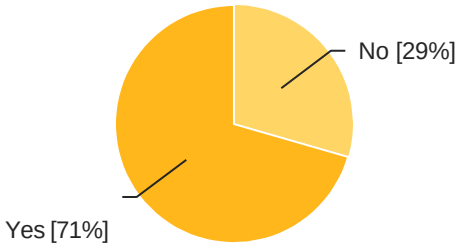
Within the past year, has the hot water consumption patterns of your home changed? This might be due to a change in occupancy, behaviour or other factors.

163 Responses



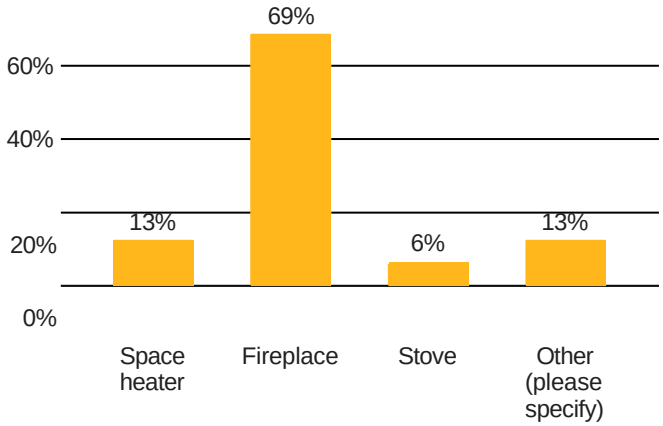
Is the hybrid heating system (furnace and heat pump) the only heating system for the home?

163 Responses



What other heating system do you use for the home?

48 Responses



Other Heating System (please specify)

6 Responses

Other (please specify)
We don't really use the fireplaces (two gas) but they are available if we needed to.
Furnace
Furnace
Second gas furnace
All three
radiant floor heating for an addition

Clean Home Heating Initiative Phase II

Year 2 Report

August 2024

ENBRIDGE
Life Takes Energy

Table of Contents

Background and Intended Project Goals

The Clean Home Heating Initiative was a collaborative program delivered by Enbridge Gas and the Government of Ontario (GOO). The Initiative provided incentives to homeowners who installed an electric air source heat pump and smart controls to pair with a new or existing natural gas furnace (thus creating a hybrid heating system). Eligible heat pumps for this Initiative included both standard Energy Star air source heat pumps (referred to herein as ASHP) as well as cold climate air source heat pumps (referred to herein as ccASHP).

The Initiative was funded by the Government of Ontario and was offered in select communities across the province. This report discusses the results of Phase II of this Initiative, which took place from April 2023 until February 2024. Phase II served as an expansion to both the Hybrid Heating pilot that was completed in London, Ontario in 2021 as well as Phase I of the Initiative which ended in the spring of 2023.

Eight communities were eligible in Phase II including London, Peterborough, Sault Ste. Marie, St. Catharine's, Barrie, Whitby, Pickering, and Ajax. This Phase was an up to $5,486,375 allocation that included a target of up to 1025 homes (participants). An estimated 154 homes were projected to receive an Energy Star air source heat pump, and 871 homes were projected to receive a cold climate air source heat pump.

The Initiative's primary goal was to support the GOO's plan to strike the right balance between energy affordability and emission reductions. Hybrid heating with smart controls decreases the consumption of natural gas while managing a homeowner's energy spend. Driving the adoption of hybrid heating technology would also achieve additional objectives. Firstly, it would assist with building market readiness and diversifying the supply chain for scaling up low-carbon heating options in Ontario. In turn, this could support Ontario's economy by creating jobs and building capacity in the skilled trades, including the province's Heating, Ventilation, and Air Conditioning (HVAC) industry, and local Ontario-based suppliers. The Initiative would also provide key learnings and could inform decisions on offering similar programs more broadly in the future. Specific objectives of the Initiative include:

- Diversify market offerings with smart controls;
- Build capacity with HVAC manufacturers and contractors to sell, install, and service hybrid heating systems with smart controls;
- Build support for, and awareness about the benefits of hybrid heating systems

Performance Metrics and Results

The table below compares the assigned targets for Phase II of the Initiative to the overall results. The comments section provides Enbridge's insights on the overall impact/effectiveness in achieving these results.

Metric/Target	Results	Comments (Impact/Effectiveness)
Install hybrid heating with smart controls in 1025 existing homes across the 8 participating regions. **The expected breakdown by unit type is:** • **154 ASHP installations** • **871 ccASHP installations**	1007 customers participated and installed hybrid heating systems with smart controls in their homes. The actual breakdown of these installations by unit type was: • 7 ASHP installations • 1000 ccASHP installations	Phase II was launched with the goal of achieving 1025 installations. To adjust for a greater uptake of ccASHPs than originally projected (and the higher incentive value of these units), the overall target was adjusted down to 1000 units. Later, due to high interest in the program, budget adjustments were made to accommodate more participants, ending with 1007 installations in total. Considering these necessary target adjustments, Enbridge exceeded its installation target. Furthermore, the Initiative saw an uptake of heat pumps in all eight communities. When compared to Phase I, the number of installations more than doubled (Phase I achieved 488 installations). While this can be attributed to several factors, these results show that customers in various areas of the province are continuing to look to hybrid technology to support their home heating needs. Across all regions, the market was very receptive to ccASHP technology, with cold climate units making up 99.3% of sales in the program. This was consistent with behavior seen in Phase I, where the uptake of cold climate units was about 95%.
Build capacity with HVAC contractors to sell, install, and service hybrid heating systems with smart controls.	• 8 HVAC Manufacturers participated • 47 new HVAC contractors were trained and onboarded. Note that 26 existing Phase I contractors also continued their participation in the program. This brings the total Phase II contractor base to 73 contractors	Enbridge offered 19 training sessions in total throughout the duration of Phase II. This included mandatory training sessions for new contractors as well as some re-training for existing contractors who continued their participation in the program from Phase I. 18 of the sessions were core Initiative trainings that covered the 3 mandatory training topics; Hybrid Heating Awareness and Technical Training, Smart Controls, and the DropZone application portal training. An additional training session was delivered in partnership with NRCan's

Metric/Target	Results	Comments (Impact/Effectiveness)

		Local Energy Efficiency Partnerships (LEEP) team. This session expanded on the Initiative's core trainings and strove to provide a more in-depth session on the topics of sizing, selection, and integrated controls. The event also included an industry panel to discuss the optimization of heat pump performance.
		
		Overall, contractors found the training content valuable. This was validated through a post-training survey that was conducted after one of the Initiative's core technical training sessions. The findings from the survey are summarized below:
		
		• There were 57 respondents that completed the survey
		• All respondents felt the training was either good, very good or excellent
		• Most respondents felt that all aspects of the training were useful (program details, heat pump technical information, NRCan sizing & selection, and sales benefits to homeowners)
		• Some respondents provided some areas for improvement which included:
		  ○ Spending additional time on sizing and selection & technical information
		  ○ Having a longer period for questions at the end of the sessions
		• All respondents felt that they were more comfortable discussing hybrid heating with customers after the training
		
		The LEEP event also garnered lots of interest and had 57 attendees. This shows the increasing desire amongst the Clean Home Heating Initiative contractor base to learn more and increase their skillset to improve the quality of heat pump installations. The above results, including the strong participation from

Metric/Target	Results	Comments (Impact/Effectiveness)
		manufacturers and contractors from across the regions, shows that Enbridge was effective in achieving this target.
Build support for, and awareness about the benefits of hybrid heating systems	Enbridge's marketing strategy consisted of a diversified portfolio of tactics. This included digital campaigns, social media and radio advertisements, as well as personalized tactics like direct mail and e-mail blasts. The content educated homeowners on hybrid heating technology, smart controls, and their benefits. The dedicated program email continued to operate to field questions from contractors and customers about the program. This email was heavily monitored to ensure a quick turnaround to program inquiries. Enbridge communicated with contractors and manufacturers consistently to ensure successful delivery of the Initiative. Enhanced collaboration and partnerships with external parties, such as LDCs and municipalities, were achieved throughout Phase II. Key results of Enbridge's marketing efforts in Phase II are summarized below: • Digital and social campaigns leveraged platforms such as Google Search, Facebook, Instagram, YouTube, and Enbridge Gas social media channels. The digital campaign delivered over 13 million impressions with 255,507 total clicks to the program webpage (note that impressions are the number of times an ad is displayed or seen) • Enbridge delivered 3 email campaigns over the course of Phase II. The average open rate	The marketing results display the vast reach that Enbridge was able to achieve throughout the course of Phase II. Successful results in comparison to industry averages show that customers were engaging with this content. Contractors and manufacturers were well supported with consistent communication and timely response to their inquiries. Enbridge also created a strong network of external partners to support the Initiative. The cross promotion that Enbridge was able to achieve, in particular with the municipalities, is a testament to the support received throughout Phase II.

Metric/Target	Results	Comments (Impact/Effectiveness)
	across these campaigns was 39.87%, which greatly exceeded the industry average of 21.33%. The click through rate of the campaigns was 4.61% and also exceeded the industry average (which is 2.62%). • Direct mail letters were delivered to over 20,000 customers in 4 of the communities • Enbridge secured meetings with 3 LDCs on the topic of cross promotion • Initiative brochures were handed out at 5 different community events across the participating regions • Information about the Initiative was posted to two community webpages • 3 participating communities posted ads and/or social media content promoting the Initiative	
Diversify market offerings with smart controls	Two smart controllers were approved for use in Phase II. The smart control manufacturers (BKR Energy and Napoleon) delivered the mandatory controls training sessions for new contractors. The training sessions educated contractors on the unique benefits of smart controls in hybrid heating applications. It also covered proper implementation of the controls, including installation and commissioning.	Prior to participating in the Initiative, contractors were most familiar with proprietary controllers (from various heat pump manufacturers) or other widely adopted thermostats in the market (nest, ecobee etc). Mandating the use of smart controls in the Initiative and delivering the necessary training provided contractors with learnings that they may have not acquired otherwise. This enhanced their knowledge of different control capabilities for hybrid heating applications. Moving

Metric/Target	Results	Comments (Impact/Effectiveness)
		forward, contractors can apply this knowledge to provide their customers with more choices when it comes to hybrid heating controls. Enbridge marketing materials also included information on smart controls. This included consumer-friendly descriptions of how the technology works and how it is integrated with the hybrid system. The marketing content, in addition to the contractor training, garnered more exposure for this type of control in the market. As a result, Enbridge feels it was effective in achieving this target.

Rationale for Variances in Projected Results

While Phase II was successful in achieving its objectives, there were variances between the actual results and what was originally projected. This was the result of specific market conditions including a higher-than-expected uptake of ccASHPs as well as varying regional heat pump sales. Enbridge adjusted heat pump targets and re-allocated the budget in order to respond to these market conditions while maximizing participation in the Initiative.

With approval from the Province, the overall heat pump target for Phase II was adjusted down from 1025 units to 1000 units. The Initiative's budget was originally structured by allocating certain amounts to various budget categories (such as incentives, project delivery costs, salaries, and measurement and verification). The amounts assigned to each category were based on best estimates using Phase I insights and other market information. For example, the incentive portion of the budget was based on estimates that a certain number of ASHPs and ccASHPs units would be achieved. The original estimated breakdown by unit type was 154 ASHP installations and 871 ccASHP installations. Over the course of Phase II, the number of cold climate units began to surpass the original forecasted amount. The higher incentives offered for ccASHPs and the improved performance of these units in colder temperatures were key selling features that contributed to their success. To accommodate this greater uptake, the Initiative's overall target was adjusted down. Despite this reduced target, Enbridge continued to monitor and optimize the spend across various other budget categories (such as program delivery) to maximize participation in the program. In the end, the team was able to accommodate a total of 1007 heat pump installations.

Phase II also launched with a specific allotment of heat pumps per community. As the program progressed, the demand for heat pumps was far greater in certain communities compared to others, which was reflected in their sales. To ensure the program would be successful in achieving its overall target, it was decided that communities would be allowed to exceed their original forecast of heat pumps. The program was operated on a first come first served basis to ensure fairness.

Summary of Challenges

The table below identifies the challenges faced during Phase II of the Clean Home Heating Initiative.

Challenge	Description	Effect
Competing Programs	Based on market insights, programs like Canada Greener Homes Grant (HER+) were very enticing to contractors and their customers due to the higher heat pump incentive offered. The presence of multiple heat pump incentive programs in the market also created some confusion amongst customers. This created further sales challenges. A customer survey conducted by Enbridge in September validated these findings. The survey targeted customers who had filled out their information on the Initiative's website intake form but had not yet registered for the program. The goal was to obtain feedback on their experience, including what may have prevented them from participating in the Initiative thus far. In total, 374 responses were received from the survey. Many responses referenced requirements of other programs which showed that customers were not always clear of the distinction between programs and what program they were participating in.	Certain contractors in the program provided limited contributions as they focused their attention on other incentive offers. While overall targets were still achieved, program progress could have been enhanced with consistent contributions from all contractors. Additionally, customer confusion between the various programs could have inhibited sales progress throughout the Initiative. Customers may not have realized the different and unique benefits offered by the Clean Home Heating Initiative compared to other programs. Enbridge worked throughout the program to reiterate the differences between the CHHI and other incentive programs to the contractor base and through marketing efforts.
Economic Conditions	Challenging economic conditions, such as inflation, pose challenges for customers. This is especially true when it comes to investing in newer technologies such as heat pumps. In the customer survey mentioned above, a number of customers highlighted cost as a barrier to participation. In addition to customers feeling that the technology was too expensive, customers also suggested that they would like to be made aware of the average price points of installations so that they can make informed decisions and ensure that contractors are providing fair pricing.	These economic challenges could have prevented potential sales in the program. Customers may not have wanted to provide the upfront capital to install new HVAC equipment, especially if the technology is less familiar to them. To try to mitigate economic effects in the program, HVAC contractors were encouraged to utilize their financing tools, where applicable, as well as capitalize on their respective manufacturer's incentives to mitigate costs for customers.
Consumer Education	Since heat pump technology remains newer to the Ontario market, the need for customer education continues. Consumers are more comfortable with investing in technology that is familiar to them and where they understand the outcomes.	Throughout Phase II, Enbridge continuously brainstormed ways to improve our marketing materials and enhance customer knowledge. Several new marketing tactics were also implemented in attempts to expand our customer reach. Customers who did not engage with the content or who were looking for even more information and market feedback may not have participated in the program.
Smart Controls	Throughout Phase II, there remained contractor push back with regards to installing the program's	The natural learning curve associated with understanding and applying a new control method may

Challenge	Description	Effect
	prescribed smart controllers. Contractors are most comfortable with installing specific types of controllers based on the equipment they carry. Additionally, they feel their sales and installation processes are most effective when they install equipment that they are highly familiar with.	have prevented some contractors from contributing to the program. Enbridge worked closely with the smart controls providers to fill in any gaps and make installations as easy as possible for contractors.
Supply Chain	Several manufacturers in the program experienced distribution issues at various points throughout Phase II.	During these times, affected contractors experienced reductions in available product to sell to their eligible customer base, thereby limiting their sales progress.

Added or Modified Tasks

Aside from the budget and target adjustments discussed above, minor modifications were made to several other program items.

The first modification pertains to the measurement and verification work. In Phase I, the M&V analysis required the deployment of two participant surveys. The first survey was used as a marketing survey for participant feedback and to get information on their energy usage patterns leading up to the heat pump installation. The second survey was designed to identify usage patterns or household changes after the installation of the heat pump. The information would be used to sort participants into various categories depending on whether the energy changes shown in their usage data can be primarily attributed to the heat pump or not. However, it was decided that deploying multiple surveys could be inconvenient for participants and has increased potential to yield poor response rates. Many of the questions could be re-purposed so that sufficient data for the M&V study could be collected through a single survey. Therefore, the Phase II M&V work will contain only one survey that will be released for participant completion closer to the spring of 2025.

Additionally, a minor modification was also made to the detailed progress report. The original template provided for the progress report included a column titled “New Furnace installed with ASHP (YES/NO)”. This heading was changed to “Install Type” due to how the information is captured in the application portal. The “Install Type” field is pulled directly from the portal and identifies whether the job was a heat pump only installation or a furnace and heat pump installation, thereby tracking the same information.

Participant Feedback

Participant feedback will be collected during the deployment of the M&V survey (aimed for spring of 2025). A section of questions on this survey will be attributed to collecting feedback regarding the Initiative. The responses can be shared with the Province at that time.

Lessons Learned

Phase II continued to provide great insights and learnings regarding the hybrid heating landscape. Some of the key lessons learned from the Initiative are summarized in the table below.

Topic	Lessons Learned
Contractor Training	• Contractors appreciate and are seeking out additional learning opportunities with respect to heat pumps • Further training on heat pump sizing and selection training remains an area of interest for contractors and industry • Moving forward, continued heat pump training in the market is necessary
Customer Marketing	• Focus should be given on the timing of customer education. If customers are pre-educated on the benefits of heat pumps before replacing their current system, it could improve the chances of customers converting to a heat pump. In terms of implementation, this could mean deploying marketing materials and resources ahead of official program start dates • Heat pump educational materials for customers should continue to be enhanced. Developing further technical resources for customers could help reduce homeowner hesitation with regards to trying new technology (this could include guidance on what to discuss with their contractor, real life installation examples etc.)
External Collaboration and Partnerships	• Engaging with relevant third parties for collaboration (such as municipalities, LDCs) can increase the marketing reach and strengthen partnerships • Collaboration with electrical LDCs proved more difficult in terms of arranging cross promotion of heat pumps
Time Period of Offer	• In the previous Phase of the Initiative (Phase I), one of the biggest challenges identified was the time period for which the Initiative was offered. Phase I was mainly offered during the wintertime. However, cold weather months create challenging conditions, such as cold/snow/ice, for effectively installing systems. Based on the success of Phase II (whose installation numbers more than doubled those achieved in Phase I), it's clear that aligning the offer with the prime summer selling season is a contributing factor to overall program success.
Smart Controls	• Mandating specific controllers continued to generate push back from contractors • Development of in-field training and more robust troubleshooting guides could be beneficial in future programs that may mandate smart controls
Application Portal Modifications	• It is important to ensure that online software for contractor-delivered programs is user friendly. Portal updates were made prior to the Phase II launch, as well as throughout the course of the Initiative, to increase the ease of use of the portal for contractors. This also included enhancing our step-by-step training guides

Topic	Lessons Learned
ccASHP vs ASHP	• Market demand for cold climate air source heat pump technology continued to be greater than that for standard Energy Star air source heat pumps

Required Next Steps

There are several remaining activities to complete to meet the commitments of Phase II of the Initiative. These activities are listed in the table below.

Date	Activity
September 30th 2025	Draft M&V Report to be provided to the Government of Ontario
November 28th 2025	Final M&V Report to be provided to the Government of Ontario

In addition to the remaining deliverables above, the key findings and lessons from the Clean Home Heating Initiative can be used to inform future program offers and broader carbon reductions strategies.

Co-Benefits:

Two additional co-benefits that the Initiative supported can be summarized as accessibility and collaborative partnerships.

The Initiative supported an increase in the accessibility of this technology in the marketplace by working alongside a strong base of manufacturers and contractors in eligible communities. Offering HVAC contractor training and participant incentives helped to stress the need for the HVAC community to become well versed in heat pumps and hybrid heating technology. It also encouraged the manufacturers to put additional internal support in place so that their contractors can deliver this technology effectively to homeowners. The program webpage helped to connect homeowners to contractors that could deliver this technology for them.

The Initiative also built a wide network of collaborative partners. Relationships were developed with various parties from across the industry, such as contractors, manufacturers, training partners, LDCs, and municipalities. These relationships set important groundwork for implementing future carbon reductions strategies. Collaboration across the industry promotes consistency and action.

Average Costing

At the launch of Phase II, the Initiative's application portal was updated to facilitate the capture of additional cost information. This cost information was extracted from the portal and analyzed, with the results shown in the table below. Please note that the below should only be considered as high-level costing figures. This is because the quality of the information extracted from the portal is dependent on the quality and accuracy of the information provided by the contractors. Attempts were made by Enbridge to scrub the data of obvious errors in the provided information and remove these from the analysis, although this is not a perfect exercise.

The analysis did not break down cost figures based on the type of heat pump. This is due to the fact that there were a very limited number of ASHP installations in the program (<1% of overall installations), and cost figures for this category would likely not be indicative of a true average. It is also important to note that certain contractors had higher participation levels in the Initiative compared to others, which would have an impact on the results.

Install Type	Heat Pump Tonnage	Average Installed Cost (excl HST)
Heat Pump Only	**1.5**	$8,906
	2 - 3	$9,326
	4 - 5	$11,165
Heat Pump + Furnace	**1.5**	$14,225
	2 - 3	$14,804
	4 - 5	$17,205

Item	2023/2024			
	March Actuals + Accruals	March Invoiced (80%)	March – August Actuals	August True-Up
Participant-Related Costs				
Air Source Heat Pump Incentives				
Sault Ste Marie	$0	$0	$0	$0
London	$3,000	$2,400	$3,000	$600
Peterborough	$0	$0	$0	$0
St. Catharines	$0	$0	$0	$0
Barrie	$0	$0	$0	$0
Pickering/Ajax/Whitby	$0	$0	$0	$0
Cold Climate Air Source Heat Pump Incentives				
Sault Ste Marie	$54,000	$43,200	$54,000	$10,800
London	$369,000	$295,200	$364,500	$69,300
Peterborough	$76,500	$61,200	$76,500	$15,300
St. Catharines	$49,500	$39,600	$49,500	$9,900
Barrie	$76,500	$61,200	$76,500	$15,300
Pickering/Ajax/Whitby	$279,000	$223,200	$283,500	$60,300
Sub-Total Participant Related Costs:	**$907,500**	**$726,000**	**$907,500**	**$181,500**
Project Delivery Costs				
Contractor Product and Sales Training	$8,535	$6,828	$8,535	$1,707
System Enhancements	$0	$0	$0	$0
Marketing Costs*	$9,697.18	$7,757.74	$9,490.95	$1,733.21
Sub-Total Project Delivery Costs:	**$18,232.18**	**$14,585.74**	**$18,025.95**	**$3,440.21**
Measurement and Verification				
Measurement and Verification	$13,044	$10,435.20	$13,044	$2,608.80
O&M Salaries – Fully Allocated Costs				
O&M Salaries	$48,298.74	$38,639.00	$48,298.74	$9,659.74
Project Total:	**$987,074.92**	**$789,659.94**	**$986,868.69**	**$197,208.75**

The marketing amounts included a charge to replace a customer's malfunctioning BKR thermostat

Municipal Overview

Participant	2023-2024	
	March – August Actuals	Final YTD Project Actuals
Air Source Heat Pump		
Sault Ste Marie	-	-
London	1	2
Peterborough	-	-
St. Catharines	-	2
Barrie	-	-
Pickering/Ajax/Whitby	-	3
Cold Climate Air Source Heat Pump		
Sault Ste Marie	12	55
London	81	458
Peterborough	17	67
St. Catharines	11	69
Barrie	17	77
Pickering/Ajax/Whitby	63	274
Cumulative Total	**202**	**1007**

Detailed Progress Report

Please see the below link to access the detailed progress report. This report encompasses all projects completed under Phase II.

Detailed Progress Report - Year 2 Report.xlsx

M&V Overview Report

Please find the M&V Overview report attached in the Year 2 report email communication.

Clean Home Heating Initiative Phase 2

Measurement and Verification Overview

Prepared By: The Sustainable Technologies Evaluation Program (STEP) of the Toronto and Region Conservation Authority (TRCA)

August 2024

Contact Information:

Prepared by: Erik Janssen, CMVP; Research Scientist, STEP/TRCA erik.janssen@trca.ca
Reviewed by: Doris Choi CMVP-IT; Analyst, STEP/TRCA doris.choi@trca.ca

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Acronyms

- **ASHP:** air-source heat pump
- **CMVP**: Certified Measurement and Verification Professional
- **EEM**: energy efficiency measure
- **HDDs**: Heating degree days
- **IPMVP**: International Performance Measurement and Verification Protocol
- **M&V**: measurement and verification
- **TOU**: time-of-use

1 Introduction to IPMVP

Measurement and verification (M&V) describes the *"...process of planning, measuring, collecting and analyzing data to verify and report energy savings within a facility or facilities resulting from the implementation of energy efficiency measures (EEMs)."* [1]

The energy savings associated with an EEM are not directly measurable. Energy savings are the difference between the actual post-EEM energy consumption and the energy consumption that *would have occurred* had the EEM not been implemented. This necessarily means that savings is an estimate because the calculation procedure needs to make assumptions about something that did not actually happen. The framework within which these assumptions are made is described in the International Performance Measurement and Verification Protocol (IPMVP).

This framework was developed by the Efficiency Valuation Organization (EVO) in the 1990s. Since then, it has received international recognition and is the most widely used M&V protocol by facility energy managers, project developers, energy service companies (ESCOs), non-governmental organizations (NGOs), finance firms, government, and consultants. It is the primary M&V protocol used by the Independent Electricity System Operator (IESO) and is the basis of the Certified Energy Manager (CEM) and Certified Measurement and Verification Professional (CMVP) designations.

Within the IPMVP, energy savings is determined by comparing energy usage after an EEM has been implemented (this period of time is termed the reporting period) against baseline energy use prior to the retrofit (termed the baseline period) that has been adjusted to the reporting period conditions (Figure 1).[2] An additional adjustment term may add a further correction to make both the baseline and reporting periods truly comparable. This ensures that the calculated savings are a result of the EEM rather than other factors that may have affected energy usage.

Adjustments of baseline or reporting period energy data from one set of conditions to another is based on regression analysis. A suitable mathematical model is developed that describes the measured energy consumption as a function of one or more independent energy influencing variables. With a baseline energy model, it is possible to calculate the baseline energy consumption *that would have occurred* under the reporting period conditions. This would then be compared against the actual reporting period energy consumption to determine savings.

[1] Efficiency Valuation Organization. Core Concepts: International Performance Measurement and Verification Protocol. 2022.

[2] It is also possible to project the reporting period energy consumption to baseline conditions or, even project both the baseline and reporting period to a set of standard conditions.

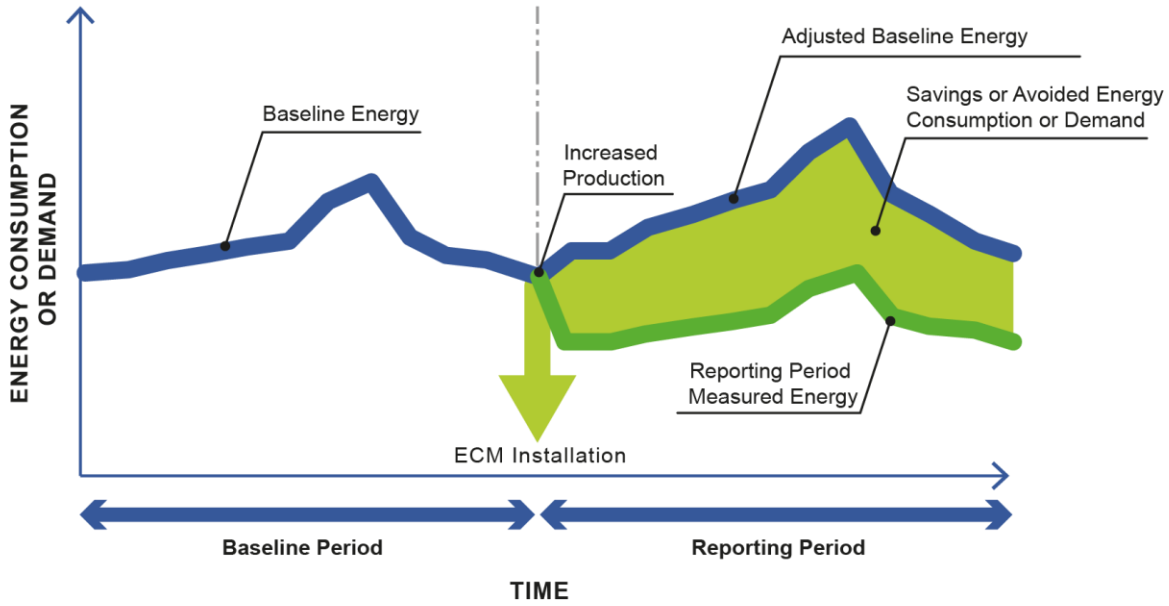

Figure 1. Baseline energy consumption data is projected to reporting period conditions to calculate the energy savings. Image from EVO.

Since the constraints on different M&V initiatives will vary, the IPMVP provides four different options. Different options may be selected depending primarily on the resources available for the evaluation and the EEM being studied, but in all cases, reporting period energy usage is compared against a baseline and the M&V is based on actual measurements.

This document is an M&V Overview rather than an IPMVP-adherent M&V Plan. This is because an M&V Plan has defined requirements within the IPMVP, specifically, it requires both the baseline data and the baseline regression models. Due to the timelines of the reporting schedule, the baseline data could not be collected and analyzed in time for the submission of this document. This M&V Overview will follow the format of an IPMVP-adherent M&V Plan insofar as is possible.

2 Project Overview

With funding support from the Government of Ontario, The Clean Home Heating Initiative (CHHI) Phase 2 was delivered by Enbridge Gas and offered an incentive to homeowners in select Ontario communities for the installation of smart hybrid heating systems. The Clean Home Heating Initiative was preceded by the CHHI Phase 1 and the successful 100 home smart hybrid heating pilot in London, Ontario.

These systems pair an air-source heat pump (ASHP) with a forced-air natural gas furnace. The ASHP replaces an air-conditioner and provides all the cooling needs for a home. It is also able to provide heating and is typically able to manage a portion of the annual heating load for the home. This can reduce home energy consumption, carbon emissions, and operating costs for the homeowner.

Smart hybrid heating systems utilize a web-enabled smart controller that selects either the ASHP or the furnace for home heating based on whichever is expected to be the lowest cost, given factors like time-of-use (TOU) electricity rates, natural gas costs, outdoor temperature, ASHP efficiency and furnace efficiency.

Phase I of CHHI was launched in the market in September of 2022 in Peterborough, London, St. Catharines, and Sault Ste Marie. At the conclusion of Phase 1 in March of 2023 there were approximately 500 customers that participated in the program. In 2023, The Government of Ontario supported the launch CHHI Phase 2 which expanded the Initiative into 4 new communities including Ajax, Barrie, Pickering, and Whitby. Phase 2 achieved 1007 participants.

This M&V covers Phase 2 with Phase 1 having been analyzed separately.

3 EEM Intent

ASHPs have efficiencies of up to 200-300% depending on unit type as well as outdoor air temperature, and are much more efficient than some of the baseline technologies which include electric resistance and furnace heating. Even though, in Ontario, electricity can be more costly than natural gas per unit of energy, the high efficiency of an ASHP can allow it to be the lower cost option for much of the year. This is typically the case in non-peak time-of-use (TOU) brackets and/or in milder outdoor temperatures.

As per the IESO's Year End Data for 2023[3], ~73% of the Energy Output in Ontario was derived primarily from low-carbon sources, mainly through nuclear and hydro as well as wind and a small amount of solar. Natural gas generated electricity was 27% of the mix, a large jump from 10% in 2022. Regardless, ASHPs can still reduce home carbon emissions because the energy source is lower carbon, and less energy is used overall due to their higher efficiency. It follows that the intent of the ASHP retrofits is to reduce home energy consumption, utility costs, and carbon emissions. The extent of the savings depends on many factors including:[4]

- the relative cost of electricity and natural gas (which fluctuates, particularly owing to variations in the natural gas rates, and also to new electricity rate structures);
- homeowner temperature setpoints;
- climate heating degree days;
- year-to-year variations in weather;
- the efficiency and cold-temperature capacity of the heat pump that was selected; and
- the relative sizing of the heat pump with respect to the home heating load.

Based on analysis from installations in Southern Ontario, it is expected that savings in the low hundreds of dollars may be feasible for many homes, with the ASHP typically handling a portion of the annual heating load. Given this analysis is being completed on installations in eight diverse areas in Ontario, it will support better clarity on performance of hybrid systems with smart controls in different weather zones.

This analysis will only look to review savings and GHG emission reductions for the timeframe of the M&V analysis. This is due to uncertainty with future utility rates and electricity marginal emissions factor.

[3] IESO 2023 Year in Review: https://www.ieso.ca/en/Corporate-IESO/Media/Year-End-Data#:~:text=Ontario%20electricity%20demand%20reflects%20a,coming%20out%20of%20the%20pandemic.

[4] The carbon reductions are also impacted by the assumptions of the analysis. Marginal emissions factor will be utilized as part of this analysis from IESO's current Annual Planning Outlook.

4 Selected IPMVP Option and Measurement Boundary

4.1 IPMVP Option Used to Determine Savings

This M&V will use Option C - Whole Facility according to IPMVP 2022. Option C will be used in homes that participated in Phase 2 of the program. Surveys will be sent to participants and their utility data will also be collected. Analysis of survey data and utility data will sort participants into different groups based on confidence in the savings estimate.

4.2 Measurement Boundary

The existing electricity and natural gas utility meters encompass the full energy consumption of each home. The measurement boundary is therefore the full home for each home considered. Interactive effects (where energy may be saved within the measurement boundary, but then also increases or decreases outside of it) are not anticipated.[5]

[5] An example of an interactive effects is an LED lighting retrofit that increases the heat load (because internal heat gains are reduced) and similarly, decreases the cooling load.

5 Baseline: Period, Usage and Conditions

5.1 Identification of the Baseline Period

The baseline period will encompass utility bill data from at least 1 year prior to the retrofit.

5.2 Baseline Utility Consumption Data

The baseline natural gas and electricity consumption has not yet been analyzed. It will be collected directly from the utilities, with homeowners having signed data-sharing agreements as a condition for participating in the program.

Natural gas utility meters are typically read bi-monthly, resulting in at least 6 data points for the baseline model (given that at least one year of baseline data will be collected). Fewer readings are possible as well. Some level of missing meter readings is permissible as baseline natural gas consumption is typically highly linear with heating degree days. However, homes with very few actual meter readings may need to be excluded from the analysis due to insufficient data. The rationale for excluding homes from the analysis will be provided in the final report since it is subject to review of the quality of the baseline models.

The typical relationship between natural gas consumption and heating degree days is shown for an example home (from previous work) below in Figure 2. The y-intercept represents the gas usage for non-temperature dependent sources (hot water as well as potentially the dryer and stove) and the HDD temperature-dependence is from the furnace consumption. As it gets colder, HDDs increase, and more gas is consumed.

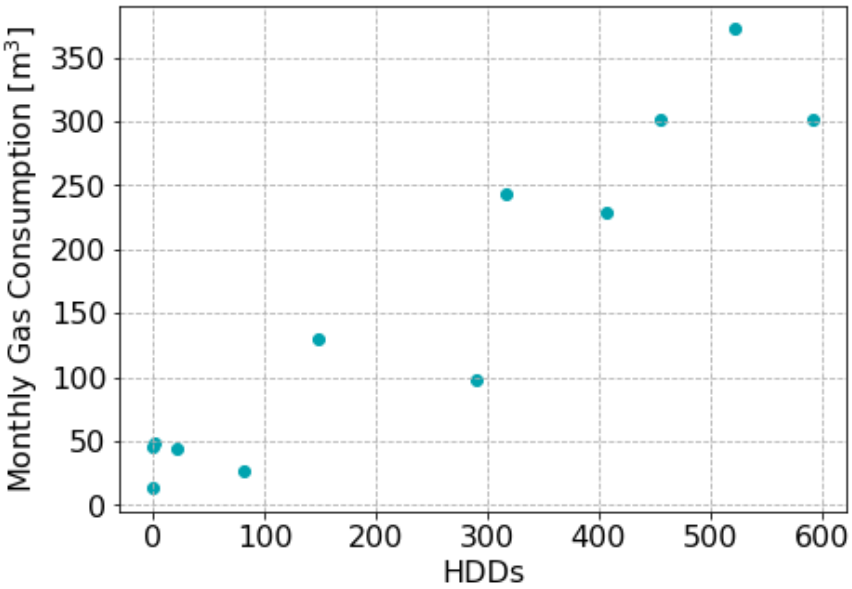

Figure 2. Example home gas consumption data from a previous project that illustrates the linear relationship between gas consumption and HDDs.

Electricity will be collected on an hourly basis when feasible and will be aggregated to higher timescales (likely monthly) for the energy savings analysis. The hourly data is needed for the electricity demand analysis. The homeowners are not charged based on maximum electricity demand but it is nonetheless an important variable for understanding the grid impacts of ASHPs. To determine the demand increase, the maximum electricity consumption for a 1-hour period in each month will be determined and then used to define a maximum electricity demand model.

To determine overall energy savings, the M&V only needs to evaluate the changes in total electricity and gas consumption. However, to determine the cost savings, it must also estimate the change in electricity reduction in each time-of-use bracket. This will likely involve creating separate linear regressions models for monthly electricity consumption in each TOU bracket, and separating the weekend TOU bracket from the weekday off-peak bracket since they cover different time periods of the day. The approach for aggregating the baseline data will be finalized once the data is received and reviewed.

5.3 Utility Influencing Variable Data

The primary independent variable influencing energy consumption is the outdoor temperature. In this M&V, outdoor temperature will be accounted for using heating degree days. Outdoor temperature data will be collected from the nearest Environment and Climate Change Canada weather station accessed through the weatherstats.ca portal.

5.4 Operating Conditions

The operating conditions of the home will be assessed using a survey of program participants. This survey will be sent out near the end of the study period (i.e.1 year post retrofit). One aim of the survey is to identify homes that are unlikely to require large non-routine adjustments within the M&V. These homes will be initially grouped within the M&V as having high confidence in the savings estimates (explained below).

Non-routine adjustments incorporate other energy influencing factors in the M&V that are not accounted for by routine adjustments based on an energy influencing variables like heating degree days. There are many factors in a home that may require non-routine adjustments, for example, a change in occupancy, an addition, other concurrent energy retrofits alongside the heat pump, new large loads (like an electric vehicle, sauna, hot tub, fireplace, and similar), etc. M&V must take these into account because they may otherwise (incorrectly) reduce or increase the results of the savings calculation for reasons unrelated to the hybrid heating system.

To be able to estimate hybrid system energy savings as accurately as possible, it is ideal if the implementation of the hybrid system is the only significant energy-influencing factor that changes between the baseline period and the reporting period (aside from that which can be accounted for with routine adjustments due to changes in weather). Quantitatively accounting for *non-routine* factors on a home-by-home basis would be onerous. Rather, the M&V will seek to group together homes based on the level of non-routine adjustments that is required.

Based on the surveys, the analysis will examine the following.

- Other energy efficiency measures that were implemented;
- Changes in occupancy;
- Changes to thermostat setpoints (will not impact how a home is categorized);
- Reported changes to DHW consumption usage;
- Changes to the size of the home or heating load (additions to home; new or removed heating/cooling for an outbuilding);
- Changes to other large gas and electricity loads in the home (upgraded fridge, addition or removal of secondary fridge/freezer, new EV charger, new fireplace, removal of electric baseboards, etc.);
- The presence of large variable energy loads whose usage may be inconsistent. Examples of these loads would include a hot tub, an electric sauna, a pool heater, or an electric car.

Based on the homeowner responses, the analysis will group the homes into different categories. This is summarized below.

- Category 1 includes homes where there is a high confidence that the energy changes pre- and post-retrofit are due solely to the hybrid heating system rather than other changes.
- Category 2 includes homes where there were other changes to the energy consumption of the home. However, they are believed to be much smaller in scale than that from the hybrid system, and the primary energy usage changes are due to the hybrid heating system.
- Category 3 includes homes where there were other large changes to the energy consumption of the home that are unrelated to the hybrid system. In this category, it may be the case that the hybrid system is not the primary influencer of the energy changes that are observed.
- Category 4 homes include those where there is utility data sufficient to calculate energy savings and other metrics, but no survey data to place the home in Category 1, 2, or 3.

It is important to note that, in all of these homes, the *hybrid heating system installations may benefit all homes in the initiative.* The purpose of sorting homes into categories is only to identify those homes where *it is more feasible to calculate the savings* using the methods of IPMVP Option C, i.e. regression analysis of whole-home utility consumption.

After the final placement of candidate homes into each category, the baseline regression models will be used to project baseline energy consumption to reporting period conditions and savings will be determined. Results will be presented for each category and also aggregated according to location and other factors.

6 Reporting Period

The reporting period will encompass (at least) April 2024 to April 2025.

7 Basis for Adjustment

Savings will be reported as avoided energy (discussed in Section 8). Baseline energy consumption will be projected to reporting period conditions using the baseline models.

8 Calculation Methodology and Analysis Procedure

13.5 Baseline Consumption Models

The final IPMVP-adherent M&V report will fully define the baseline utility consumption data for each candidate home included in the M&V, and will also define the baseline regression model and statistics. As an example, the data shown in Figure 3 can be represented by the line defined in Equation 1 with a coefficient of determination (R^2) of 0.89. Note that Equation 1 is just an example linear regression model, and it does not represent any home included in the M&V. Statistical parameters outlined in the IPMVP, like the standard error, help to further define the overall quality of the model.

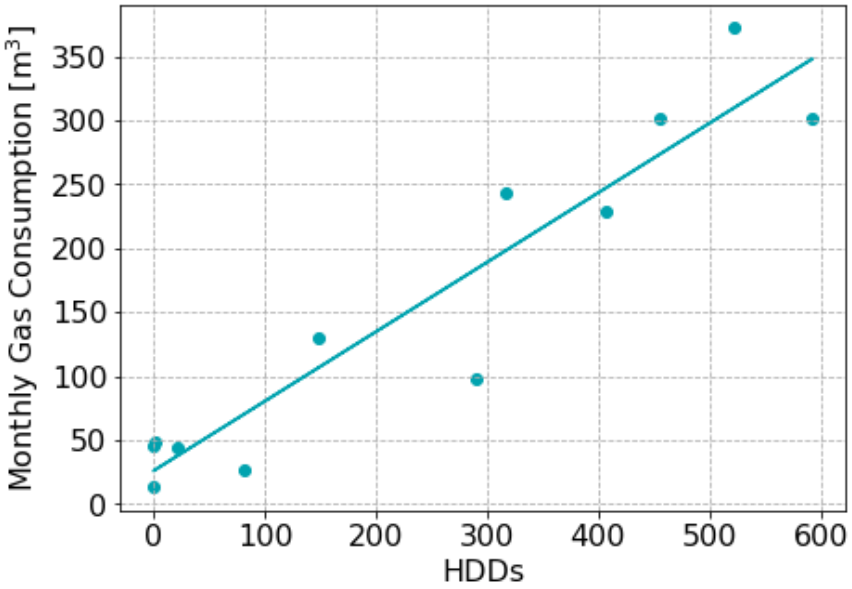

Figure 3. Baseline energy consumption can be represented using a linear regression model according to HDDs. The reporting period HDDs can be used in the baseline model to determine the projected baseline energy, against which the actual energy consumption can be compared.

$$Monthly\ Gas\ Consumption = (0.543\ \times HDDs) + 26.0 \qquad \text{Equation 1}$$

With a mathematical model of baseline gas consumption as a function of HDDs, it is then possible to determine the baseline energy consumption using the HDDs that occur for the reporting period. This allows for a fair “apples-to-apples” comparison against the actual energy consumption, with the savings being the difference in energy consumption between the projected baseline energy and the actual energy consumption. Baseline models will be determined both for the gas consumption and the electricity consumption, with the electricity consumption models (likely) to be further broken down according to TOU.

13.5 Avoided Energy Consumption

The avoided energy consumption will be calculated using Equation 2. Separate calculations will be done for gas and electricity, with electricity likely to be further broken down into TOU. In each case, baseline models will be projected to reporting period conditions using heating degree days. This is the “Adjusted Baseline Energy” term. The term for “Non-routine Adjustments” will be zero because the surveys will be used to identify candidate homes where non-routine adjustments are not required or are very small.

$$Avoided\ Energy\ Consumption = \begin{array}{c} Adjusted\ Baseline\ Energy \\ -Reporting\ Period\ Energy \\ \pm Non \\ -\ routine\ Adjustments\ to\ Reporting \\ Period\ Conditions \end{array} \quad \text{Equation 2}$$

13.5 Electricity Demand Increase

The electricity demand increase will be evaluated for those included in the M&V where hourly electricity consumption data is provided from the electricity utility. The demand will therefore be an hourly demand, rather than a truly instantaneous demand. Avoided demand will be calculated monthly using Equation 3. Note that “Avoided Demand” is the terminology used in the IPMVP, but here it will be negative because electricity demand will increase. “Adjusted Baseline Demand” is the baseline model projected to reporting periods conditions based on HDDs. “Reporting Period Demand” is the actual demand that occurred during the reporting period.

$$Avoided\ Demand = \begin{array}{c} Adjusted\ Baseline\ Demand \\ -Reporting\ Period\ Demand \end{array} \quad \text{Equation 3}$$

13.5 Avoided Cost

Avoided cost will be calculated monthly using Equation 4 and totaled for the reporting period. In this calculation, the “Avoided Elec Consumption” is negative since there will be an increase. The increases will be determined separately, and rates applied separately, for each TOU (as indicated by the summation in Equation 4).

$$Avoided\ Cost = (Avoided\ Gas\ Consumption \times Gas\ Rate) + \left(\sum_{i}^{All\ TOUs} Elec\ Rate_i \times Avoided\ Elec\ Consumption_i \right) \quad \text{Equation 4}$$

13.5 Avoided Greenhouse Gas (GHG) Emissions

Avoided GHGs will be calculated monthly using Equation 5 and totaled for the reporting period. In this calculation, the “Avoided Elec Consumption” is negative since there will be an increase. Unless otherwise stipulated by Enbridge Gas Inc. (or the Province of Ontario), GHG savings will be calculated using the most recent federal National Inventory Report values associated with Ontario electricity and natural gas.

$$Avoided\ GHGs = \begin{array}{l}(Avoided\ Gas\ Consumption \times Gas\ Emission\ Factor) + \\ (Avoided\ Elec\ Consumption \times Elec\ Emission\ Factor)\end{array}$$ Equation 5

9 Energy Rates

Utility bills can be complicated and have many line items. In this M&V, *marginal* utility rates for electricity consumption and natural gas consumption will be used to calculate savings. The marginal utility rates include all utility bill line items that are linearly dependent on consumption (including tax) and ignores any line items that are fixed and do not vary with consumption. As an example, for natural gas consumption, the Customer Charge is fixed, but all other line items vary linearly with consumption.

The M&V will determine the marginal gas and electricity rates for each home at the time of final reporting using the Ontario Energy Board Bill Calculator (https://www.oeb.ca/consumer-information-and-protection/bill-calculator). Using the calculator, the marginal rates can be determined for each geographical region by calculating two sample bills for different levels of energy consumption. The change in cost divided by the change in consumption is equal to the marginal rate that will be used for savings calculations.

As an example, two sample bills are calculated below. On the left, is a bill for 200 m^3 consumption and on the right is one for 100m^3. The reduction in cost is $47.13 and the reduction in consumption is 100 m^3. The marginal utility rate is therefore $0.471 $/m^3$. This marginal rate is the approximately the same regardless of the magnitude of the reduction. A similar exercise can be done for each electricity time of use bracket to determine marginal electricity rates.

SAMPLE MONTHLY BILL STATEMENT

Enbridge Gas - All

Account Number: 000 000 000 0000
Meter Number: 0000000

Your Natural Gas Charges

Customer Charge	$22.88
Delivery	$20.90
Gas Supply Charge	$26.46
Cost Adjustment	$4.08
Transportation Charges	$8.51
Federal Carbon Charge	$24.78
Total Natural Gas Charges	**$107.61**
HST	$13.99
Total Amount	**$121.60**

SAMPLE MONTHLY BILL STATEMENT

Enbridge Gas - All

Account Number: 000 000 000 0000
Meter Number: 0000000

Your Natural Gas Charges

Customer Charge	$22.88
Delivery	$10.84
Gas Supply Charge	$13.23
Cost Adjustment	$2.04
Transportation Charges	$4.25
Federal Carbon Charge	$12.39
Total Natural Gas Charges	**$65.63**
HST	$8.53
Total Amount	**$74.17**

Figure 4. Example invoices from the Ontario Energy Board bill calculator for 200 m^3 consumption (right) and 100 m^3 consumption (left).

10 Meter Specifications

Utility meters will be used for gas and electricity consumption/demand. Since these are the meters upon which the homeowners are charged for their consumption, the measurement uncertainties of the meters will not be considered within the M&V.

11 Monitoring Responsibilities

The baseline and reporting period utility data for the participating homes will be collected by Enbridge Gas Inc. and provided to STEP for analysis. Surveys will be created jointly by STEP and Enbridge Gas Inc. but they will be administered by Enbridge Gas Inc. and provided to STEP. Enbridge will use a unique identifier for each home. The unique identifier will be consistent between the utility data and the survey data. It is expected that data will be provided from Enbridge to STEP/TRCA in two batches. The first batch will cover the baseline period for 1 year pre-retrofit. The second batch will cover the reporting period.

12 Expected Accuracy

Without the baseline data and regression models, the expected accuracy cannot be provided in this M&V Overview. The final IPMVP-adherent M&V Report will calculate the accuracy of the energy savings calculations based on the quality of the baseline models.

13 Report Format

In addition to this overview, two additional documents will be provided as part of the M&V:

1. A draft Final M&V Report which will be provided after the final reporting period data and survey data is provided by Enbridge Gas Inc. This document will be provided to the Province by September 30th, 2025.
2. The Final M&V Report will be provided after comments have been provided by Enbridge Gas Inc. and the Ontario Government. This document will be provided by November 28th, 2025.

The Final M&V Report will include all required sections outlined in Section 13.3 of IPMVP Core Concepts 2022. It will include, at minimum:

- Definitions or terminology.
- Overview of M&V objectives and goals.
- Detailed description of the approach for data collection, measurement, and verification.
- The results of applicable performance metrics measuring the impact and effectiveness. At minimum, the following performance metrics are to be included: (i) natural gas savings in cubic meters or GJ and as percentage of change; (ii) electricity increases in kWh and as a percentage of change; (iii) natural gas bill savings in $ and as a percentage of change; (iv) electricity bill increases in $ and a percentage of change; (v) net utility bill impact in $ and as a percentage of change; (vi) greenhouse gas emissions in tCO_2e.
- If the requested data from Local Distribution Companies is provided, an analysis of peak demand increases.
- Description of and rationale for any variances in relation to intended or programed results.
- Identification and description of any challenges with achieving M&V objectives, if applicable.
- Description of and rationale for any added or modified tasks.
- Summary of lessons learned from M&V, including participant behavioural insights based on the questionnaire results (e.g. tendencies to or likelihood for changing the set temperatures).
- Conclusions and recommendations.

- Appendices with sample questionnaire, the M&V Plan, and any relevant datasets.

14 Quality Assurance

- Based on survey results, the analysis will categorize homes according to the confidence that the observed energy changes are due to the hybrid systems. This will allow the M&V to consider all data available, while also highlighting those homes with high confidence in the results. It follows that other energy-influencing factors will not cause misleading conclusions – where they may be present, they will be identified in the reporting.
- For energy measurements, this M&V will only use utility meter data. These are the meters upon which the homeowners are charged for their consumption. It follows that measurement errors from submeters will not be a factor in this M&V.
- The analysis will be completed by an individual with a CMVP designation and reviewed by another individual with a CMVP designation.

ENBRIDGE GAS INC.

Answer to Undertaking from
Pollution Probe (PP)

Undertaking:

Tr: 65

To provide the preliminary statistical analysis related to review of participants for the original pilot project.

Response:

Please note that the preliminary statistical review information provided below relates to the initial Southern Lake Huron Pilot Project application (filed on July 19, 2023).

See Table 1 for the margin of error calculation (given a 95% confidence level) for the Southern Lake Huron Pilot Project Area of Influence, based on estimated sample size.

See Table 2 for the margin of error calculation (given a 95% confidence level) for the total Southern Lake Huron Pilot Project area, based on estimated sample size.

Table 1

Margin of Error Calculation for Southern Lake Huron Pilot Project Area of Influence based on Estimated Sample Size

		Estimated # of Participants (Sample Size) *[% Margin of Error]*
Sector [1]	Total # of Customers	Enhanced DSM
Residential	4,086	303 *[+/- 5.4%]*

[1] The ETEE Enhanced DSM residential offering was limited to the Southern Lake Huron Pilot Project area of influence for the initial application.

Table 2

Margin of Error Calculation for Total Southern Lake Huron Pilot Project Area based on Estimated Sample Size

		Estimated # of Participants (Sample Size) *[% Margin of Error]*	
Sector [2]	Total # of Customers	Enhanced DSM	DR
Residential	27,392	-	1164 *[+/- 2.8%]*
Commercial	1,921	168 *[+/- 7.2%]*	-
Multi Res	565	59 *[+/- 12.1%]*	-
Industrial	77	9 *[+/- 30.9%]*	-

[2] The ETEE Enhanced DSM commercial and industrial offering, and demand response offering was available to all general service customers in the total Southern Lake Huron Pilot Project area for the initial application.

ENBRIDGE GAS INC.

Answer to Undertaking from
Association of Power Producers of Ontario (APPrO)

Undertaking:

Tr: 72

To respond to the first question in KT1.1.

Response:

The first question (APPrO-9) at Exhibit KT1.1 is as follows:

Reference 1: *Exhibit I.APPrO-3.*

Reference 2: *Exhibit B Tab 1 Schedule 1 Page 4 of 9*

Reference 3: *Decision and Order EB-2020-0091*

Preamble: *Reference 1 confirms that the Southern Lake Huron Project has a lower net present value than the baseline facility alternative. Reference 2 states that there no baseline facility projects associated with the Southern Lake Huron Pilot Project.*

Reference 3 states that Enbridge Gas is encouraged to use the IRP pilot projects as a testing ground for an enhanced DCF+ test as discussed in section 8.3. In the December 2023 version of the application Enbridge stated that the total cost of the Southern Lake Huron Project was $6.8 million. However, in the updated application the Southern Lake Huron Project now has an estimated cost of $14.2 million.

Question(s):

1. *Please clarify what baseline facility alternative is being considered in Reference 1.*

2. *In the December 2023 version of the application at Exhibit E Tab 1 Schedule 1 Page 19 of 20, the Southern Lake Huron Project had a net present value ("NPV") of negative $3.4 million. What is the updated NPV of the Southern Lake Huron Project using the same approach as the December 2023 version of the application?*

3. *Will Enbridge Sustain participate, or could be eligible to participate, in the execution of any demand side alternatives for the Southern Lake Huron Project, which APPrO understands are listed at Exhibit A Tab 3 Schedule 1 Page 11 of 11?*

Enbridge Gas's responses are provided below:

1. The baseline facility alternative that was being considered in Reference 1 (Exhibit I.APPrO-3) refers to the facilities provided at Exhibit E, Tab 1, Schedule 1, Page 12, Table 7 of Enbridge Gas's December 21, 2023 version of the application.

   For clarity, Exhibit I.APPrO-3 was marked by Enbridge Gas as no longer applicable within the Company's cover letter for its June 28, 2024 updated interrogatory responses (as a result of Enbridge Gas's June 28, 2024 amended application, there is no longer a baseline facility alternative related to the Southern Lake Huron Pilot Project).

2. Negative $8.9 million.

3. Enbridge Sustain would be treated in the same manner as any other contractor in the market, and therefore could be eligible to participate in the execution of demand side alternatives for the Southern Lake Huron Pilot Project.

ENBRIDGE GAS INC.

Answer to Undertaking from
Association of Power Producers of Ontario (APPrO)

Undertaking:

Tr: 72

To respond to the second question in KT1.1.

Response:

The second question (APPrO-7) at Exhibit KT1.1 is as follows:

Reference 1: *Exhibit B Tab 1 Schedule 1 Page 7 of 9*

Reference 2: *Exhibit A Tab 3 Schedule 1 Page 10 of 11*

Preamble*:*

At Reference 1, Enbridge states the Southern Lake Huron system is no longer expected to require reinforcement in the 2025-2034 capital forecast.

At Reference 2, Enbridge states that as a result of the changes to the identified system constraints for the Southern Lake Huron Pilot Project, the updated Southern Lake Huron Pilot Project no longer differentiates between an "area of influence" and a "greater Southern Lake Huron area". Instead, the Southern Lake Huron Pilot Project will now target all of the City of Sarnia and Village of Point Edward with all demand-side alternatives.

Question(s):

1. *Please justify why it is prudent for Enbridge to increase the scope of the Southern Lake Huron Pilot Project from the initial application when the need to reinforce the Southern Lake Huron system was revisited and found to not materialize during the 2025-2034 capital forecast?*

2. *What incremental value is provided by the increased scope of the Southern Lake Huron Pilot Project ($14.2 million) versus Enbridge's initial application ($6.8 million)?*

3. *What costs are being avoided, deferred, or reduced by the Southern Lake Huron Pilot Project? What is the present value of those avoided, deferred, or reduced costs?*

4. *Please discuss why Enbridge believes the learnings from a project located in Southern Ontario may be applicable for consumer demand side response / uptake in other climate areas of Ontario (e.g., Northern Ontario)? Would the location of the Parry Sound Project have provided this comparative data?*

5. *Please confirm whether the baseline facility alternatives described in Table 7 (Exhibit E Tab 1 Schedule 1 Page 12 of 20) of the December 2023 version of the application is the "reinforcement" work required beyond the 2025-2034 capital forecast. If not, please describe what "reinforcement" work may be required.*

6. *Please confirm whether the baseline facility costs laid out in Table 7 (Exhibit E Tab 1 Schedule 1 Page 12 of 20) of the December 2023 version of the application are still valid estimates. If not, please update Table 7 and state all assumptions.*

Enbridge Gas's responses are provided below:

1. As noted at Exhibit B, Tab 1, Schedule 2, paragraph 6, "the primary objectives of the Southern Lake Huron Pilot Project are to gather learnings regarding demand-side alternatives, rather than to address an existing system constraint using the most cost-effective alternative." The Southern Lake Huron Pilot Project learnings will be used to refine Enbridge Gas's current assumptions regarding IRPAs and provide more accurate data and information that can be used in future IRP assessments.

2. The incremental value includes:
    - Reduced timeframe required for obtaining learnings on the Pilot Project's objectives. This is achievable through avoiding the requirement to install ERTs and collect baseline data during the heating season prior to the deployment of the demand-side alternatives for residential and small commercial customers. It is expected that higher participation can be achieved in a shorter timeframe compared to the initial application, due to the shortened timeframe for deployment.
    - Avoid the costs associated with incremental ERT installation for residential and small commercial customers.
    - Enhanced representative nature of the Pilot Projects in extrapolating learnings to other geographies.
    - Additional ETEE funding for advanced technologies and residential electrification measures to maintain the learnings that would have been achieved in the Parry Sound Pilot Project (which was withdrawn from the application).

3. No direct costs are being avoided, deferred or reduced by the Southern Lake Huron Pilot Project as there is no longer a baseline facility need related to the Southern Lake Huron Pilot Project. See the response to part 1) above.

4. As noted at Exhibit D, Tab 1, Schedule 3, paragraphs 13 - 14, Enbridge Gas will perform customer analysis before and after measures are implemented to determine the changes in base temperature, base flow, and heating flow per degree day. Enbridge Gas believes these learnings from the Southern Lake Huron Pilot Project will inform IRP assessment for other consumers in other climate areas.

   As noted at Exhibit C, Tab 1, Schedule 2, pages 7 - 8, the Southern Lake Huron system is expected to generate transferable learnings as the customer base consists of a balanced mix of customers. The Town of Plympton-Wyoming has similar building vintages compared to provincial averages, while the City of Sarnia has slightly older homes compared to provincial averages (see Exhibit C, Tab 1, Schedule 2, Table 3).

   The Parry Sound Pilot Project would have provided similar data to the Southern Lake Huron Pilot Project, with only the potential to experience marginally colder actual temperatures over the course of the Pilot Projects. Enbridge Gas does not believe these colder temperatures fundamentally impact the applicability of learnings. The analysis will require extrapolation to design day temperatures regardless of pilot location due to the rare nature of design day temperatures.

5. For clarity, only lines 1 and 2 at Exhibit E, Tab 1, Schedule 1, Table 7 (December 21, 2023 version of the application) are “reinforcement” work. Line 3 is a replacement project.

   Not confirmed. The reinforcement projects (lines 1 and 2) at Exhibit E, Tab 1, Schedule 1, Table 7 (December 21, 2023 version of the application) were part of the baseline facility alternatives associated with the Southern Lake Huron Pilot Project prior to the June 28, 2024 amended application. As per Enbridge Gas’s June 28, 2024 amended application, these reinforcement projects were no longer required in Enbridge Gas’s 10-year capital forecast. There are no reinforcement projects anticipated at this time associated with the Southern Lake Huron Pilot Project.

6. The reinforcement projects (lines 1 and 2) at Exhibit E, Tab 1, Schedule 1, Table 7 (December 21, 2023 version of the application) are no longer included within Enbridge Gas’s 10-year capital forecast. The estimate for the replacement project (line 3) at Exhibit E, Tab 1, Schedule 1, Table 7 (December 21, 2023 version of the application) is still valid.

ENBRIDGE GAS INC.

Answer to Undertaking from
Association of Power Producers of Ontario (APPrO)

Undertaking:

Tr: 72

To respond to the third question in KT1.1.

Response:

The third question (APPrO-8) at Exhibit KT1.1 is as follows:

***Reference**: Exhibit I.APPrO-1*

***Preamble**:*

Enbridge states the learnings from this Pilot Project will not be scalable to large volume contract customers as Enbridge already has extensive experience with large volume contract customers. Enbridge states the focus of the IRP Pilot Project is on general service customers.

Question(s):

1. *Please update the following cost allocation tables with the large volume customers removed:*

    a) Exhibit E Tab 1 Schedule 2 Attachment 2

    b) Exhibit E Tab 1 Schedule 2 Attachment 3

    c) Exhibit E Tab 1 Schedule 2 Attachment 4

Enbridge Gas's response is provided below:

Please see Attachments 1, 2 and 3 to this response for Exhibit E, Tab 1, Schedule 2, Attachments 2, 3 and 4 with Rate T2[1] removed from the allocation of the IRP Operating & Capital Costs account balance related to the South Lake Huron Pilot Project.

Enbridge Gas notes that this methodology would not be considered by the Company for the disposition of account balances as it would be inconsistent with the treatment for large customers in other rate classes.

[1] Large volume customers as defined by APPrO at Exhibit I.APPrO-1: "The reference below to 'large volume customers' are those who take service as a large customer under Rate 20, 100, 125, T2 or M12." Exhibit E, Tab 1, Schedule 2, Attachments 2, 3 and 4 contain cost allocations to Rate T2 only.

Allocation
2025 IRP Operating & Capital Costs Account Balance

Line No.	Particulars	Union South Distribution Demand (1)	Allocation ($000s) Operating Costs Southern Lake Huron (2)	Capital Costs Southern Lake Huron (2)	Allocation Total
		(a)	(b)	(c)	(d)
	EGD Rate Zone				
1	Rate 1	-	-	-	-
2	Rate 6	-	-	-	-
3	Rate 9	-	-	-	-
4	Rate 100	-	-	-	-
5	Rate 110	-	-	-	-
6	Rate 115	-	-	-	-
7	Rate 125	-	-	-	-
8	Rate 135	-	-	-	-
9	Rate 145	-	-	-	-
10	Rate 170	-	-	-	-
11	Rate 200	-	-	-	-
12	Rate 300	-	-	-	-
13	Total EGD Rate Zone	-	-	-	-
	Union North Rate Zone				
14	Rate 01	-	-	-	-
15	Rate 10	-	-	-	-
16	Rate 20	-	-	-	-
17	Rate 25	-	-	-	-
18	Rate 100	-	-	-	-
19	Total Union North Rate Zone	-	-	-	-
	Union South Rate Zone				
20	Rate M1	31,063	4,369	(1)	4,368
21	Rate M2	11,510	1,619	(0)	1,618
22	Rate M4	2,539	357	(0)	357
23	Rate M5	44	6	(0)	6
24	Rate M7	2,142	301	(0)	301
25	Rate M9	-	-	-	-
26	Rate M10	-	-	-	-
27	Rate T1	813	114	(0)	114
28	Rate T2	-	-	-	-
29	Rate T3	-	-	-	-
30	Total Union South Rate Zone	48,111	6,766	(1)	6,765
31	Total In-Franchise (3)	48,111	6,766	(1)	6,765

Notes:

(1) Union South distribution demand allocation is in proportion to forecast 2024 Union South in-franchise design day demands, excluding demands served directly off transmission lines. 2024 forecast used as the 2025 forecast not available at the time of filing the Application.

(2) Allocated in proportation to column (a).

(3) The total balance in columns (b) and (c) from Exhibit E, Tab 1, Schedule 2, Table 2.

Unit Rates for Disposition
2025 IRP Operating & Capital Costs Account Balance

Line No.	Particulars	Account Balance for Disposition (1) ($000s)	2024 Forecast Usage (2) (10^3m^3)	Billing Units	Unit Rate for Disposition
		(a)	(b)	(c)	(d) = (a/b*100)
	EGD Rate Zone				
1	Rate 1	-	5,011,588	10^3m^3	-
2	Rate 6	-	4,799,240	10^3m^3	-
3	Rate 9	-	-	10^3m^3	-
4	Rate 100	-	27,429	10^3m^3	-
5	Rate 110	-	1,068,281	10^3m^3	-
6	Rate 115	-	381,873	10^3m^3	-
7	Rate 125	-	824,971	10^3m^3	-
8	Rate 135	-	52,646	10^3m^3	-
9	Rate 145	-	15,714	10^3m^3	-
10	Rate 170	-	323,254	10^3m^3	-
11	Rate 200	-	188,852	10^3m^3	-
12	Rate 300	-	-	10^3m^3	-
13	Total EGD Rate Zone	-			
	Union North Rate Zone				
14	Rate 01	-	976,880	10^3m^3	-
15	Rate 10	-	341,664	10^3m^3	-
16	Rate 20	-	929,101	10^3m^3	-
17	Rate 25	-	126,831	10^3m^3	-
18	Rate 100	-	1,076,378	10^3m^3	-
19	Total Union North Rate Zone	-			
	Union South Rate Zone				
20	Rate M1	4,368	3,238,864	10^3m^3	0.1349
21	Rate M2	1,618	1,343,314	10^3m^3	0.1205
22	Rate M4	357	592,623	10^3m^3	0.0602
23	Rate M5	6	59,493	10^3m^3	0.0104
24	Rate M7	301	789,737	10^3m^3	0.0381
25	Rate M9	-	90,073	10^3m^3	-
26	Rate M10	-	-	10^3m^3	-
27	Rate T1	114	431,289	10^3m^3	0.0265
28	Rate T2	-	5,005,643	10^3m^3	-
29	Rate T3	-	249,200	10^3m^3	-
30	Total Union South Rate Zone	6,765			
31	Total In-Franchise	6,765			

Notes:
(1) Attachment 1, column (d).
(2) 2024 forecast usage used as the 2025 forecast usage not available at the time of filing the Application.

Bill Impacts for Typical Small and Large Customers
2025 IRP Operating & Capital Costs Account Balance

Line No.	Particulars	Unit Rate for Disposition (1) (cents/m³)	Annual Volume		Bill Impact ($)
		(a)	(b)	(c)	(d)
	EGD Rate Zone				
1	Rate 1 - Residential	-	2,400	m³	-
2	Rate 6 - Heating & Other Uses	-	22,606	m³	-
3	Rate 6 - General Use	-	43,285	m³	-
4	Rate 100 - Small	-	339,188	m³	-
5	Rate 110 - Small	-	598,568	m³	-
6	Rate 110 - Average	-	9,976,121	m³	-
7	Rate 115 - Small	-	4,471,609	m³	-
8	Rate 125 - Average	-	2,315,000	m³	-
9	Rate 135 - Average	-	598,567	m³	-
10	Rate 145 - Average	-	598,568	m³	-
11	Rate 170 - Average	-	9,976,121	m³	-

Notes:
(1) Attachment 2, column (d).

Bill Impacts for Typical Small and Large Customers
2025 IRP Operating & Capital Costs Account Balance

Line No.	Particulars	Unit Rate for Disposition (1) (cents/m³)	Annual Volume		Bill Impact ($)
		(a)	(b)	(c)	(d)
	Union North Rate Zone				
1	Rate 01 - Residential	-	2,200	m³	-
2	Rate 10	-	93,000	m³	-
3	Rate 20 - Small	-	3,000,000	m³	-
4	Rate 20 - Large	-	15,000,000	m³	-
5	Rate 25 - Average	-	2,275,000	m³	-
6	Rate 100 - Small	-	27,000,000	m³	-
7	Rate 100 - Large	-	240,000,000	m³	-
	Union South Rate Zone				
8	Rate M1 - Residential	0.1349	2,200	m³	3
9	Rate M2	0.1205	73,000	m³	88
10	Rate M4 - Small	0.0602	875,000	m³	527
11	Rate M4 - Large	0.0602	12,000,000	m³	7,229
12	Rate M5 - Small	0.0104	825,000	m³	86
13	Rate M5 - Large	0.0104	6,500,000	m³	679
14	Rate M7 - Small	0.0381	36,000,000	m³	13,727
15	Rate M7 - Large	0.0381	52,000,000	m³	19,828
16	Rate M9 - Small	-	6,950,000	m³	-
17	Rate M9 - Large	-	20,178,000	m³	-
18	Rate T1 - Small	0.0265	7,537,000	m³	1,998
19	Rate T1 - Average	0.0265	11,565,938	m³	3,066
20	Rate T1 - Large	0.0265	25,624,080	m³	6,793
21	Rate T2 - Small	-	59,256,000	m³	-
22	Rate T2 - Average	-	197,789,850	m³	-
23	Rate T2 - Large	-	370,089,000	m³	-
24	Rate T3	-	272,712,000	m³	-

Notes:
(1) Attachment 2, column (d).

ENBRIDGE GAS INC.

Answer to Undertaking from
Consumers Council of Canada (CCC)

Undertaking:

Tr: 74

To provide the total cost of the pilot project, and the allocation between different rate classes.

Response:

Please see the response at Exhibit I.CCC-16, Attachment 1 (updated June 28, 2024).

ENBRIDGE GAS INC.

Answer to Undertaking from
Federation of Rental-housing Providers of Ontario (FRPO)

Undertaking:

Tr: 79

To provide in table form the station name, the station number and the set pressure and flow in 2024 design condition

Response:

Please see Table 1 for the requested information in table format.

Table 1
Southern Lake Huron System Station Information

Line No.	Station Name	Douglas Lakeshore	Lottie-Neelie	McGregor Road	Modeland Road	Vidal Street	Wyoming Gate
1	Station Number	11H-101R	13F-307R	13F-304R	14F-601R	13F-220R	13H-503
2	2024 Forecasted Flow (m3/hr)	1141.3	1903.3	15991.8	9030.6	15555.6	1884.9
3	Modelled outlet pressure (kPa)	380	380	380	380	380	380

ENBRIDGE GAS INC.

Answer to Undertaking from
Federation of Rental-housing Providers of Ontario (FRPO)

Undertaking:

Tr: 84

In Exhibit D, Tab 1, Schedule 2, Table 14, to add the six stations feeding this system with the station codes and station names; to provide the flows or the design flows out of those stations similar to this table over those 10 or 11 years.

Response:

Enbridge Gas understands this request as to add the six station names, station codes, and station flows to the table at Exhibit KT1.2, page 2, for the next 10 years.

Please see Table 1 for the requested information without ETEE and DR. Please see Table 2 for the requested information with ETEE and DR.

Table 1
Forecasted Station Flows Without ETEE & DR (m3/hr)

Year	Douglas Lakeshore	Lottie-Neelie	McGregor Road	Modeland Road	Vidal Street	Wyoming Gate	Total	Low Point Pressure (kPa)
	11H-101R	13F-307R	13F-304R	14F-601R	13F-220R	13H-503		
2024	1141.3	1903.3	15991.8	9030.6	15555.6	1884.9	45507.5	224
2025	1144.6	1889.3	15860.2	8992.6	15419.5	1876.6	45182.8	220
2026	1160.6	1884.1	15797.6	9002.7	15346.5	1873.4	45064.9	210
2027	1185.5	1880.6	15737.5	9023.8	15268.8	1867.5	44963.7	197
2028	1190.3	1883.0	15701.6	9007.1	15234.2	1862.4	44878.6	195
2029	1178.0	1869.0	15519.5	8893.7	15058.6	1839.6	44358.4	200
2030	1170.1	1862.0	15393.6	8813.3	14938.3	1824.3	44001.6	203
2031	1160.7	1852.9	15251.0	8723.0	14801.8	1807.1	43596.5	207
2032	1150.2	1843.5	15107.2	8631.4	14663.9	1789.7	43185.9	210
2033	1138.6	1831.7	14958.1	8536.5	14521.9	1771.8	42758.6	214

Table 2
Forecasted Station Flows with ETEE & DR (m3/hr)

Year	Douglas Lakeshore	Lottie-Neelie	McGregor Road	Modeland Road	Vidal Street	Wyoming Gate	Total	Low Point Pressure (kPa)
	11H-101R	13F-307R	13F-304R	14F-601R	13F-220R	13H-503		
2024	1141.3	1903.3	15991.8	9030.6	15555.6	1884.9	45507.5	224
2025	1139.9	1875.9	15743.0	8930.2	15303.9	1876.3	44869.2	222
2026	1151.5	1857.3	15563.3	8877.8	15115.3	1872.7	44437.9	214
2027	1179.3	1862.2	15576.4	8937.9	15109.9	1867.0	44532.7	200
2028	1184.2	1864.6	15540.4	8921.2	15075.3	1862.0	44447.7	198
2029	1171.9	1850.5	15358.3	8807.7	14899.6	1839.2	43927.2	202
2030	1164.0	1843.6	15232.4	8727.3	14779.3	1823.9	43570.5	205
2031	1154.6	1834.5	15089.8	8637.0	14642.8	1806.6	43165.3	209
2032	1144.2	1825.1	14945.9	8545.4	14505.0	1789.2	42754.8	213
2033	1132.6	1813.3	14796.9	8450.5	14363.0	1771.3	42327.6	217

ENBRIDGE GAS INC.

Answer to Undertaking from
Federation of Rental-housing Providers of Ontario (FRPO)

Undertaking:

Tr: 89

To identify changes and how did they affect the flow conditions in the South Huron/Sarnia system

Response:

Enbridge Gas interprets this undertaking as a request to provide a summary of the main drivers for the change in system flows (shown at Exhibit I.FRPO-15) as between the original filing of that response and the updated filing of that response.

The main drivers for the changes in the forecasted demands and flows in the Southern Lake Huron system are:

- The annual model updates as part of the design hour demand process (as noted at Exhibit I.CCC-10); and,
- The 2022 to 2024 system reinforcement plan (SRP) updates which included two primary updates (an updated 10-year customer forecast for new customer additions and updated Energy Transition assumptions).

The annual model updates refer to design hour demand calculations for the area using methodologies outlined in Enbridge Gas's 2024 Phase 1 Rebasing Application[1]. It should be noted that this process will take place annually throughout the Pilot Project term, as part of Enbridge Gas's normal processes. This includes updating actual customer usage to their most recent 2-year data.

With respect to the SRP updates from 2022 to 2024, these updates incorporated several changes. The first of which was the customer forecast updates (2021 to 2023, and 2023 to 2024) as well as Energy Transition updates (annual updates as well as an additional egress update). There are also historical and growth weighting changes that take place with regards to forecasting growth by area. Examples are shown in the TWG Meeting #35 slides (see Exhibit I.ED-2, Attachment 1, pages 255-264) of how areas and historical attachments, and customer average loads, are used and have changed. The

[1] EB-2022-0200.

Energy Transition assumptions update to include additional egress in 2024 can be seen in TWG meeting #37 meeting notes (see Exhibit I.ED-2, Attachment 2, pages 296-299).

All of the drivers summarized above contributed to the reduction in demands on the Southern Lake Huron system.

ENBRIDGE GAS INC.

Answer to Undertaking from
Vulnerable Energy Consumers Coalition (VECC)

Undertaking:

Tr: 105

To provide information Enbridge has, either specifically or generically, about what proportion of the customer base in the pilot project area would be considered low income.

Response:

19% of customers in the Southern Lake Huron Pilot Project Area are estimated to be income qualified (residential and multi-residential segments). Applying this percentage estimate to the customer amounts for the Southern Lake Huron Pilot Project area results in 4,940 customers estimated to be income qualified (residential and multi-residential segments).

Please note that this is a general estimate only and that the actual percentage breakdown for income qualified customers for the residential and multi-residential segments may not necessarily be consistent.

ENBRIDGE GAS INC.

Answer to Undertaking from
Ontario Greenhouse Vegetable Growers (OGVG)

Undertaking:

Tr: 109

To confirm whether Enbridge has reconsidered the cost allocation directed solely at the Union South rate zone.

Response:

Enbridge Gas has not reconsidered the cost allocation methodology for the Southern Lake Huron Pilot Project and maintains that it is appropriate to follow the existing OEB-approved methodologies.

Enbridge Gas acknowledges that the baseline facility projects for the Southern Lake Huron Pilot Project being pushed out of the Company's 10-year capital forecast may create an argument to allocate costs across all three existing rate zones, however, the topic of cost allocation and rate design for the amalgamated utilities is a subject of a different proceeding (Phase 3 of Enbridge Gas's 2024 Rebasing Application). It would be premature and inappropriate to consider alternative cost allocation methodologies within the scope of this proceeding. If the OEB approves cost allocation methodologies as part of the Phase 3 Rebasing proceeding that are different than those set out in this Application, Enbridge Gas may propose a change to the cost allocation methodology as part of the Company's Utility Earnings and Disposition of Deferral & Variance Account Balances application, where disposition is requested for actual Southern Lake Huron Pilot Project costs.

Should the OEB disagree with the cost allocation methodology as proposed in this Application, Enbridge Gas suggests allocating the Southern Lake Huron Pilot Project costs proportionally across the rate zones (see Attachment 1 at Exhibit JT1.20) in alignment with the current cost allocation methodologies for the existing IRP Operating Costs Deferral Account and IRP Capital Costs Deferral Account. If the OEB approves cost allocation methodologies as part of the Phase 3 Rebasing proceeding that are different than this alternative methodology, Enbridge Gas may propose a change to this allocation methodology as part of the Company's Utility Earnings and Disposition of Deferral & Variance Account Balances application, where disposition is requested for actual Southern Lake Huron Pilot Project costs.

ENBRIDGE GAS INC.

Answer to Undertaking from
Ontario Greenhouse Vegetable Growers (OGVG)

Undertaking:

Tr: 110

To provide an alternate view cost of allocation, where the costs are allocated to customers in all rate zones.

Response:

Please see Attachment 1 to this response for an alternative cost allocation for the year 2025, where the costs are allocated to customers in all rate zones. Please see Exhibit JT1.19 for an explanation of the alternative cost allocation methodology.

ENBRIDGE GAS INC.
Allocation of EGI 2025 IRP Project Deferral Costs to Rate Zones - Alernate Proposal

Line No.	Particulars ($ millions)	Allocation to Rate Zone (1) (a)	Allocation Total ($000's) (2) (b)
1	EGD rate zone	6,729	3,571
2	Union rate zones	6,018	3,194
3	Total Balance (lines 1 + 2) (3)	12,748	6,765

Notes:
(1) 2018 actual rate base per EB-2019-0105, Exhibit B, Tab 2, Appendix B, Schedule 1 for the EGD rate zone and EB-2019-0105, Exhibit C, Tab 2, Appendix A, Schedule 4 for the Union rate zones.
(2) Column (b) allocated in proportion to column (a)
(3) The total balance in column (b) is from Exhibit E, Tab 1, Schedule 2, Table 2.

Allocation - Alternate Proposal
2025 IRP Operating & Capital Costs Account Deferral Balance

Line No.	Particulars	Board Approved Rate Base ($000s) (1) (a)	Allocation of Operating & Capital Costs ($000s) (2) (b)
	EGD Rate Zone		
1	Rate 1	3,835,982	2,343
2	Rate 6	1,619,255	989
3	Rate 100	18,199	11
4	Rate 110	70,193	43
5	Rate 115	25,757	16
6	Rate 125	56,370	34
7	Rate 135	3,224	2
8	Rate 145	5,772	4
9	Rate 170	8,090	5
10	Rate 200	14,649	9
11	Rate 300	449	0
12	Rate 332 (3)	189,704	116
12	Total EGD Rate Zone (4)	5,847,642	3,571
	Union North Rate Zone		
13	Rate 01	659,800	571
14	Rate 10	101,688	88
15	Rate 20	72,027	62
16	Rate 25	19,712	17
17	Rate 100	55,495	48
18	Total Union North Rate Zone	908,722	786
	Union South Rate Zone		
19	Rate M1	1,441,159	1,247
20	Rate M2 (5)	218,335	189
21	Rate M4	54,282	47
22	Rate M5	46,033	40
23	Rate M7	18,903	16
24	Rate M9	3,583	3
25	Rate T1	37,644	33
26	Rate T2	166,377	144
27	Rate T3	21,976	19
28	Total Union South Rate Zone	2,008,293	1,738
	Union Ex-Franchise		
29	Rate C1	6,894	6
30	Rate M12	765,893	663
31	Rate M13	521	0
32	Rate M16	947	1
33	Total Union Ex-Franchise	774,255	670
34	Total Union Rate Zones (6)	3,691,271	3,194
35	Total EGI	9,538,913	6,765

Notes:

(1) EGD rate zone rate base per EB-2017-0086, Exhibit G2, Tab 5, Schedule 1, Item No. 6 and Union rate zone rate base per EB-2011-0210, Exhibit G3, Tab 2, Schedule 2, pp.1-3, RATE BASE line.

(2) Allocated in proportion to column (a).

(3) The amount in column (a) is equal to 60% of the 2018 utility rate base amount, for the shared transportation component of Segment A of the GTA Project, as per EB-2012-0459, Exhibit C1, Tab 5, Schedule 1, Appendix D, page 2, updated to reflect the approved depreciation rates.

(4) Total in column (b) as per Page 1, line 2, column (b).

(5) Includes Rate M10 rate base of $138,000.

(6) Total in column (b) as per Page 1, line 3, column (b).

ENBRIDGE GAS INC.

Answer to Undertaking from
Building Owners and Managers Association (BOMA)

Undertaking:

Tr: 114

To add a column to Table 2 at Exhibit D, Tab 1, Schedule 2 indicating the weather-normalized annual system load in metres cubed for each of the sectors shown in that table

Response:

Please see Table 1 for Table 2 at Exhibit D, Tab 1, Schedule 2 with a column added for weather normalized annual system m3 load.

Table 1
Southern Lake Huron Pilot Area Customer Sector Breakdown

Line No.	Sector	Number of Customers	Number of Customers (%)	% of 2023 Weather Normalized Annual System m3 Load	2023 Weather Normalized Annual System m3 Load
1	Residential	25,452	91.1%	64.7%	55,127,767
2	Commercial	1,820	6.5%	26.1%	22,252,183
3	Multi-Residential	547	2.0%	7.6%	6,490,863
4	Industrial	112	0.4%	1.5%	1,312,448
5	Total	27,931	100.0%	100%	85,183,261

ENBRIDGE GAS INC.

Answer to Undertaking from
Building Owners and Managers Association (BOMA)

Undertaking:

Tr: 122

To provide an updated version of Table 3 at Exhibit D, Tab 1, Schedule 2 that includes multi-residential customers, including three categories of large customers, 50,000 to 100,000; 100,000 to a million; and over a million cubic metres

Response:

Please see Table 1 for Table 3 at Exhibit D, Tab 1, Schedule 2 with Multi-Residential customers added. Table 1 includes Commercial, Industrial, and Multi-Residential customers.

Please note, there are no customers with 2023 weather normalized annual system m3 loads over 1 million $m^{3.}$

Table 1
Southern Lake Huron Commercial, Industrial, and Multi-Residential Customer Breakdown

Line No.	Customer Annual Load Size Segments	Number of Customers	Number of Customers (%)	% of 2023 Weather Normalized Annual System m3 Load
1	<50K m3	2,356	95.0%	58.4%
2	50K-100K m3	84	3.4%	18.8%
3	100K-1M m3	39	1.6%	22.8%
4	>1M m3	0	0.0%	0.0%
5	Total	2,479	100.0%	100.0%

ENBRIDGE GAS INC.

Answer to Undertaking from
Ontario Energy Board Staff (STAFF)

Undertaking:

Tr: 148

To provide a table which shows the number of customers in the original area of influence, and in the expanded and updated Southern Lake Huron project; where possible, broken down by customer class

Response:

The initial Southern Lake Huron (SLH) Pilot Project defined an “area of influence” (where changes in peak hour demand would most significantly impact the identified system constraint) and a “greater Southern Lake Huron area” (where changes would not significantly impact the constraint). The previously defined area of influence (AOI) included a small portion of the City of Sarnia and Plympton-Wyoming.

In Enbridge Gas’s December 21, 2023 application, enhanced existing DSM offerings for all sectors were proposed to be limited to the AOI, whereas enhanced existing DSM offerings for only commercial and industrial sectors were proposed for the “greater SLH area”. Demand Response was proposed for the entire SLH pilot area (inclusive of AOI and greater SLH).

Table 1 provides the number of customers by customer class within:

- The December 21, 2023 version of the application, broken out by the AOI and the greater SLH area (where the addition of AOI and Greater SLH Area represents the total pilot area); and,
- The June 28, 2024 amended application which no longer differentiates an AOI.

Table 1
Customer Count Comparison Between December 21, 2023 and June 28, 2024 Applications

Customer Class	Application Dated December 21, 2023		Application Dated June 28, 2024
	AOI	Greater SLH Area	
Residential	4,086	22,388	25,452
Commercial/Industrial	115	2,348	2,479
TOTAL	4,201	24,736	27,931

The variation in counts between the combined totals filed within the application dated June 28, 2024 and in the application dated December 21, 2023 are due to several factors including different geographic areas, the timing of data pulls, and sector classification updates which are made periodically using internal and external data sources to improve account classification.

ENBRIDGE GAS INC.

Answer to Undertaking from
Ontario Energy Board Staff (STAFF)

Undertaking:

Tr: 152

To advise as to how much Enbridge gas plans to spend on electrification measures and on advanced technology measures for the Southern Lake Huron pilot project, along with an estimate of the amount that would be spent on marketing for each of these sets of measures.

Response:

Enbridge Gas estimates that approximately $23,000 of ETEE Enhanced DSM marketing budget (from line 4 at Exhibit E, Tab 1, Schedule 1, Table 2) would be attributed to marketing for ETEE Electrification Measures. This amount reflects the total estimated marketing budget for ETEE Electrification Measures. Regarding ETEE Advanced Technologies, approximately $45,000 is budgeted for marketing (included within line 14 at Exhibit E, Tab 1, Schedule 1, Table 2).

Based on the estimate above, the total budget for ETEE Electrification Measures would increase from approximately $355,000 (as shown at line 11 at Exhibit E, Tab 1, Schedule 1, Table 2) to an estimated total budget of $378,000. Regarding ETEE Advanced Technologies, the total budget is $1,523,000 (as shown at line 16 at Exhibit E, Tab 1, Schedule 1, Table 2).

Additionally, based on the estimate above, the $/$m^3$/hr for ETEE Electrification Measures would increase from $14,500/$m^3$/hr (as shown at Exhibit E, Tab 1, Schedule 1, para. 8) to $15,450/$m^3$/hr. However, as noted at Exhibit E, Tab 1, Schedule 1, paragrpah 8, “this is not a true representation of the cost per peak hour reduction” as “this cost does not take into consideration or reflect the impact on the electric grid and associated costs”. Unlike ETEE Electrification Measures, ETEE Advanced Technologies measures (natural gas heat pumps and thermal energy storage, specifically) can achieve natural gas peak load reductions without adding significant electricity peak load to the electricity grid.