STAFF INTERROGATORY #1

INTERROGATORY

Issue 1 – New Business Activities

Topic: Introduction

Ref: Exhibit B / Tab 1 / Schedule 1 / p. 4 #11 and 12

Preamble:
Enbridge Gas states it intends to offer two services – Upgrading and Injection Services – for RNG producers.

Enbridge Gas also states that it is of the view that the combined effect of the Cap and Trade Framework and the Undertakings (Order in Council/Directives) support the inclusion of carbon abatement activities such as the RNG Enabling Program described in this submission in the regulated utility.

Questions:

a) Please explain why Enbridge Gas' RNG Enabling Program – Upgrading Service should be a regulated utility business.
   i) Does Enbridge Gas offer a similar type of service to natural gas producers (for traditional natural gas supplies) to ensure that these natural gas producers inject pipeline quality natural gas into Enbridge Gas' distribution system? Please explain.

   ii) Please explain why Enbridge Gas believes that cleaning biogas (the Upgrading Service) should be considered a core utility business?

   iii) Please discuss whether there are unregulated companies in the marketplace that can provide Upgrading Service to RNG suppliers.
      a) Please explain whether Enbridge Gas' proposed regulated service fees will affect market competition in RNG Upgrading Services.

b) Please explain in detail why the RNG Enabling Program – Upgrading Service could not be offered by an affiliate of Enbridge Gas.

c) Please explain why Enbridge Gas' RNG Enabling Program – Injection Services should be a regulated utility business.

i) Please discuss whether there are unregulated companies in the marketplace that can provide Injection Service to RNG suppliers.
   1. Please explain whether Enbridge Gas' proposed regulated service fees will affect market competition in RNG Injection Services.

d) Please identify and discuss other regulators that have approved a similar RNG Enabling Program – Upgrading and Injection Services where this Program is part of the natural gas distributor's regulated business.

e) Over the next ten years, please outline the expected GHG reductions associated with Enbridge Gas' RNG Enabling Program only (i.e., please do not include GHG reductions associated with RNG, the commodity). Please provide all supporting documentation including data, assumptions and analysis.

RESPONSE

a) A detailed explanation as to why Enbridge may include the RNG Enabling Program and the Geothermal Energy Services Program in the regulated utility is set out in response to Energy Probe Interrogatory #2 filed at Exhibit I.1.EGDI.EP.2.

   i. Enbridge does not currently offer an upgrading service or similar type of service to natural gas producers (for traditional natural gas supplies). Enbridge injects all gas supplies from various sources (for traditional natural gas supplies) into its gas distribution system and relies on contractual provisions and North American natural gas industry standards to insure that the volumes of natural gas entering its gas distribution meet quality requirements.

   ii. Please see the Company's response to Energy Probe Interrogatory #2 at Exhibit I.1.EGDI.EP.2.

   iii. With respect to the Company's proposed Upgrading Service Enbridge is aware of other organizations that are capable of providing the design of RNG upgrading facilities and supplying the necessary equipment and installing this equipment and operating it. Enbridge is not proposing to have a monopoly franchise over the upgrading of RNG. Given the nascent state of the RNG industry in Ontario Enbridge does not believe that its proposed RNG Upgrading Service will affect market competition with respect to RNG upgrading.

b) Please see the Company's response to Energy Probe Interrogatory #2 filed at Exhibit I.1.EGDI.EP.2.

c) The injection of RNG into the Company's gas distribution system is no different than the injection of traditional supplies of natural gas into the system. Enbridge owns its gas distribution system and is responsible for the safety, reliability and integrity of that system. The Company also must insure that the volumes of gas it delivers to its customers are of sufficient quality such that customers' end-use equipment and appliances will not be damaged, suffer from declines in performance or become unsafe.

Enbridge must ensure that;

- the pipeline to be connected to has volumetric capacity to handle injected RNG volumes,
- there is adequate demand for gas from the pipeline, if gas is not withdrawn for consumption the RNG cannot be injected in to it,
- seasonal variations in natural gas demand can be accommodated as RNG production volumes do not necessarily vary seasonally,
- injected RNG volumes do not result in pipelines operating beyond their maximum allowable operating pressure,
- safety-related operational constraints in the gas distribution system are recognized and accommodated as volumes and/or pressures can be reduced for long periods while pipe upgrades are designed and built.

In light of the above noted considerations the Company must be in a position to control the volumes of gas including RNG volumes entering its gas distribution system in order to insure safe and reliable operations.

Based on the above there are no other companies regulated or non-regulated in the marketplace that can provide injection service to RNG suppliers. As such Enbridge's proposed regulated service fees will not affect market competition in RNG Injection Services.

d) British Columbia and Quebec – Please see response to Canadian Biogas Association Interrogatory #10 filed at I.2.EGDI.CBA.10.

e) Enbridge is not able to provide an estimate of GHG reductions that will be associated with it RNG enabling services at this time due to the unknown nature of many inputs to the necessary calculations. The GHG reductions will depend on a number of factors, including the number of RNG projects served by the Company's

RNG enabling program, and specific details for each project such as; the volume of RNG injected, the source of the RNG, (i.e., landfill gas, anaerobic digesters, etc.), and the methane content of raw biogas.

STAFF INTERROGATORY #2

INTERROGATORY

Issue 1 – New Business Activities

Topic: Context and Background

Ref: Exhibit B / Tab 1 / Schedule 1 / pp. 7-8, #21 and 22

Preamble:
Enbridge Gas states that it is working with the Ontario Geothermal Association (OGA), MOECC and the MOE to find solutions to overcome barriers (initial high costs and inconsistent deployment and installation practices).

Questions:

a) Please describe all the possible solutions that were considered to potentially overcome high costs and inconsistent practices (e.g., Climate Change Action Plan (CCAP) funding, improved training for industry workers, industry standards, etc.)?
   i) Given the possible solutions discussed above, please explain why the preferred solution is for Enbridge Gas to enter into the geothermal energy industry with its Geothermal Energy Service (GES) Program.

b) Has the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) (and OGA as an affiliated association) established any industry standards related to the deployment and installation practices of geothermal energy systems?
   i) Please explain what is OGA's and HRAI's role in reducing inconsistent deployment and installation practices in Ontario?

c) Has the Ontario government established any industry standards relating to the deployment and installation practices of geothermal energy systems? Please explain.

d) Has the federal government established any industry standards relating to the deployment and installation practices of geothermal energy systems? Please explain.

e) Please explain why it's Enbridge Gas' responsibility (or role) as a rate-regulated distributor to reduce inconsistent deployment and installation practices in the Ontario geothermal energy industry?

RESPONSE

a) & i) The adoption of Geothermal technology in Ontario has been hampered by several market barriers including high costs and inconsistent installation practices. Enbridge's proposed GES program is intend to address these barriers as discussed below:

Affordability: A geothermal system comprised of a ground loop and heat pump is more expensive than conventional HVAC systems. This translates to a higher new home price which has been a barrier for builders as well as higher costs for existing homeowners compared to the option of more conventional heating / cooling system. The GreenON rebate program has narrowed this cost difference somewhat. The Enbridge proposal will complement the GreenON program by converting the cost of the long life underground loop infrastructure installation and maintenance to a monthly utility service fee.

Awareness: Customers are generally unaware of this technology and the environmental, comfort, and aesthetic (no outside A/C unit) benefits associated with it. Enbridge will promote geothermal technology along with its environmental benefits in both the retrofit market as well as in the new construction market with builders.

Accessibility: Market adoption has primarily been in rural areas. Land availability is not usually a constraint in these areas so lower cost horizontal loops are more common. In a new construction subdivision or urban environment, more expensive vertically drilled loops will typically be required. A lack of qualified vertical loop drillers/installers in the Province presents a potential accessibility barrier for new subdivision construction projects and urban retrofit installations. The Ontario Geothermal Association (OGA) acknowledges this situation and has committed to work with Enbridge to investigate and implement driller/loop specific training. In due course this could include community college involvement as the industry scales and matures.

Acceptance: Customers generally don't like change. Geothermal technology is foreign to them and a lack of visible, successful, large scale deployment that demonstrates the benefits and performance of the technology limits its acceptance. The fragmentation in the industry has also been a limiting factor. Enbridge will oversee the early stages of system design through to final installation, inspection and transfer of system to the homeowner, thereby ensuring the quality of installation. Enbridge will employ similar quality processes to those used in the natural gas business.

A regulated model has been proven to be able to achieve high rates of market adoption, e.g. natural gas and natural gas water heating has had near universal adoption in Ontario under OEB regulation. A regulated model will also allow the Ontario ground source heat pump market to achieve scale much more quickly which is expected to lead to lower costs to all Geothermal customers in the future.

With Federal and Provincial policy driving towards a lower carbon economy, it is imperative that a sound, transparent framework be used for the market transformation and faster adoption for new lower carbon technologies like Geothermal. Geothermal is a key way to reduce the GHG emissions of its current and future customer base consistent with the OEB's Cap and Trade framework and as such should be approved to form a part of the Company's regulated utility operations. See response to Energy Probe Interrogatory #2 filed at Exhibit I.1.EP.2

This proposal in effect seeks to enable market transformation, enhanced by a regulated utility business model and aligns with both Provincial goals of carbon emissions. The program is designed to minimize the prospect of subsidies flowing from existing customers to future customers through the application of the EBO188 feasibility guidelines. Enbridge believes the best way to address the barriers Ontario's geothermal industry has faced is to undertake the offering through a regulated model.

The Company considered an alternative business model where Enbridge would own and operate both the underground geothermal loop and heat pump system. However both OGA and the Company recognized that the heat pump equipment, like a furnace, should be the homeowner's responsibility to preserve the current market paradigm (Please refer to Exhibit B, Tab 1, Schedule 1, Paragraph 62 and Figure 2, which explains the typical scenario for gas customers, where the customer owns the furnace and in-home equipment)

The Company also discussed the need for training and certification. The OGA has formed a Technical Training and Certification Committee, entered into discussions with Ontario College of Trades, worked with the IESO and the Green Ontario Fund on program guidelines and secured training for geothermal system installers and designers through an arrangement with the International Ground Source Heat Pump Association ("IGSHPA").

It is the Company's position that customers will benefit and Ontario's geothermal market will be enhanced if Enbridge is to install, own and operate the underground geothermal loops and provide quality assurance and reliability to the homeowners as a utility service.

b) & i) The OGA has formed a Technical Training and Certification Committee, entered into discussions with Ontario College of Trades, worked with the IESO and the Green Ontario Fund on program guidelines and secured training for geothermal system installers and designers through an arrangement with the International Ground Source Heat Pump Association ("IGSHPA").

c) Currently, the Ontario Building Code prescribes a version of the CSA 448 standard in their requirements for design and installation of Geothermal Energy Systems. However, in contrast to gas installations (which are overseen by the TSSA), no provincial body is in place to oversee the quality management of geothermal installations aside from municipal building inspectors. Due to the low uptake of this technology, building inspectors may not be as familiar with the technology and the specifics of installation criteria as they would a typical HVAC system.

d) The Company is not aware of any federal government standards or oversight related to the deployment and installation practices with respect to geothermal energy.

e) As explained in the prefiled evidence, Enbridge believes that it can play an important role in encouraging and increasing the installation and use of geothermal energy systems in Ontario. It is appropriate for Enbridge to participate in this activity for the reasons set out in response to Energy Probe Interrogatory #2, filed at I.1.EGDI.EP.2.

STAFF INTERROGATORY #3

INTERROGATORY

Issue 1 – New Business Activities

Topic: Geothermal Energy Service (GES) Program

Ref: Exhibit B / Tab 1 / Schedule 1 / p. 21-22 #61 and #62, p. 23 #65 and p. 70 #70

Preamble:
Enbridge Gas indicates that geothermal systems have been available in Ontario for a number of years.

Enbridge Gas states it will see complementary investments between customers, Enbridge Gas and GreenON Funding. The provincial government's GreenON Fund's website[1] provides a list of contractors for the procurement and installation of geothermal energy systems.

Based on OGA's website[2], the association represents geothermal energy system designers, drillers, installers, equipment manufacturers and distributors to advance Ontario's geothermal heating and cooling industry. This website lists suppliers and contractors.

Based on HRAI's website[3], the association also directs customers to its HRAI Contractor Locator that will find a qualified HRAI Contractor Member in your area.

Questions:

a) Given GreenON, the OGA and HRAI, please confirm that there are suppliers and contractors in Ontario that will supply and install geothermal energy systems in residential homes.
   i) Please explain why a company that supplies geothermal energy systems could not ensure that the appropriate equipment is procured and installed for a customer?
   ii) Please explain why selling and installing geothermal loops should be considered a regulated utility business (i.e., a core utility business)?

[1] https://www.greenon.ca/programs/greenon-rebates-ground-source-heat-pumps

[2] http://www.ontariogeothermal.ca

[3] http://www.hrai.ca

iii) Please explain why providing support to customers related to ground-source heat pumps should be considered a core utility business?

iv) Please explain why Enbridge Gas has decided not to offer this service through an affiliate?

b) Please explain whether Enbridge Gas believes that the geothermal energy industry is a competitive industry in Ontario?

c) Please explain under what section of the *OEB Act*, 1988 gives Enbridge Gas the authority to set service fees for its GES Program.

d) If this Program is deemed a regulated service, how will Enbridge Gas ensure the OEB that it will not use its regulated utility assets to enhance its position in the competitive geothermal energy market. Please explain.

e) Please identify and discuss other regulators that have approved a similar GES Program where this Program is part of the natural gas distributor's regulated business.

RESPONSE

a) Confirmed

i) While it is the case that companies installing geothermal energy systems could ensure that appropriate equipment is installed and procured, that has not always been the case. The installation processes and the performance of installed systems have been inconsistent. In part, this may be because a geothermal system does not contain dangerous substance and thus does not require third party quality assurance from regulatory bodies such as TSSA. This has resulted in inconsistent approaches by some contractors and lack of standardized quality assurance process. As explained in the prefiled evidence, Enbridge expects that its participation in the market, which will include appropriate procurement and installation standards, will help ensure quality geothermal systems for its customers.

ii) Please see Company's response to Energy Probe Interrogatory #2 filed at I.1.EGDI.EP.2.

iii) Please see Company's response to Energy Probe Interrogatory #2 filed at I.1.EGDI.EP.2.

iv) The proposed Geothermal Energy Services Program is an abatement initiative, intended to reduce the Company's compliance obligation from

what it would be in the event that the geothermal customers instead chose to be gas customers. This makes it an appropriate activity to undertake through the regulated utility.

b) Enbridge believes there is a competitive industry for geothermal system contractors in Ontario. Enbridge will not impact that competitive industry, because it will be using those qualified contractors for its geothermal loop installations and because customers will be buying the heat pump systems from those contractors. Enbridge only proposes to own and operate the underground geothermal loop portion. This will not affect market competition. Please also see the Company's response to ENWAVE Interrogatory #5 (vii) filed at I.1.EGDI.ENWAVE.5.

c) Please see Company's response to Energy Probe Interrogatory #2 filed at I.1.EGDI.EP.2.

d) Please see Exhibit B, Tab 1, Schedule 1, paragraph 62.

The OEB has developed several tools ensure minimization of cross subsidization

a. EBO 188 – Feasibility guidelines create framework for assessing cross subsidies
b. Affiliate Relationship Code – Guides cost allocation and resource use between regulated and unregulated activities
c. GDAR – Co-existence of utility offerings with competitive offerings

Enbridge's proposed program is designed to avoid any potential cross subsidies by existing rate payers.

e) Various regulators in other jurisdictions have approved models in response to a rapidly changing energy sector and to align to climate change goals.

PanTerra Energy have received a Public Utilities Commission (PUC) registration in Colorado. This PUC designation is the first step in allowing PanTerra to apply for a permit to act as a sole utility, leasing and selling direct access to a geothermal loop field without additional third-party involvement. PanTerra designs, builds and installs what many believe to be the next wave in eco-friendly and cost-effective improvements for homes, businesses and municipalities.

http://panterra-energy.com/panterra-in-the-news-ghp-firm-is-puc-registered/

British Columbia Utility Commission

- Approval of Alternative Energy Systems which includes behind the meter community systems and thermal energy systems including geothermal.

http://www.bcuc.com/Documents/Guidelines/2015/DOC_42213_TES-Guidelines.pdf

New York – Reforming the Energy Vision (REV)

- Utilities are able to earn returns tied to meeting system demands with alternative methods, such as using customer-sited solar and demand management instead of new central station capacity.
- REV Demonstration Projects
- New York's electric utilities and leading technology companies are working together to develop new business models to enable greater adoption of the new clean energy solutions that customers want.

https://rev.ny.gov/

California Public Utility Commission

- California has approved utility owned on customer site Distributed Energy Resource Services (DERS).

A.14-08-007 DERS PD- Revision 4 (Redline)

STAFF INTERROGATORY #4

INTERROGATORY

Issue 1 – New Business Activities

Topic: Geothermal Energy Service (GES) Program

Ref: Exhibit B / Tab 1 / Schedule 1 /p. 24, #70

Preamble:
Enbridge Gas states that it has been consulting and meeting with the OGA.

Questions:

a) Has Enbridge Gas entered into an agreement (formal and/or informal) with OGA and/or HRAI? Please explain.
   i) To date, please outline your discussions with OGA and/or HRAI? Did Enbridge Gas prepare any material (e.g., presentations, briefing notes, etc.) for these discussions? If so, please file this material with the OEB.

b) Please explain how Enbridge Gas intends to leverage the OGA and/or HRAI?
   i) Does Enbridge Gas intend to sub-contract with OGA members for its GES Program? Please explain.
   ii) Does Enbridge Gas intend to sub-contract with the list of contractors on the GreenOn Fund website for its GES Program? Please explain.

RESPONSE

a) and i) Enbridge Gas and OGA have entered into an MOU. The MOU referenced above is filed as Attachment 1 to this response.

b) i) Enbridge will contract with qualified geothermal drillers (some of whom may be OGA members).
   ii) Yes. The GreenOn website lists contractors that are eligible to provide the heat pump system which is the responsibility of the homeowner. Please see Exhibit B, Tab 1, Schedule 1, paragraph 62. Enbridge will not be responsible for the Heat Pump systems.

COLLABORATION AGREEMENT

THIS Collaboration Agreement ("**Agreement**") is made as of February 17, 2017.

BETWEEN:

ENBRIDGE GAS DISTRIBUTION INC., an Ontario corporation ("**Enbridge**");

-and-

ONTARIO GEOTHERMAL ASSOCIATION, an Ontario non-share corporation (the "**OGA**");

(collectively, the "**Parties**" and sometimes individually referred to as a "**Party**").

RECITALS:

A. The Parties wish to cooperate in the development of mutually beneficial business models which will promote geothermal energy systems in the province of Ontario; and

B. The Parties wish to set out the terms under which such cooperation will be conducted.

1. GEOTHERMAL COLLBORATION AGREEMENT

a) Purpose of Agreement: Enbridge and the OGA desire to cooperate on the:

i. Understanding of geothermal energy systems, including ground loops and heat and cooling transfer equipment (heat pumps),
ii. Application, deployment and use of geothermal energy systems,
iii. Development of mutually beneficial business models which will promote geothermal energy systems, and
iv. Application of utility regulatory concepts to ownership and use of geothermal energy systems,

collectively referred to as the Geothermal Collaboration Agreement "**GCA**" or "**GCA activities**".

In support of the GCA, Enbridge and the OGA may pilot technologies or market approaches, coordinate on public and governmental communications efforts, and coordinate on other activities as may be agreed. As required, the Parties may enter into additional agreements to document GCA activities, such as a pilot project.

b) Formation of GCA: The Parties will collaboratively work together as joint and equal participants in the development and execution of the GCA activities.

c) Additional Participants: The Parties may agree that it would be advantageous to have additional participants ("**Additional Participants**") in the GCA. Additional Participants may only be added to the GCA by the mutual agreement of both the OGA and Enbridge. The role, terms, responsibilities and other conditions upon which such additional participants may join and participate in this GCA will be set out in amendment(s) to this Agreement.

d) Expenses: The Parties agree that any out-of-pocket costs or in kind contributions associated with the development and execution of Agreement activities will be borne by the Party incurring such costs, unless otherwise agreed as set forth herein.

e) Governance: Any significant or material decisions regarding the development and execution of the GCA will be made jointly by the Parties. The initial governance structure for the GCA is set out in Exhibit "A". Exhibit "A" may be updated from time to time by agreement of the Parties.

2. BUSINESS MODELS

a) Defined Terms: In this subsection, the following terms have the following meanings:

i. "**Fully Regulated Model**" means a business activity under which Enbridge would own and maintain Ground Source Loops attached to a customer's premises and the associated Heat Pump and Related Mechanical Systems and recover all costs associated with the provision and maintenance of the Ground Source Loops and Heat Pump and Related Mechanical Systems including a return on investment and related taxes from the customer under an Ontario Energy Board approved rate.

ii. "**Ground Source Loop(s)**" means a ground heat exchanger, typically constructed of polyethylene piping inserted in the ground, pond or lake for the purpose of transferring heat from or to a Heat Pump and Related Mechanical Systems.

iii. "**Heat Pump and Related Mechanical Systems**" means a mechanical device or devices that reject heat into the ground, pond or lake during the cooling mode, and take heat out of the ground, pond or lake while in the heating mode. Components of this system typically include a heat pump, a hydronic pump, water heating and heating / cooling distribution subsystems.

iv. "**Hybrid Model**" means a business activity under which Enbridge would own and maintain Ground Source Loops attached to a customer's premises and recover all costs associated with the provision and maintenance of the Ground Source Loops including a return on investment and related taxes from the customer under an Ontario Energy Board approved rate.

b) Enbridge will not initiate an Ontario Energy Board application proposing a Fully Regulated Model during the term of this Agreement. In consideration of the foregoing, the OGA will support and not oppose Enbridge's initiatives to advance a Hybrid Model. Each Party's sole remedy in the event of a suspected or actual breach of the obligations set out in this section shall be to advise of the other Party of the alleged breach and

request that the other Party comply with the obligation.

3. TERM AND TERMINATION

a) Term: This Agreement will be effective as of the date first set out above and expire on December 31, 2018, unless extended by mutual agreement of the Parties.

b) Termination: Either Party may terminate this Agreement immediately upon written notice to the other Party for any reason or for no reason. The obligations in section 4 (Ownership of Materials) and section 5 (Confidentiality) will survive the termination or expiration of this Agreement.

4. OWNERSHIP OF MATERIALS

The Parties agree that any documents, data, research, images or other materials jointly developed by the Parties or developed for the Parties pursuant to and in furtherance of this Agreement (the "**GCA Materials**") shall be the joint property of the Parties. Each Party shall have the right to use the GCA Materials solely for its own purposes or activities, whether or not the other Party is involved in such activities.

Despite the foregoing, each Party has the right to advise the other in writing that any documents, data, research, images or other materials that a Party develops or pays for ("**Individually Owned Material**") under this Agreement, shall remain the property of the Party who developed or paid for such Individually Owned Material. For example, a Party paying for or conducting a research study may advise in writing that it will retain full ownership of the research study as Individually Owned Material, and in such instance, the other Party will not have the right to use the research study (being Individually Owned Material) without the prior written consent of the Party that owns such Individually Owned Material.

Unless otherwise specifically agreed by a Party, no license of any intellectual property, information or materials is granted or implied hereunder, and a Party shall not use the other Party's name or trademarks without the express written permission of the other Party.

5. CONFIDENTIALITY

a) Confidentiality Obligations: Each of Enbridge and the OGA agree to be bound by the terms of the Confidentiality Agreement attached as Exhibit "C" (the "**Confidentiality Agreement**") in respect of their interactions under this Agreement and each Party is deemed to have signed the attached Confidentiality Agreement. Each of the Parties shall be responsible for compliance with the terms of the Confidentiality Agreement by their respective affiliated entities, directors, officers, employees, consultants, agents, advisors, and representatives. The terms and conditions and performance of this Agreement are Confidential Information.

b) Disclosure by the OGA to Members and Others: The OGA shall not disclose any Enbridge Confidential Information to its members, directors or other parties involved with the OGA, unless such party has executed a Confidentiality Agreement with Enbridge in the form attached as Exhibit "C", or such other form as Enbridge and the party may

agree (also referred to as a Confidentiality Agreement). Parties that sign a Confidentiality Agreement with Enbridge shall be listed in Exhibit "B" as Collaboration Participants. Exhibit "B" may be updated from time to time by agreement of the Parties.

6. RELATIONSHIP

Nothing herein shall be deemed to constitute either Party as an agent or representative of the other Party, or both Parties as joint venturers or partners for any purpose. Neither Party shall act in a manner that expresses or implies a relationship other than that of independent businesses or legal entities. Neither Party will have the authority or right to represent or obligate the other Party in any way.

This Agreement will not be construed as an obligation on the part of either Party to refrain from discussing or participating in the same or similar opportunities as those contemplated or engaged in under this Agreement. Either Party may meet with third persons to discuss similar opportunities to those contemplated in this Agreement. Further, except as otherwise agreed in writing, each Party's future plans remain tentative and do not represent firm decisions or commitments by either Party.

7. PUBLIC ANNOUNCEMENTS

Neither Party shall make any public announcements concerning this Agreement or the other Party without the prior written consent of the other Party.

8. ASSIGNMENT

Neither this Agreement nor any of the rights or obligations hereunder may be assigned by either Party without the prior written consent of the other Party.

9. GOVERNING LAW

This Agreement shall be governed by, and construed and enforced in accordance with the laws in force in the Province of Ontario.

10. NOTICES

Any notice, document or other communication required or permitted to be given hereunder (each, a "notice") shall be sufficiently given if set out in writing and personally delivered or sent by facsimile or electronic mail. Any notice shall be deemed to have been received by the Party to whom it is directed, (i) if delivered, when delivered, or (ii) if sent by facsimile or electronic mail, on the date of transmission; provided in each case that it is delivered or transmitted on a business day prior to 5:00p.m. local time in the place of delivery or receipt. If a notice is delivered or transmitted after 5:00p.m. local time or such day is not a business day, then such notice shall be deemed to have been given and received on the next business day. Each notice shall be addressed to the Parties as follows:

in the case of Enbridge:	500 Consumers Road North York, Ontario, M2J 1P8 Attn: Steve McGill, Senior Strategist Email: steve.mcgill@enbridge.com
with a copy to:	Law Department Fax: (416) 495-5994
in the case of the OGA:	2350 Matheson Blvd. East, Suite 101 Mississauga, Ontario, L4W 5G9 Attn: Martin Luymes Email: mluymes@hrai.ca

A Party may, from time to time, change its address for service hereunder by notice to the other Party.

IN WITNESS WHEREOF, this Agreement has been duly executed by the Parties as of the date first above written.

ENBRIDGE GAS DISTRIBUTION INC.

APPROVED AS TO FORM LEGAL

Per: _____
Name: Malini Giridhar
Title: Vice President, Market Development Public & Government Affairs

Per: _____
Name: Scott Podd
Title: Director Business Development

ONTARIO GEOTHERMAL ASSOCIATION

Per: _____
Name: Jim Bolger
Title: President

Per: _____
Name: Stanley Reitsma
Title: Vice President

EXHIBIT "A"

GOVERNANCE

EXECUTIVE OVERSIGHT AND STRATEGY COMMITTEE

1. Composition: The Executive Oversight and Strategy Committee (the "**Executive Committee**") shall consist of four (4) voting members and non-voting advisors.

2. Voting Members: The voting members will consist of two co-chairs (one each from the OGA and Enbridge) and two other voting members (one each from the OGA and Enbridge), one of whom will also act as Secretary. The initial members and roles of the Executive Committee shall be:

   i. Jim Bolger, OGA, Co-Chair;
   ii. Steve McGill, Enbridge, Co-Chair;
   iii. Stan Reitsma, OGA; and
   iv. Owen Schneider, Enbridge.

3. Non-Voting Advisors: Any non-voting advisors appointed to the Executive Committee must be by mutual agreement by the Parties, and shall not exceed three advisors per Party.

4. Responsibilities: The Executive Committee shall have the following responsibilities:

   i. Setting the strategic direction of the GCA and approval of all activities.
   ii. Approval of any key messaging and advocacy efforts and timing.
   iii. Approval of the addition of any Additional Participants including the role, terms, and other conditions.
   iv. Approval of which Party takes on project management role(s), including taking the lead on project management and daily tactical execution on various GCA elements.
   v. Approval of any expenditures in support of the GCA.
   vi. Removal of internal barriers and ensuring organizational alignment to the GCA.

5. Frequency of Meetings and Update Calls: Meetings will be conducted as follows:

   i. Monthly face-to-face meetings (location to alternate been the OGA and Enbridge offices in Toronto).
   ii. Bi-weekly half hour update calls that can be conducted by telephone.
   iii. Otherwise, on an as needed based on issues.

EXHIBIT "B"

COLLABORATION PARTICIPANTS

Jim Bolger

Stan Reitsma

Martin Luymes

EXHIBIT "C"

FORM OF CONFIDENTIALITY AGREEMENT

Mutual

CONFIDENTIALITY AGREEMENT

THIS AGREEMENT made as of _____.

B E T W E E N:

ENBRIDGE GAS DISTRIBUTION INC.

- and -

_____

WHEREAS the parties wish to exchange information and enter into discussions on a confidential basis for the purpose collaborating on geothermal initiatives under the framework set out in the Collaboration Agreement between Enbridge Gas Distribution Inc. and the Ontario Geothermal Association dated ("OGA") as of February 17, 2017 (the "Purpose")

AND WHEREAS _____ is a [member, director (state relationship to the OGA)] of the OGA;

AND WHEREAS in relation to the Purpose, it may become necessary for the parties to provide each other with information and/or documentation that each party herein considers confidential in nature;

NOW THEREFORE in consideration of each party being provided with such Confidential Information (as hereinafter defined) and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the parties hereto covenant and agree as follows:

1. "Confidential Information" shall mean all information relating to the current or proposed business, operations and assets of each party hereto, their present and future parent companies, affiliates and subsidiaries or the Purpose (whether communicated orally, in writing or in electronic media), which either party hereto respectively treats as confidential or proprietary, including, but not limited to, contracts, letters of intent, financial statements, valuation information, cost and expense data, environmental data, production data, customer information, technology (including information technology), business plans, research, strategies and any other information that is not generally ascertainable from public or published information.

   "Confidential Information" shall not include information which:

   (a) was already known to or owned by the recipient prior to the date of disclosure by the disclosing party hereto;

   (b) at the time of disclosure or thereafter becomes public knowledge through no fault or omission of the recipient; or

   (c) is lawfully obtained by the recipient on a non-confidential basis from a third party who, to the knowledge of the recipient, is not under any obligation of confidence to the disclosing party hereto.

Any party claiming that any of the foregoing exceptions apply shall have the onus of establishing such applicability.

2. Each party agrees that it, and its affiliated entities, will keep confidential and will require their respective directors, officers, employees, consultants, agents, advisors, affiliated entities and representatives receiving Confidential Information to keep confidential, all Confidential Information disclosed by the disclosing party hereto. Each party hereto further agrees that it will neither use nor disclose to others, nor permit the use or disclosure by their respective directors, officers, employees, consultants, agents, advisors, affiliated entities and representatives, of any such Confidential Information except as may be required for the purposes expressly set forth in this Agreement. Without limiting the foregoing, neither party shall be permitted to disclose the existence of this Agreement or the fact that the parties are engaging in the confidential discussions described above without the express written consent of the other party.

3. Each party hereto agrees to disseminate the other party's Confidential Information only to its affiliated entities, and its and their respective directors, officers, employees, consultants, agents, advisors or representatives, if any, directly concerned with the Purpose who have a reasonable need-to-know and to ensure that such persons are made aware of this Agreement and agree to be bound by it or are bound by a duty of confidentiality by virtue of their relationship to the applicable party. The foregoing shall not release either party of any obligations hereunder, including, but not limited to, its responsibility for unauthorized use or disclosure and each party hereto shall defend, indemnify and hold harmless the other party from and against all suits, actions, damages, claims and costs arising out of any breach of this Agreement by any of its respective directors, officers, employees, consultants, agents, advisors, affiliated entities and representatives.

4. Either party may disclose the other party's Confidential Information to the extent required by a court of competent jurisdiction or other governmental or regulatory authority or otherwise as required by applicable law, provided that the party that has received the request or order must first give the other party prompt notice (except where the governmental or regulatory authority has expressly ordered that no notice be given) and must make reasonable efforts to obtain a protective order.

5. Neither party represents or warrants that any Confidential Information disclosed by it to the other party is accurate or complete, or that such Confidential Information constitutes any representation, warranty, assurance or guarantee to the other party with respect to the infringement of rights, including, without limitation, intellectual property and privacy rights, of third persons. Neither party shall be liable for any errors or omissions in its Confidential Information.

6. All Confidential Information shall remain the exclusive property of the disclosing party. No license under any trade-mark, trade secret, patent or copyright is either granted or implied by the disclosure or use of any Confidential Information disclosed hereunder.

7. Immediately upon the written request of either party, the receiving party shall return to the disclosing party all Confidential Information provided to it by the disclosing party, including all originals and all summaries and partial and complete copies thereof. If the disclosing party or receiving party requests the destruction, and not the return, of such Confidential Information, the receiving party shall provide the disclosing party with written certification of a duly authorized officer of the receiving party attesting to the destruction of the Confidential Information, including all originals and all summaries and partial and complete copies thereof. Notwithstanding the foregoing, the receiving party will not be required to return, destroy, delete or redact Confidential Information that has been saved to a back-up file in accordance with the receiving party's commercially reasonable information security policies (including but not limited to applicable back-up and records retention policies), so long as the back-up file is secured by the receiving party in a commercially reasonable manner against unauthorized use or access by a third party or by the receiving party's representatives, and further provided that such back-up files will be deemed to constitute Confidential Information and remain subject to the terms of this Agreement.

8. Notwithstanding the return or destruction of all or any part of the Confidential Information, the terms of this Agreement shall nevertheless remain in full force and effect until seven (7) years from the date hereof.

9. Each party hereunder agrees that the other party would be irreparably injured by a breach of this Agreement by such party, its affiliated entities, or their respective directors, officers, employees, consultants, agents, advisors, affiliated entities and representatives and that the party not in breach shall be entitled to equitable relief, including injunctive relief and specific performance, in the event of any breach of the provisions of this Agreement. Such remedies shall not be deemed to be the exclusive remedies for a breach of this Agreement but shall be in addition to all other remedies available at law or equity.

10. This Agreement shall be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable therein and the parties hereby irrevocably attorn to the jurisdiction of the Courts of the Province of Ontario.

11. This Agreement constitutes the entire agreement between the parties and supersedes any and all prior understandings with regard to the subject matter hereof and shall be binding upon the parties hereto and their respective successors, assigns and affiliates and may be modified only in writing signed by the parties hereto.

12. No waiver of any of the provisions or a breach of this Agreement shall constitute a waiver of any other provision or other breach of this Agreement unless expressly provided otherwise. No waiver shall be binding unless executed in writing.

13. Neither party may assign its rights and obligations hereunder without first obtaining the express consent in writing to such assignment from the other party.

14. If any provision of this Agreement is found to be illegal or unenforceable, the remainder of this Agreement shall be enforced as fully as possible and the unenforceable provision shall be deemed modified to the limited extent required to permit its enforcement in a manner most closely representing the intention of the parties hereto as expressed herein.

15. Neither the holding of discussions by the parties nor the disclosure of Confidential Information will be construed as an obligation on the part of either party to refrain from engaging at any time in the same business or any business similar or dissimilar to the business in which the other is now engaged. Further, except as otherwise agreed in writing, Confidential Information received concerning the other party's future plans is tentative and does not represent firm decisions or commitments by either party. Either party may meet with third persons and may receive information similar to the Confidential Information which the party receives under this Agreement.

16. This Agreement may be executed by the parties in separate counterparts, each of which when so executed and delivered will be deemed to be an original, and all such counterparts will together constitute one and the same instrument. Delivery of signed counterparts of this Agreement by facsimile or other electronic means shall constitute valid and effective delivery.

[The following page is the signature page.]

IN WITNESS WHEREOF the parties have executed this Agreement by the signatures of their duly authorized representatives set out below.

Dated as of the date first set out above.

Legal Name:_____

By: _____

Name:
Title:

By: _____

Name:
Title:
(Please print name and title of Signing Officer)

Witness: _____
Name:

(Witness required if an individual)

ENBRIDGE GAS DISTRIBUTION INC.

By:
_____
Name
Title:

By:
_____
Name:
Title:

ANWAATIN INTERROGATORY #2

INTERROGATORY

Issue 1

Reference:
- Exhibit B / Tab 1 / Schedule 1 / pp. 21-22, #61 and #62; p. 23, #65; and p. 70, #70
- Issues 1.2, 4.1, and 4.2

Preamble: Enbridge states that it will see complementary investments between customers, Enbridge, and Green Ontario Fund (**GreenON**) funding. Enbridge will own and maintain the geothermal loops while customers will own and maintain the heat pump system that will receive GreenON funding to offset some of that cost. GreenON's website provides a list of contractors for the procurement and installation of geothermal systems.[1]

a) Please explain how Indigenous rights-holding communities will be, or can be, involved in the procurement and installation of geothermal systems.

b) Please explain how bona fide Indigenous contractors will be involved in the procurement and installation of geothermal systems.

c) Please explain why selling and installing geothermal loops for households within First Nations should be considered part of Enbridge's regulated business (i.e., a core utility business).

d) Please explain, given the investment framework, how Enbridge will accommodate geothermal loops serving multiple First Nation households and/or institutional buildings.

RESPONSE

a) Please see the Company's response to part b) below.

b) The Ontario Geothermal Association (the "OGA") has formed a Technical Training and Certification Committee, entered into discussions with the Ontario College of Trades, worked with the IESO and the Green Ontario Fund on program guidelines

[1] Green Ontario Fund, "Find a Contractor", available online: https://www.greenon.ca/find-a-contractor.

and secured training for geothermal system installers and designers through an arrangement with the International Ground Source Heat Pump Association ("IGSHPA"). Any Indigenous contractors with an interest in becoming qualified to install geothermal heating / cooling systems could contact the OGA with respect to their installer training and certification program or look into other means of attaining recognized qualifications. Once qualified, Indigenous contractors will be able to compete for this work as would any other qualified geothermal heating /cooling contractor.

c) Please see the Company's responses to Board Staff Interrogatory #3, part a) at Exhibit I.1.EGDI.STAFF.3 and the response to Energy Probe Interrogatory #2 at Exhibit I.1.EGDI.EP.2.

d) Enbridge's Geothermal Energy Service proposal is designed for the low-density residential market. Please see response to Enwave Interrogatory #5 at Exhibit I.1.EGDI.ENWAVE.5.

ANWAATIN INTERROGATORY #3

INTERROGATORY

Issue 1

Reference: • Exhibit B / Tab 1 / Schedule 1 / pp. 21-23, #61-63, #66 and p. 25, #74
• Issues 1.2, 2.4, 4.1 and 4.2

Preamble: Enbridge indicates that it plans to implement its GES Program in 2018 as a greenhouse gas (**GHG**) emission abatement program to offset natural gas usage. Enbridge also indicates that geothermal systems provide space heating, water heating and cooling, and are typically electrically powered. Enbridge states that it sees geothermal systems as a key way to abate GHG emissions. Deploying geothermal systems where natural gas would otherwise be consumed will offset natural gas usage. Many First Nation communities are not currently served by natural gas.[1]

a) Please explain, with respect to First Nation communities in Ontario, whether the GES Program is intended to facilitate the installation of ground source heat pumps solely in homes currently heated with natural gas.

b) Please confirm that the GES Program will not include installing ground source heat pumps in electrically- or wood-electric-heated First Nation homes and other buildings.

c) Please confirm that the GES Program will not include installing ground source heat pumps in propane-heated First Nation homes and other buildings.

d) Please outline Enbridge's analysis demonstrating that installing a geothermal system in a home on a First Nation reserve — currently heated with natural gas or heated through other means — will be cost-effective for a typical household customer (e.g., when a heat pump is installed in a natural gas-heated home, the net impact on the customer's electricity bill and the customer's natural gas bill would be reduced overall for years 1 to 10).
   i) If Enbridge has not completed this analysis, please conduct this analysis and provide all supporting documentation including data, assumptions, and analysis for existing heating of typical First Nation reserve homes with (1) natural gas, (2) electricity, and (3) for typical wood-electric heating appliances.

[1] See EB-2016-0004, Final Argument of Anwaatin Inc. (June 20, 2016).

ii) If Enbridge has completed this analysis, in addition to outlining the analysis, please provide all supporting documentation including data, assumptions, and analysis for existing heating of typical First Nation reserve homes with (1) natural gas, (2) electricity, and (3) for typical wood-electric heating appliances.

e) Please explain Enbridge's intentions or plans to expand natural gas services to First Nation reserve communities throughout its current and future (Union Gas) service areas to ensure that the program is intentionally inclusive of First Nation reserve households as potential beneficiaries.

RESPONSE

a) and b) Please see response to Board Staff Interrogatories #10 a) and #12 a) filed at Exhibits I.2.EGDI.STAFF.10 and I.2.EGDI.STAFF.12.

c) Please see response to part a) above.

d) Please see Board Staff Interrogatory #10 c) filed at Exhibit I.2.EGDI.STAFF.10 for a comparison with natural gas. Enbridge has not performed the requested analysis of wood-electric heated or electric homes.

e) In this proceeding Enbridge is proposing a Geothermal Energy Service and RNG Enabling service. Natural gas system expansions are not part of this proceeding.

APPrO INTERROGATORY #1

INTERROGATORY

Issue 1

Reference: Exhibit B1, Tab 1, Schedule 1

Preamble: Enbridge proposes to introduce certain rate regulated services and rate base certain assets. Enbridge further proposes that the ratepayers, bear at least some of the financial risks of the success of the project as the annual sufficiency/deficiency of these programs is proposed to be included in the Cap & Trade Compliance Obligation Variance Accounts.

Question:

(a) In the event that the Board does not approve Enbridge's request to regulate the RNG Enabling Program and the Geothermal Energy Service Program, will Enbridge or a non-regulated affiliate, seek to invest in these potential opportunities on a non-rate regulated basis? If the answer is 'no', please fully explain why Enbridge or the customer would not want to take the risk of offering these services on a non-regulated basis.

RESPONSE

(a) In the event that the Board does not approve Enbridge's request to include the RNG Enabling Program and the Geothermal Energy Service Program within the regulated utility, Enbridge will determine whether or not to proceed with these initiatives and if they are to be implemented how best to situate them within the organization.

APPrO INTERROGATORY #2

INTERROGATORY

Issue 1

Reference: Exhibit B1, Tab 1, Schedule 1

> "With respect to the advancement of RNG production in Ontario, Enbridge sees its role as that of a facilitator that can assist RNG producers in the process of upgrading raw untreated biogas into pipeline quality RNG and the injection and transportation of this gas to market. Over the course of the past eighteen months, the Company has conducted discussions with several municipalities and other potential RNG producers with respect to the services Enbridge could provide to accelerate the development of RNG production capacity in its service area. Enbridge believes this will support the growth of RNG production which will facilitate lower cost RNG to supply market demand. This dialogue has led the Company to develop the RNG enabling program described in this submission which is based on utility investment in RNG upgrading and injection equipment."

Questions:

(a) Is Enbridge proposing to have a monopoly franchise over the upgrading and injection of RNG into its natural gas system?
(b) Describe the competitive environment in Ontario related to either (i) upgrading RNG; or (ii) injecting RNG into the natural gas system; or (iii) both? If there are other companies that are currently offering any of these services please identify those companies and provide information on their service offering. If Enbridge reasonably anticipates that a competitive market will develop in this area, please provide an explanation of the anticipated market evolution assuming first that the Board approves Enbridge's proposed RNG services and secondly assuming it does not approve these services.
(c) Provide a list of any and all risks ratepayers will be exposed to if the OEB approves Enbridge's proposal to undertake this new business activity, together with a qualitative, and if possible quantitative, description of the risk.
(d) The converse of (c) - provide a list of any and all risks ratepayers will be exposed to if the OEB does not approve Enbridge's proposal to undertake this new business activity, together with a qualitative, and if possible quantitative, description of the risk.
(e) Describe any and all potential alternative sources of funding (other than ratepayers) available from the Provincial Government, the Federal Government,

granting agency, or an alternative source, that could support the proposed business activity.

(f) Describe any precedents whereby the OEB has previously permitted RNG upgrading and injection equipment to be included in ratebase of a regulated utility in Ontario. If there are none, say so.

(g) Describe any precedents whereby a utility regulator in another jurisdiction in North America that is similar in nature and function to the OEB has previously permitted RNG upgrading and injection equipment to be included in ratebase of a regulated utility. Pay particular attention to other jurisdictions that are also members of the Western Climate Initiative (WCI). If there are none, say so.

RESPONSE

(a) Enbridge is not proposing to have a monopoly franchise over the RNG upgrading. Enbridge's position is that it must be the party that provides the injection facilities.

(b) Please see the Company's response to Board Staff Interrogatory #1 filed at Exhibit I.1.EGDI.STAFF.1. Enbridge is not aware that any party is currently offering the turnkey cost of service upgrading service option. It is not currently clear how the market may develop in the future.

(c) Given that the Company will employ the OEB approved EBO 188 Feasibility Guideline as the basis for the determination of the revenue requirement to ensure the economic feasibility of its RNG enabling services, the risks faced by ratepayers will be equivalent to those they face today in respect of any other utility investment. Customers will sign contracts with Enbridge with a fixed fee for the term of the contract and will provide security for their obligations where appropriate.

(d) The principal risk ratepayers will be exposed to if the OEB does not approve Enbridge's proposal to undertake this new business activity will stem from the loss of the opportunity to have a physical hedge against escalating carbon costs. Further, it is expected that in the near future either, the federal government, the Ontario government or both will introduce a Low Carbon Fuel Standard(s) or a minimum renewable content standard(s) that the Company will need to meet. By facilitating the development of local RNG production, there will be more Ontario RNG supply and potential price competition that will serve to reduce the cost that will be incurred by the Company to meet these standards.

(e) Ratepayers will not be funding the RNG Enabling Program. It will be paid for by contracting parties. The only other source of government funding that the Company is aware that is currently available that may support the development of RNG upgrading facilities is the Green Ontario Challenge. This program is focused on

projects that propose low-carbon technologies and/or improving processes in buildings or the production of goods. There may also be other sources of Federal or Provincial funding available, but no other specific applicable programs are currently identified.

(f) The Company is not aware of any precedents whereby the OEB has specifically permitted RNG upgrading and injection equipment to be included in ratebase of a regulated utility. Injection equipment for conventional natural gas is customarily included in utility ratebase.

(g) Please see the Company's responses to Board Staff Interrogatory #1, part d), filed at Exhibit I.1.EGDI.STAFF.1, and Canadian Biogas Association Interrogatories #10 and #13 filed at Exhibit I.2.EGDI.CBA.10 and Exhibit I.2.EGDI.CBA.13. California is a member of the Western Climate Initiative (WCI).

APPrO INTERROGATORY #3

INTERROGATORY

Issue 1

Reference: Exhibit B1, Tab 1, Schedule 1

> *"Enbridge has been working with the Ontario Geothermal Association ("OGA"), the MOECC, and the MOE to find solutions that will overcome these barriers faced by the geothermal industry which will lead to further the adoption of ground source heating and cooling systems. The solution that Enbridge has developed is a utility service that combined with financial support from the MOECC's Greenhouse Gas Reduction Account ("GGRA") administered by the Green Ontario ('GreenON") Fund will make this technology cost competitive compared to more traditional building heating and cooling alternatives. Enbridge will own and maintain the geothermal loops while customers will own and maintain the heat pump system."*

Preamble: APPrO members are engaged in the generation of electricity, including through use of combined heat and power systems. Enbridge's geothermal proposal would create a risk for existing CHP systems and technologies.

Questions:

(a) Is Enbridge proposing to have a monopoly franchise over the ownership and maintenance of geothermal loops?
(b) Describe the competitive environment in Ontario related to (i) installation, ownership and operation of geothermal systems as a whole; or (ii) ownership and maintenance of geothermal loops in particular?
(c) Approximately how many geothermal systems have been installed in Ontario? To the extent possible, differentiate between individual homeowner systems, moderate systems for commercial (or farm) use, and larger systems for industrial use.
(d) Provide a list of the risks that the individual or business that chooses to install a geothermal energy system (the "Benefiting Customers") would be exposed to if the OEB does not approve Enbridge's proposal to undertake this new business activity, together with a qualitative, and if possible quantitative, description of the risk.

(e) Provide a list of any and all risks ratepayers will be exposed to if the OEB approves Enbridge's proposal to undertake this new business activity, together with a qualitative, and if possible quantitative, description of the risk.
(f) Provide a list of any and all risks ratepayers will be exposed to if the OEB does not approve Enbridge's proposal to undertake this new business activity, together with a qualitative, and if possible quantitative, description of the risk.
(g) Describe any and all potential alternative sources of funding (other than ratepayers) available from the Provincial Government, the Federal Government, granting agency, or an alternative source, that could support the proposed business activity. Why is ratepayer funding needed?
(h) Describe any precedents whereby the OEB has previously permitted the ownership and operation of geothermal loops to be included in ratebase and operations of a regulated utility in Ontario. If there are none, say so.
(i) Describe any precedents whereby a utility regulator in another jurisdiction in North America that is similar in nature and function to the OEB has previously permitted ownership and operation of geothermal loops to be included in ratebase and operations of a regulated utility. Pay particular attention to other jurisdictions that are also members of the Western Climate Initiative (WCI). If there are none, say so.

RESPONSE

(a) No.

(b) Please see the response to SEC Interrogatory #11, filed at Exhibit I.1.EGDI.SEC.11. Please also see Exhibit B, Tab 1, Schedule 1, paragraph 65.

(c) Based on available data from the Canadian Geo-exchange Coalition, the company estimates there were 30,000 systems installed in Ontario from 2007-2011 with the majority of installations in single family residential homes. Prior to 2007, the number of installations Nation-wide ranged from 1000-5000 per year with available data dating back to 1996. Please see Attachment 1 to this response for further information.

(d) Due to the lack of inspection and quality assurance requirements for geothermal systems, a potential homeowner is exposed to risk involving both in the design and installation and commissioning stage including: under-sizing of the system relative to the home, under-sizing of the loop relative to the heat pump system installed causing an imbalance in the surrounding ground temperate and freezing of the loops which leads to bad performance. Enbridge's Geothermal Energy Services

program will address these risks though appropriate standards and installation practices.

(e) The proposed geothermal energy service program is designed using principles of EBO188 in a manner to minimize risk to existing ratepayers.

(f) If the Geothermal Energy Services (GES) program is not approved, then current ratepayers will miss the opportunity identified in the response to OGA Interrogatories #6 and #9, filed at Exhibit I.1.EGDI.OGA.6 and 9. Additionally, current or future ratepayers who wish to take advantage of geothermal heating / cooling service under the GES model will lose that option. Please see response to Board Staff Interrogatory #2a) filed at Exhibit I.1.EGDI.STAFF.2 which outlines the market transformation aspects of the GES proposal.

(g) The Ontario government has already announced Green Ontario Fund grants that are now available to homeowners up to $20,000 defray the cost of a geothermal heating / cooling system. Even with these grants, the typical homeowner will still be faced a greater initial cost for this type of system compared to a conventional natural gas electric air conditioner combination. The Company is not aware of any other currently available source of government or other funding that would further reduce the initial cost of a geothermal heating / cooling system. Under the Company's Geothermal Energy Service proposal, the capital investment is funded by shareholders not ratepayers, ratepayer impact is only temporary to cover early year revenue deficiencies of the program just as it is today with respect to the addition of new natural gas distribution customers. The proposed GES service fee is set to provide a sufficiency back to ratepayers in the future years.

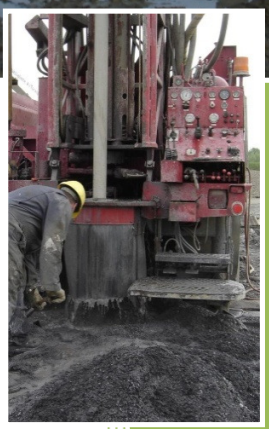
(h) The Company is not aware of any situations where the OEB has previously permitted the ownership and operation of geothermal loops to be included in ratebase and operations of a regulated utility in Ontario.

(i) Please see response to Board Staff Interrogatory #3, filed at Exhibit I.1.EGDI.STAFF.3.

Canadian GeoExchange Coalition
Coalition canadienne de l'énergie géothermique

The State of the Canadian Geothermal Heat Pump Industry 2011

Industry Survey and Market Analysis



February 2012

Acknowledgements

The CGC is grateful to the installers, designers, contractors and other Canadian industry stakeholders who participated in the many consultations and surveys conducted by the CGC in the past five years. They have clearly demonstrated their desire to contribute to the national efforts deployed by the CGC to better understand the nature of our industry and provide government, utilities and other stakeholders with the best neutral market information available.

The statistics presented in this report have been gathered from different sources over a period of more than five years. Sources include three CGC annual industry surveys and market data collected directly from close to 500 installation companies through the CGC Company Qualification Market Survey. It also includes the CGC certification database, which includes technical information on over 16,000 residential systems installed by more than 800 companies. Additional information was taken from selected companies' annual reports as well as from documents published by government agencies. The CGC Research Unit, comprised of two economists, an engineer, a geographer, an MBA and co-op students from the University of Sherbrooke with, a combined experience of over 50 years in market research, analysed the information and prepared this report.

Special thanks go to Maxime Leroux, a co-op student in Economics from the University of Sherbrooke, for his rigorous work in gathering and computing the most recent set of data during the fall of 2011.

Denis Tanguay

President & CEO
Canadian GeoExchange Coalition

Highlights

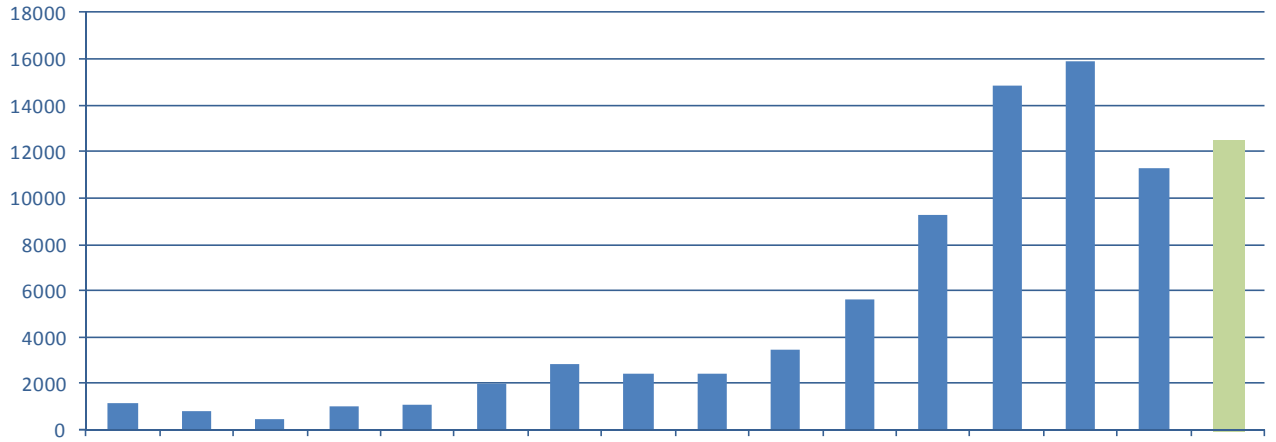
- ✓ After many years of sustained growth, the Canadian geothermal heat pump industry experienced a significant set-back in 2010 with an estimated decline of roughly 28%. Early estimates tend to show that the markets re-bounded and stabilized in 2011 for Canada as a whole.
- ✓ Together, Ontario, Québec and British Columbia represented about 87% of the GHP market in 2010 compared to 76% in 2007.
- ✓ Manitoba is the only Canadian province which experienced annual market decline in each of 2007, 2008, 2009 and 2010. In fact, the market for GHP crashed by 64% between 2007 and 2010, by far the worst performance of all Canadian provinces.
- ✓ Ontario, Saskatchewan and New Brunswick lead in terms of units installed per capita. Boasting the highest number of units per capita in 2007, Manitoba dropped to fourth place the year after, a position held by the province since, now followed very closely by British Columbia, Prince Edward Island and Québec.
- ✓ Looking at the industry average over 2008-2010, 56.4% of residential systems had a horizontal ground heat exchanger (GHX) and 24.2% had a vertical GHX. Open loop systems follow with 13% of residential applications while pond and lake loops account for 6.4%.
- ✓ In Canada, thousands of GHP systems have been installed in existing homes since 2007. For the years 2008 to 2010 taken together, these systems replaced heating oil and electricity in nearly equal proportions of 39.2% and 39.1% respectively. Propane displacement follows with 10.1%, natural gas with 7.2% and a combination of wood, wood pellets, heating oil and electricity and fuel oil and wood in 4.5% of cases.
- ✓ In 2010 for example, the average vertical GHP system sold for $7886 per ton in Canada compared to $6116 per ton for a GHP system with a horizontal GHX. The total average price for a 4-ton system is $31,544 for a GHP system with a vertical GHX and $24,464 for a system with a horizontal GHX.
- ✓ About 80% of all GHP systems sold in Canada are equipped with an auxiliary heating unit.
- ✓ One important heat pump brand lost significant market share between 2008 and 2010. This major decline in a growing market benefited smaller suppliers while the other top brands maintained their positions or slightly improved.
- ✓ In Canada, 20% of all the residential GHP installations are done by 9 companies and 50% of all installations by 47 companies.
- ✓ In recent years, the Canadian GHP industry became generally more competitive as manufacturing and distribution capacity improved in a fast-growing market environment.

General Industry Trends

1.0 Overall Trends[1]

After many years of sustained growth, the Canadian geothermal heat pump industry experienced a significant set-back in 2010 with an estimated decline of roughly 28%. As noted in a previous report, the market for geothermal heat pumps grew by more than 40% in 2005 and by more than 60% annually in 2006, 2007 and 2008. The market increased by an additional 5% in 2009 before declining in 2010, the first decline since 2003. Early estimates tend to show that the markets stabilized in 2011 for Canada as a whole.

Figure 1
Units Installed - All Markets



As more statistics become available, and as our analytical capacity improves, the CGC is increasingly in a position to draw interprovincial comparison and identify or qualify market failures and market successes for various sub niches. Figure 2 shows the number of GHP units installed per province over four years, 2007 to 2010 for all market segments.

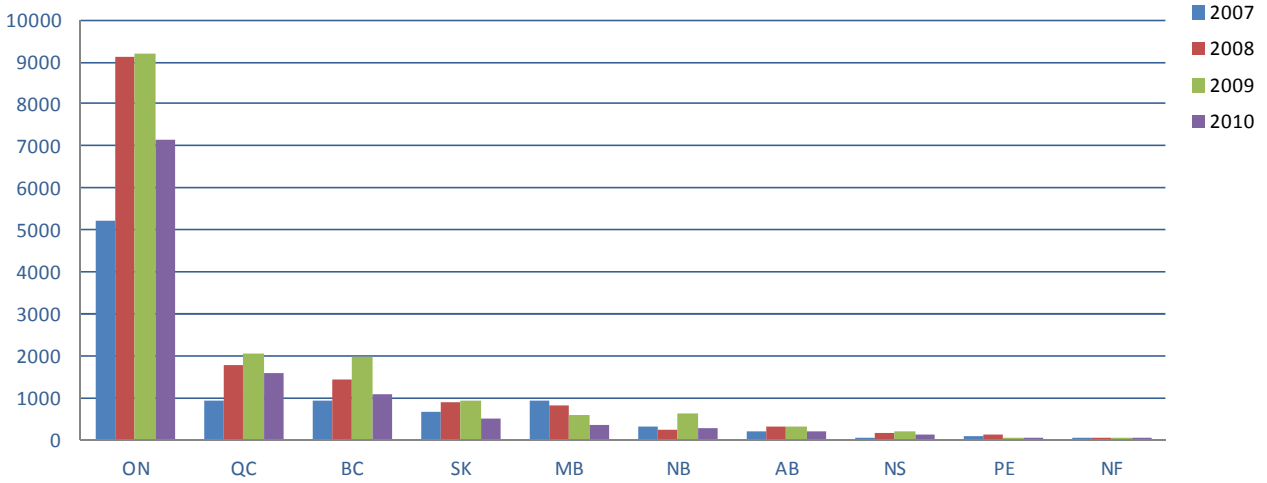
Figure 2 shows that provinces with the largest population account for a significant part of the overall Canadian market. Together, Ontario, Québec and British Columbia represented about 87% of the GHP market in 2010 compared to 76% in 2007. Overall, the markets in Atlantic Canada remained relatively stable over the 4-year period. In the Prairies, the number of units installed in 2010 was lower than in 2007 in all three provinces. The number of units installed in Alberta in 2010 is slightly under the achieved level of 2007 but grew in 2008 and 2009. Saskatchewan declined 24% in 2010 compared to 2007 after two solid years in 2008 and 2009.

Manitoba is the only Canadian province which experienced annual market decline in each of 2007, 2008, 2009 and 2010. In fact, the market for GHP crashed by 64% between 2010 and 2007, by far the worst performance

[1] The information presented in this section (figures 1 to 4) covers all market segments. The balance of the report discusses residential applications only.

of all Canadian provinces. This is highly surprising as the province of Manitoba was long seen by many as a model and an example to follow. In 2010, Manitoba represented 3% of the Canadian GHP market, down from 10% in 2007. Obviously, something went awfully wrong.

Figure 2
Number of Units Installed by Province



The interprovincial trend is illustrated in Figure 3. Figure 3 shows the number of units installed indexed to 100 for each province. As we can clearly see from this graph, provinces such as Nova Scotia and Québec improved their respective situation quite significantly in 2007 over 2010. Other provinces such as Ontario and British Columbia also fared well while New Brunswick and Newfoundland mostly had stable markets. The growth patterns in Alberta and Saskatchewan are comparable and the continuous and steady decline of Manitoba observed once again.

Figure 3
Relative Market Growth (Index 2007 = 100)

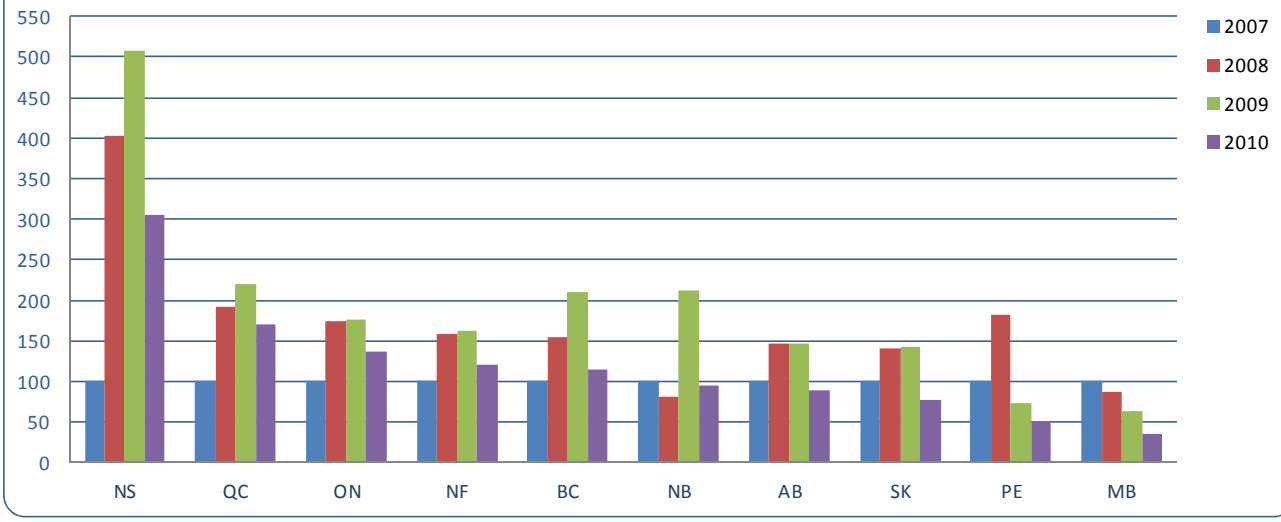
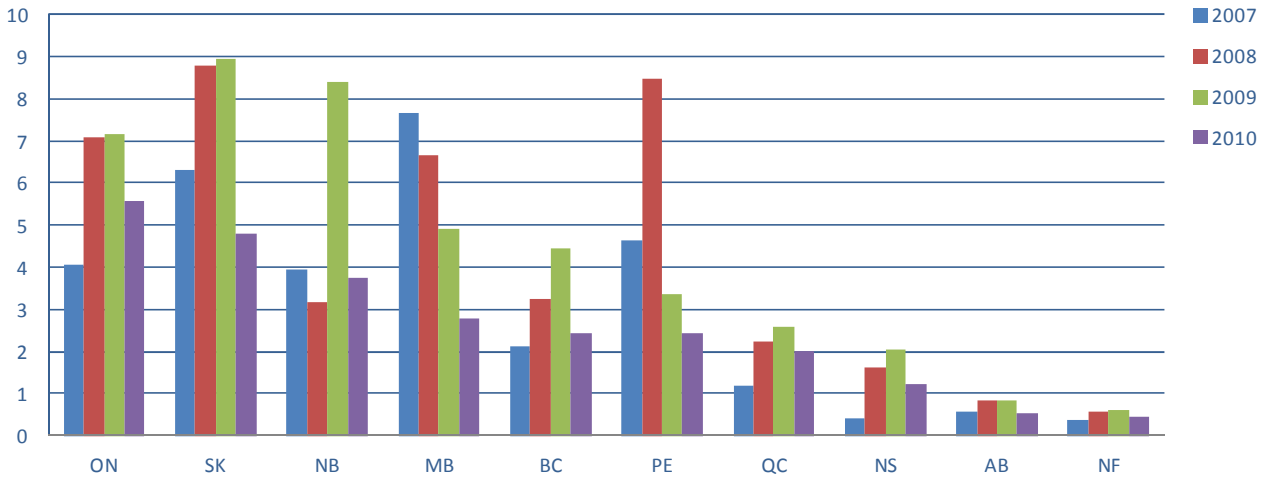


Figure 4 is instructive in a number of ways and shows the number of units installed per capita. In this figure, the province ranking was based on our latest full-year data set, 2010. We can see this when comparing the decline of the purple bar when reading from left to right. In 2010, Ontario showed the highest number of units installed per capita followed by Saskatchewan and New Brunswick. Ontario and Saskatchewan have been leading the country in term of units installed per capita in three consecutive years – 2008, 2009 and 2010. After peaks in 2008 and 2009, the number of units installed in Québec, British Columbia and Nova Scotia decreased in 2010 but remains above 2007 in all three provinces showing a continuous upward trend overall.

Figure 4
Number of Units Per 10,000 Inhabitants by Province



Boasting the highest number of units per capita in 2007, Manitoba dropped to fourth place the year after, a position held by the province since, now followed very closely by British Columbia, Prince Edward Island and Québec. Despite remaining in forth position, we can clearly see the steady decline of units installed per capita in Manitoba.

2.0 Residential Systems by Loop Type

When looking at the industry average over 2008-2010, 56.4% of residential systems had a horizontal ground heat exchanger (GHX) and 24.2% had a vertical GHX. Open loop systems follow with 13% of residential applications while pond and lake loops account for 6.4%. Over the period, there is a slight trend for proportionally fewer horizontal GHXs and more open and pond / lake loops.

Because of Ontario's significant weight in the Canadian GHP industry, national averages are necessarily biased and it is necessary to perform a province by province analysis in order to fully understand the exact nature of the GHP industry. Indeed, the types of GHX installed vary significantly from one province to the other. This wide variation is largely due to varying geological conditions and, to some extent, to population density in those areas.

Figure 5 - Residential Systems by Loop Type Canada (2008-2010)

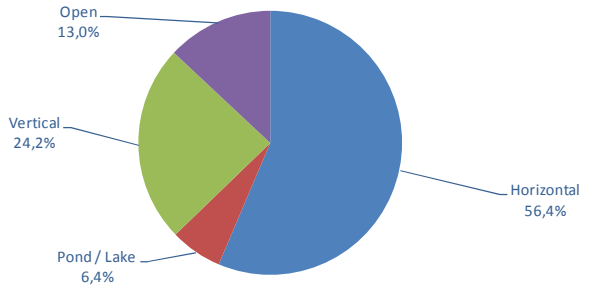
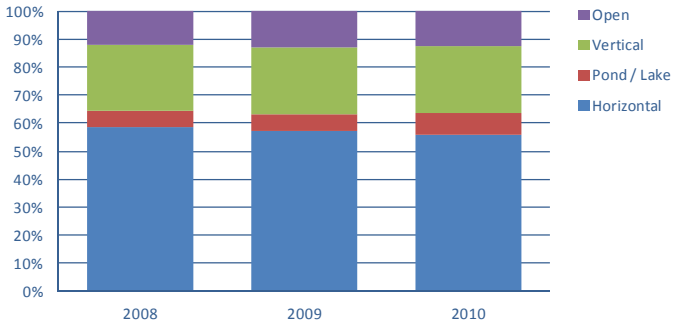


Figure 6 - Residential Systems by Loop Type Canada



Provincial distinctions are extremely important from a market perspective – particularly in terms of industry components used in various parts of the country – but also from a policy and a regulatory perspective. For example, in Prince Edward Island, New Brunswick and Newfoundland, open loops in the residential sector account for 89.7%, 47.1% and 31.6% respectively of all installations. In comparison, open loops account for only 1.6% of the installations in Saskatchewan, 5.3% in Alberta and 7.3% in Québec.

If we exclude Prince Edward Island, the province of Ontario has Canada's lowest penetration rate for vertical GHX at only 15.3% of all systems installed. This is also reflected in the fact that 64.9% of the systems installed in Ontario have horizontal GHX. Looking at the province next door, the opposite situation prevails. Québec has the largest proportion of vertical GHX of all Canadian provinces with a penetration rate of 82.9% and only 8.0% horizontal GHX.

When comparing data for 2008, 2009 and 2010, we found no significant change in loop types used within each province. Although we do observe some movements here and there – largely due to sample size variation – we can safely say that the three year average and annual splits do reflect the current state of the markets in most provinces.

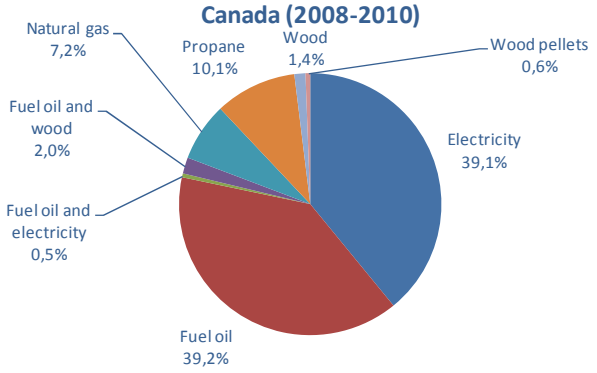
We generally found more consistent patterns across Canada for commercial GHP systems. According to our surveys and market observations, the vast majority of commercial GHP systems have vertical GHX. Other types of heat exchangers are also encountered – open loops for example – but much less frequently. More details will be available in the future as the CGC refines its survey methods and data collection strategies.

3.0 Fuel Replaced – Residential Retrofits

GHP systems are often referred to as renewable energy systems. On the other hand, the notion of moving heat around from the ground to a building and putting heat back from the building into the ground (or a body of water) invites us to treat GHP systems as building technologies, conservation technology or simply energy efficiency technology.

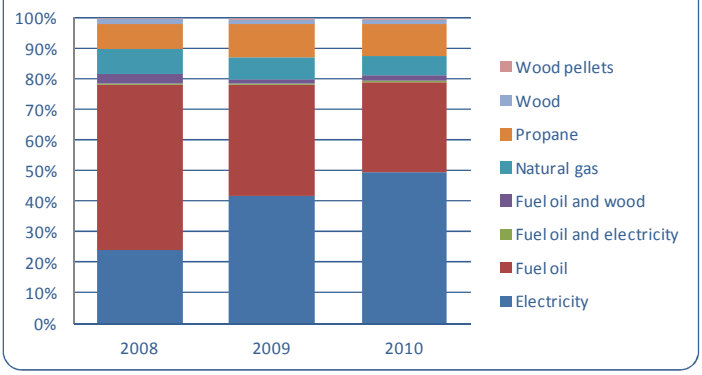
Regardless of the definition however there are some simple undeniable facts common to all GHP systems: (1) they save energy and, (2) they displace or replace other energy sources for heating and cooling purposes. As such, GHP systems help home and building owners save energy and can radically reduce green house gases emissions. In addition, they play a role in the overall energy supply environment by displacing or replacing other forms of energy and on the demand side by reducing global energy use and moderating peaks and valleys.

Figure 7 - Fuel Replaced Canada (2008-2010)



In Canada, thousands of GHP systems have been installed in existing homes since 2007. For the years 2008 to 2010 taken together, these systems replaced heating oil and electricity in nearly equal proportions of 39.2% and 39.1% respectively. Propane displacement follows with 10.1%, natural gas with 7.2% and a combination of wood, wood pellets, heating oil and electricity and fuel oil and wood in 4.5% of cases.

Figure 8 - Trends In Fuel Replaced - Canada



Here again, the provincial portrait if often quite different from the national average. Heating oil is replaced in a larger proportion in provinces such as Saskatchewan, Ontario, Nova Scotia and Prince Edward Island as well as Newfoundland & Labrador. Replacement of electricity (baseboards and central units) is proportionally more important in British Columbia, Manitoba, Québec and New Brunswick.

Natural gas prices have been relatively low in recent years in Canada and it would have been surprising to witness a major fuel switching movement from natural gas to GHP. One interesting observation comes from the increased proportion of electric systems replaced with GHP systems over 2008, 2009 and 2010 in many provinces. For example, in British Columbia, this proportion went from 23% in 2008 to 43% in 2010. In New Brunswick, this proportion was 31% in 2008 but up to 68% in 2010. This trend can also be observed in Ontario, in Manitoba but less so in Québec. One could argue that this trend reflects recent electricity price increases in those provinces or announced / planned increases. Though it makes eminent technical sense from a system point of view, electric heating replacement did not occur at the same rate in all provinces.

4.0 System Prices – Residential Sector

As mentioned in last year's report, average system price is not necessarily an accurate indicator for system price as it includes variables such as home size and relative cost of local construction. On the other hand, average price per BTU-ton, a better indicator, is biased by design practices. A market where systems are designed at 100% of the calculated heat loss will obviously have a higher average price per ton than a market where the systems are designed at 80% or 75% of the calculated heat loss.

Table 1A

Average Price - Vertical Loops

	Average Price / BTU-Ton			Capacity as % of Heat Loss		
	2008	2009	2010	2008	2009	2010
BC	$7 553	$7 581	$7 813	77%	79%	78%
AB	$7 123	$7 682	$7 331	79%	73%	76%
SK	$7 145	$6 899	$7 115	91%	89%	93%
MB	$6 188	$6 309	$6 379	84%	83%	85%
ON	$7 521	$8 138	$8 132	79%	80%	82%
QC	$8 013	$8 359	$8 263	73%	72%	71%
NB	$5 856	$6 784	$6 857	85%	93%	88%
NS	$9 325	$7 472	$8 620	82%	91%	92%
PE	n/a	n/a	n/a	n/a	n/a	n/a
NF	$5 651	$5 239	n/a	74%	77%	n/a
CANADA	**$7 374**	**$7 784**	**$7 886**	**79%**	**80%**	**80%**

Table 1B

Average Price - Horizontal Loops

	Average Price / BTU-Ton			Capacity as % of Heat Loss		
	2008	2009	2010	2008	2009	2010
BC	$5 462	$5 479	$5 890	79%	83%	80%
AB	n/a	$5 807	n/a	n/a	95%	n/a
SK	$5 463	$5 917	$6 348	88%	88%	92%
MB	$5 579	$6 267	$6 363	82%	85%	82%
ON	$5 644	$5 923	$6 100	80%	81%	82%
QC	$6 336	$5 373	$5 523	78%	74%	69%
NB	$4 737	$5 916	$6 752	75%	89%	82%
NS	$6 758	$7 000	$8 405	85%	78%	88%
PE	$7 586	$7 063	$4 058	82%	88%	72%
NF	n/a	$4 878	$6 405	n/a	70%	74%
CANADA	**$5 644**	**$5 921**	**$6 116**	**80%**	**82%**	**82%**

Table 1C

Average Price - Pump Replacement Only

	Average Price / BTU-Ton			Capacity as % of Heat Loss		
	2008	2009	2010	2008	2009	2010
BC	$3 989	$3 682	$5 149	151%	123%	155%
AB	n/a	n/a	n/a	n/a	n/a	n/a
SK	n/a	$5 043	$5 842	n/a	66%	87%
MB	$3 045	$4 406	$2 801	99%	86%	100%
ON	$3 525	$3 716	$3 591	79%	80%	83%
QC	$6 453	$5 998	$5 320	75%	78%	78%
NB	$2 320	$2 957	$3 175	106%	94%	107%
NS	n/a	$3 660	n/a	n/a	86%	n/a
PE	n/a	n/a	n/a	n/a	n/a	n/a
NF	n/a	n/a	$3 482	n/a	n/a	75%
CANADA	$3 602	$3 811	$3 584	79%	85%	84%

The following tables show the average system price per ton of calculated heat loss capacity for horizontal loops, vertical loops and heat pump replacement in existing residential GHP systems. The tables show the average price over three years, 2008, 2009 and 2010 for all Canadian provinces and the average for Canada. In some cases, the sample was too small to be statistically significant and we decided not to present the information.

On average, a GHP system with a horizontal GHX is roughly $1800 cheaper per ton than the vertical GHX option. In 2010 for example, the average vertical GHP system sold for $7886 per ton in Canada compared to $6116 per ton for a GHP system with a horizontal GHX. The total average price for a 4-ton system is $31,544 for a GHP system with a vertical GHX and $24,464 for a system with a horizontal GHX.

4.1 Vertical GHX

It is interesting to see that the lowest price per ton for a GHP system with a vertical GHX is found in Manitoba, a province where GHP markets have been continuously declining

since 2007. The average price per ton for such a system was $6379 in 2010 slightly up from $6188 in 2008. At the other end of the spectrum, the same system cost $8263 in Québec in 2010, up from $8013 in 2008 but down by about $100 from the average price in 2009. This difference could be explained by drilling practices. In Manitoba, it is relatively common to drill only in overburden which will result in a bore field with 5, 10 or even 20 boreholes with a depth of 30 m each. In contrast, drilling for GHP systems in Québec will often be mostly in solid rock at depths of 125-150 m with one or two boreholes only, depending on the system's capacity.

In addition to being more expensive on a per-ton basis, GHP systems with vertical GHX are usually designed in Québec at a much lower percentage of the calculated heat loss. In fact, Québec shows the lowest design ratio of all provinces with system size averaging 73%, 72% and 71% of total heat loss in 2008, 2009 and 2010. This means that the ratio of energy produced by the GHP system with a vertical GHX to system price is the lowest of all provinces. On average, for a comparable unit cost, Québec customers are getting less energy services for their system than in other provinces. The situation is the opposite in Saskatchewan where the average system price per ton is much lower than the Canadian average and where the capacity as percentage of heat loss is among the highest in Canada.

In general, we note that year-over-year price increases have remained relatively modest at 1 or 2 percentage points above inflation in most provinces. The notable exception is New Brunswick where average prices for a GHP system with a vertical GHX increased by 17% between 2008 and 2010 compared to the Canadian average of 6.9%. Despite this increase, it should be noted that New Brunswick still has the second lowest average price per ton in the country. For Canada, the average price increased by 5.6% in 2009 over 2008 and by 1.3% in 2010 over 2009. Likely, this has much to do with provincial relative energy prices, and CGC Research Unit may pursue this analysis in the next update of this report.

4.2 Horizontal GHX

Intuitively, we believe GHP systems with horizontal GHX should be less expensive that vertical GHX. Although the horizontal GHX may require more piping, there are significant savings made on trenching versus drilling. As we saw earlier, horizontal systems are roughly 25% less expensive per ton, than the vertical option.

If we exclude provinces where sample size is relatively small, surprisingly, Québec is the province showing the lowest average price for GHP systems with a horizontal GHX. As for vertical GHX, the average Québec system capacity as a percentage of the calculated heat loss is also the lowest amongst the provinces. British Columbia also shows a relatively low per ton price at $5890. On the other hand, Nova Scotia has the highest average price of all provinces at $8405 per ton or about 40% above the Canadian average.

Year-over-year price increases for GHP systems with a horizontal GHX were of a comparable magnitude to the vertical GHX. Horizontal GHX prices increased by 4.9% in 2009 over 2008 and by 3.4% in 2010 over 2009. From 2008 to 2010, the largest price increases were observed in New Brunswick (43%), Saskatchewan (16%) and Manitoba (14%).

5.0 GHP System Options – Residential Systems

The figures discussed above include GHP system components such as auxiliary heating units and/or desuperheaters. The penetration rates of these components are presented in Table 2A and in Table 2B. The reader will notice that the penetration rate for auxiliary heating units in Prince Edward Island is much lower than the Canadian average. This could be explained by the fact that the GHP systems in the province are mainly (89.7%) open loops.

Table 2A

Auxiliary Heating Units

	2008	2009	2010
BC	67,0%	70,5%	59,3%
AB	88,9%	90,9%	83,3%
SK	90,6%	88,5%	92,5%
MB	90,5%	92,9%	93,7%
ON	79,9%	78,2%	74,5%
QC	93,8%	93,7%	95,1%
NB	66,2%	81,1%	67,1%
NS	89,2%	78,7%	68,4%
PEI	25,8%	44,4%	16,7%
NFL	100,0%	80,0%	100,0%
CANADA	81,6%	80,8%	77,5%

Table 2B

Desuperheaters

	2008	2009	2010
BC	91,5%	71,3%	65,9%
AB	72,2%	78,8%	100,0%
SK	84,8%	89,8%	85,6%
MB	76,4%	80,4%	77,9%
ON	86,3%	85,6%	82,7%
QC	86,0%	86,8%	82,5%
NB	77,4%	76,8%	81,6%
NS	83,8%	90,7%	73,7%
PEI	96,8%	100,0%	100,0%
NFL	100,0%	80,0%	100,0%
CANADA	85,8%	85,0%	82,2%

About 80% of all GHP systems sold in Canada are equipped with an auxiliary heating unit. In 2010, provinces with the highest penetration rates are Québec (95.1%), Manitoba (93.7%) and Saskatchewan (92.5%). From 2008 and 2010, we observe significant decline in some provinces. In 2010, the penetration rate in British Columbia was down to 59.3% from 76% two years earlier. In Ontario, they went down from 79.9% to 74.5% over the same period and from 89.2% to 68.4% in Nova Scotia.

There were also some interesting movements in the penetration rate of desuperheaters. In British Columbia, they declined from 91.5% in 2008 to 65.9% in 2010. In Ontario and Québec, the penetration rates for desuperheaters declined by 3.5 percentage points. Over the same period, they increased slightly in Saskatchewan and Manitoba.

The inclusion or exclusion of these system components could explain some GHP system price movements in recent years. For example, if the average system price on a per ton basis remained constant and the penetration rate of components declined by 10%, then it could be assumed that the average unitary system price with components increased while the average unitary system price without components decreased. Further analysis could determine the magnitude of these price movements in recent years.

6.0 Market Concentration[2]

In recent years, the Canadian GHP industry became generally more competitive as manufacturing and distribution capacity improved in a fast-growing market environment. Furthermore, as more contractors entered the industry, brands' territorial / distribution exclusivity was challenged by existing contractors who could benefit from increased competition in the marketplace.

Table 3A

Heat Pump Market Share by Brand - Canada

	2008	2009	2010
Brand 1	33,4%	32,2%	33,6%
Brand 2	32,2%	27,8%	20,5%
Brand 3	11,9%	12,4%	13,0%
Brand 4	4,9%	6,1%	5,8%
Brand 5	0,1%	2,8%	6,2%
Brand 6	2,2%	3,3%	3,1%
Brand 7	1,7%	1,7%	2,2%
Brand 8	3,0%	3,1%	2,2%
Brand 9	1,7%	2,4%	3,7%
Brand 10	0,8%	1,1%	1,6%
Brand 11	1,3%	0,8%	1,8%
Brand 12	1,0%	1,4%	0,9%
Brand 13	1,0%	0,9%	0,7%
Brand 14	1,4%	0,7%	0,4%
Brand 15	0,8%	0,6%	0,6%
All Others	2,6%	2,7%	3,7%
Total	100,0%	100,0%	100,0%

Table 3B

Concentration Indexes by Brand - Canada

	2008	2009	2010
C4	82,4%	78,5%	72,9%
C5	85,4%	81,8%	76,1%
HH	0,2343	0,2041	0,1833

Increased demand driven by new contractors entering the industry likely contributed to the introduction of new brands in the market. Existing contractors switching brands also contributed to this market diversification as they were looking for market differentiation. This situation is clearly reflected by movements in brand market share.

As a result of these movements in the market place, industry's concentration ratios improved. The Herfindahl-Hirschman Index (HHI) went from 0.2343 in 2008 to 0.1833 in 2010, moving from the near high concentration measure to a moderate concentration figure. The C4 and C5 concentration indexes also indicate that the largest brands have seen their relative market share decline over the same period, moving from 82.4% to 72.9% market share for the four largest brands and from 85.4% to 76.1% for the five largest brands.

As we can see in Table 3A, brand 2 lost significant market share over the period. This major decline in a growing market benefited smaller suppliers while the other top brands maintained their positions or slightly improved. This was particularly the case for brands 5 and 9 which saw their respective market shares go from 0.1% and 1.7% in 2008 to 6.2% and 3.7% in 2010.

[22] The Herfindahl-Hirschman Index (HHI) is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them. The index involves taking the market share of the respective market competitors, squaring it, and adding them together. A HHI below 0.01 indicates a highly competitive index. A HHI below 0.15 generally indicates an un-concentrated index. A HHI between 0.15 and 0.25 indicates moderate concentration and a HHI above 0.25 indicates high concentration. The four firm concentration ratio, C4, indicates the sum of the industry market share hold by the four largest firms. The five firm concentration ratio, C5, indicates the sum of the industry market share hold by the five largest firms.

The market diversification is also reflected in the market share held by brands outside of the top 15 which saw their share go from 2.6% to 3.7% from 2008 to 2010. Although these figures related to small volumes it indicates an increasingly healthy industry.

Market share by brand in individual provincial markets is also very interesting to observe[3]. The provincial annexes at the end of this report provide extensive detail on market share by brands for each province. Individual provincial markets go from very highly concentrated (Alberta, Prince Edward Island, Saskatchewan, New Brunswick, Nova Scotia, Newfoundland & Labrador) to moderately concentrated (British Columbia, Manitoba, Ontario, Québec).

But provincial data may not reflect the whole story behind concentration indexes. A more detailed and refined analysis using geo-referencing software contrasting brands as well as installation companies allow us to assess regional and sometimes local brand market shares. Here's an example. Considering that installation companies normally operate within a limited radius around their head office, a single contractor representing a large proportion of a particular brand sales within the province will influence the overall concentration ratios of the province although in reality, the market could be heavily concentrated only in one local market while the rest of the province shows moderate to competitive concentration ratios.

Table 4A

Market Share by Installation Company - Canada

	2008	2009	2010
Company No. 1	2,39%	1,88%	2,97%
Company No. 2	2,84%	3,26%	2,74%
Company No. 3	2,42%	2,61%	2,54%
Company No. 4	1,91%	2,76%	2,46%
Company No. 5	0,06%	0,08%	2,20%
Company No. 6	3,51%	3,13%	1,86%
Company No. 7	2,42%	1,66%	1,83%
Company No. 8	0,08%	0,61%	1,77%
Company No. 9	1,66%	1,46%	1,71%
Company No. 10	1,49%	1,85%	1,68%
Company No. 11	0,17%	0,82%	1,57%
Company No. 12	1,07%	0,98%	1,11%
Company No. 13	0,81%	0,98%	1,08%
Company No. 14	2,11%	1,53%	1,06%
Company No. 15	0,81%	1,02%	1,00%
All Others	76,26%	75,38%	72,42%
Total	100,00%	100,00%	100,00%

Table 4B

Concentration Indexes - Installation Companies - Canada

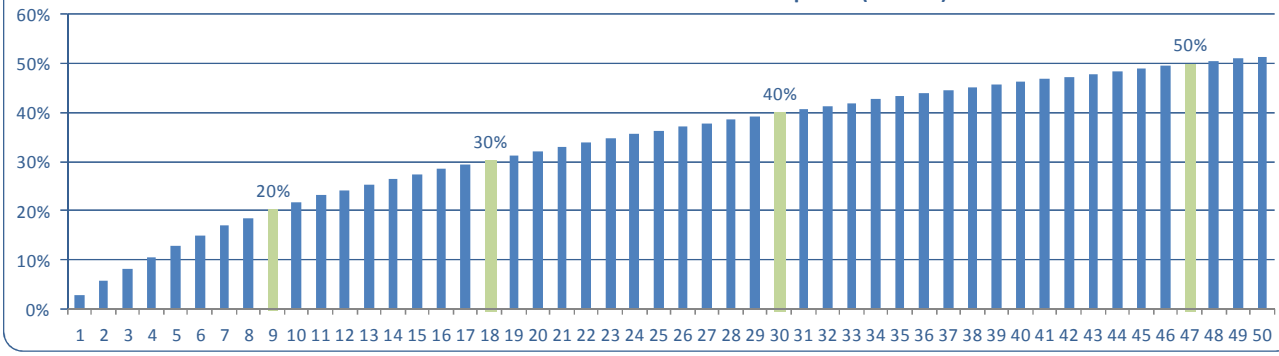
	2008	2009	2010
C4	11,16%	11,76%	10,71%
C5	13,58%	13,64%	12,90%
HH	0,0053	0,0053	0,0056

Alternatively, we could take the hypothetical case of another province which shows a lower concentration index for the province as a whole but where we find highly concentrated regional and local markets for different brands. This could be a sign of collusion between a small group of contractors who informally (or formally) divided the territory between themselves even if they do not sell the same heat pump brand. Some preliminary analysis performed by the CGC Research Unit, indicate that this situation is likely happening in at least one province. Such limitation of competition in the market would necessarily have an impact on market penetration and growth.

[3] Note that the brands ranking in each province reflects the local situation. This means that Brand 1 in Canada is not necessarily Brand 1 in Québec or Brand 3 in New Brunswick not necessarily the same as Brand 3 in Manitoba. In fact, some brands are at the top of the ranking in some provinces but totally out of sight of the top 15 brands in other provinces.

At the Canadian level, it is no surprise that company concentration ratios by installation companies show a highly competitive market. However, because of the local nature of the GHP industry, the national concentration ratios are not necessarily meaningful in understanding the market dynamic. From Table 4A and Table 4B, we see that the relative ranking of the top 15 installation companies varies a lot more than the relative ranking of the top 15 brands. Normally, this would illustrate a competitive environment.

Figure 9
Cummulative Market Share - Installation Companies (Canada)



However, there is an interesting fact which is reflected in Figure 10. As we can see, 20% of all the residential GHP installations in Canada are done by 9 companies and 50% of all installations by 47 companies. When these companies are spread across Canada, and again, considering that contractors will normally only work in the vicinity of their head office, we can reasonably conclude that some of these companies have significant market leadership position within their local market.

In fact, understanding local competition amongst and between installers in a given census region may be important to understand regional or local market dynamics. We hypothesize that installer / designer firms will show much higher concentration than for heat pump brands in all but a few census regions. Where very rural areas may benefit from social pressure under a kind of reputational economics, and more densely populated areas may have enough local firms to spawn competition dynamics, the in-between areas containing moderately populated territory with a low or moderate number of non-overlapping install / design firms may be more subject to less competitive markets.

Local competition ratios may also correlate to per-BTU-ton prices in meaningful or interesting ways. This in turn may be important for governments and utilities to consider in evaluating program success. A sub-provincial analysis seen in this manner may apply or even demonstrate critical market dynamics of other small-scale-renewable energy technology systems such as solar, micro-wind, or micro-hydro.

If proven, this hypothesis could lead to conclusions that subsidies, population density and geographical factors interact to affect local system prices and deliver or hinder competitive markets. Where data exists, CGC staff may be able to identify a threshold effect, i.e. a required density of CGC Qualified Firms to deliver locally competitive markets.

If various government assistance programs aim to create or introduce fully competitive GHP markets in all provinces, the importance of this dynamic is self-evident. Select provinces' poor program performance over recent years may therefore have to do with the density of installer-designers in given areas as well as policies which favor or hinder business activity.

Conclusion

This report has demonstrated an at-times dramatic growth, and a convincing overall upward trend in the installation of geothermal heat pump systems in Canada, over 2005 to 2011. Geothermal heat pump systems have displaced a significant amount of fossil fuel and therefore significantly improved many provinces' greenhouse gas emissions profiles.

Generally, Canada's manufacturers have improved their relative market position in a generally growing market. This diversification trend is an extremely positive signal and a symbol of Canadian industry's continually growing health, professionalism and maturity.

Provincial sales leadership has also shifted, at times dramatically, over 2008-2010 in particular. Several provincial dynamics have been discussed, but a detailed economic impact analysis is not part of the present document.

CGC will elaborate on the results shown here with further analysis using completed 2011 data, publishing an updated report in late 2012.

Detailed research questions or suggestions are welcomed via email to info@geoexchange.ca.

PROVINCIAL GRAPHS AND TABLES

British Columbia

Figure BC1 - Residential Systems by Loop Type
British Columbia (2008-2010)

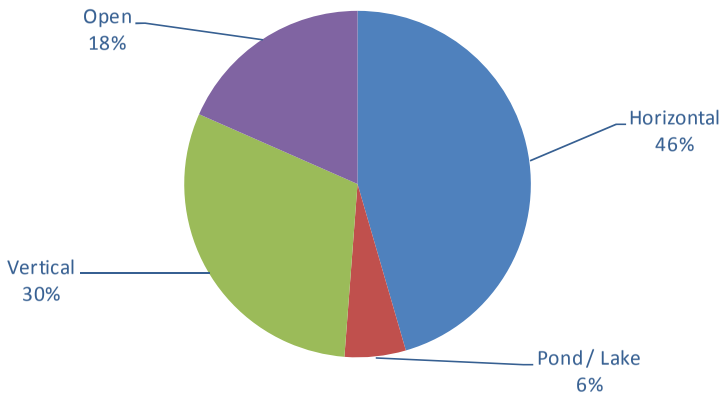


Figure BC3 - Fuel Replaced
British Columbia (2008-2010)

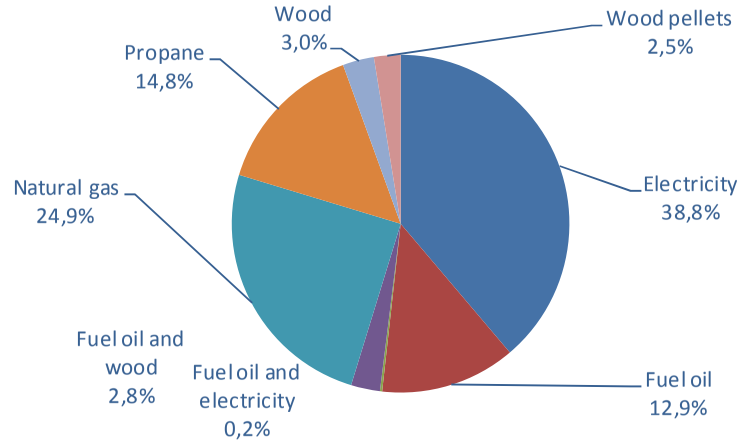


Figure BC2 - Trends in Residential Systems by Loop Type
British Columbia

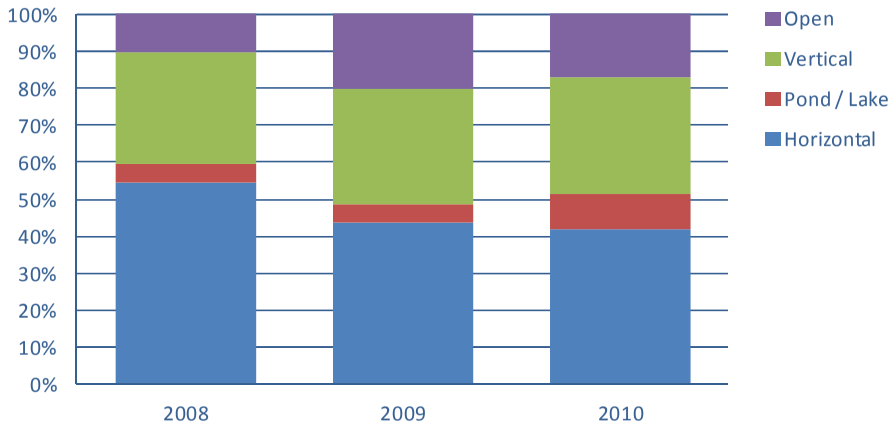


Figure BC4 - Trends In Fuel Replaced
British Columbia

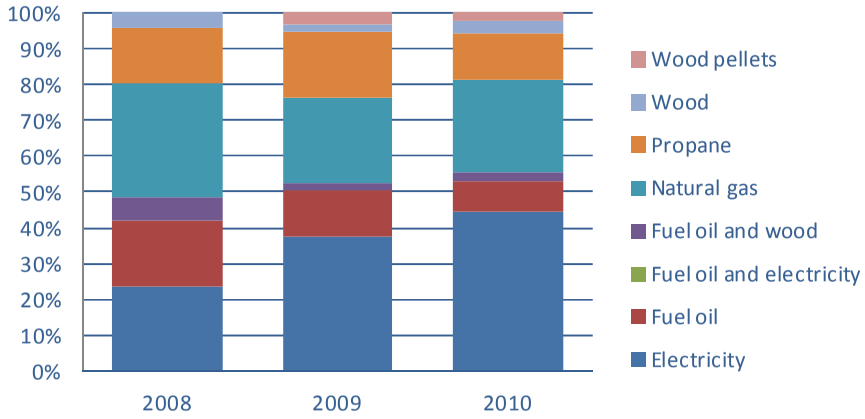


Table BC1

Heat Pump Market Share by Brand - BC

	2008	2009	2010
Brand 1	38,3%	40,5%	31,9%
Brand 2	12,1%	12,2%	23,1%
Brand 3	11,2%	10,7%	14,3%
Brand 4	2,8%	8,0%	7,7%
Brand 5	17,8%	8,0%	2,2%
Brand 6	0,9%	3,8%	2,2%
Brand 7	0,0%	3,1%	1,1%
Brand 8	2,8%	3,1%	3,3%
Brand 9	1,9%	2,7%	1,1%
Brand 10	6,5%	1,9%	1,1%
Brand 11	0,9%	1,5%	0,0%
Brand 12	0,0%	1,5%	4,4%
Brand 13	0,0%	1,1%	2,2%
Brand 14	0,0%	0,8%	3,3%
Brand 15	0,9%	0,4%	0,0%
All Others	3,7%	0,8%	2,2%
Total	100,0%	100,0%	100,0%

Table BC2

Concentration Indexes by Brand - BC

	2008	2009	2010
C4	79,4%	71,4%	76,9%
C5	85,9%	79,4%	79,1%
HH	0,2136	0,2080	0,1878

Table BC3

Market Share by Installation Company - BC

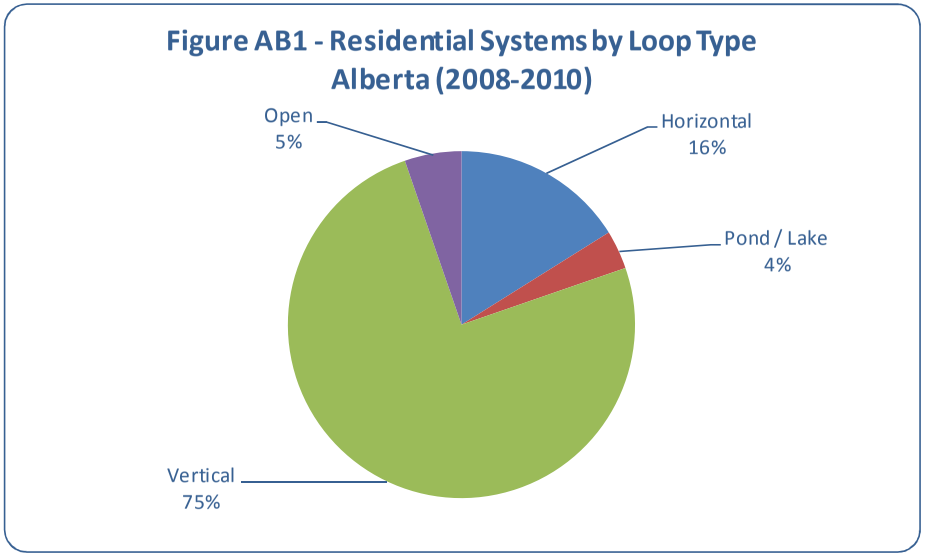
	2008	2009	2010
Company No. 1	0,00%	11,11%	7,69%
Company No. 2	7,69%	3,70%	6,59%
Company No. 3	0,00%	6,17%	6,59%
Company No. 4	3,85%	2,06%	6,59%
Company No. 5	10,58%	8,64%	4,40%
Company No. 6	2,88%	4,12%	4,40%
Company No. 7	2,88%	3,29%	4,40%
Company No. 8	0,00%	0,82%	4,40%
Company No. 9	10,58%	9,88%	3,30%
Company No. 10	6,73%	1,65%	3,30%
Company No. 11	1,92%	0,00%	3,30%
Company No. 12	0,00%	0,00%	3,30%
Company No. 13	4,81%	2,88%	2,20%
Company No. 14	4,81%	0,00%	2,20%
Company No. 15	0,00%	2,06%	2,20%
All Others	43,27%	43,62%	35,16%
Total	100,00%	100,00%	100,00%

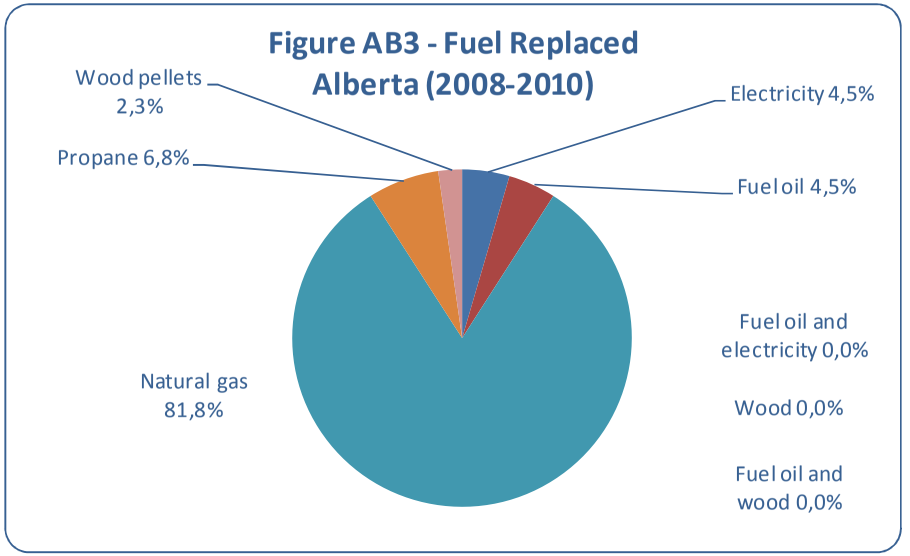
Table BC4

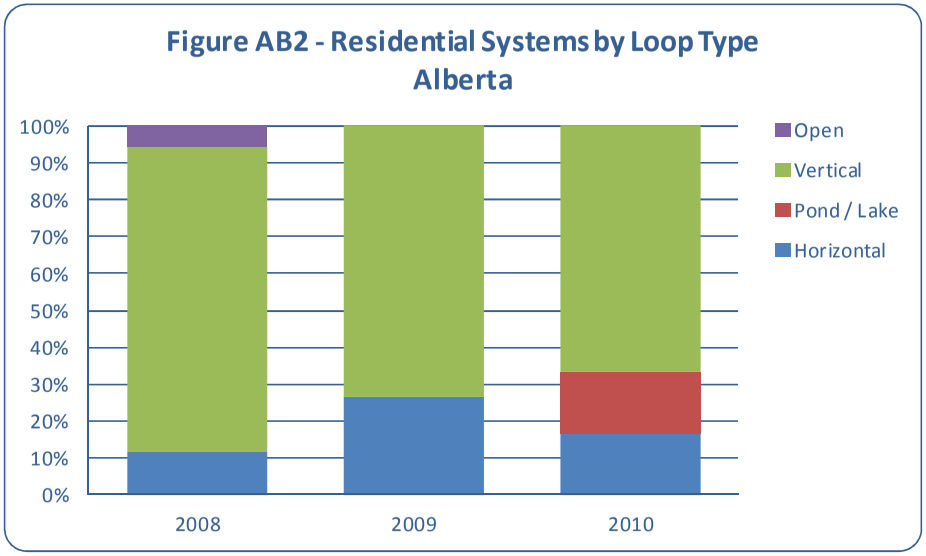
Concentration Indexes - Installation Companies - BC

	2008	2009	2010
C4	35,58%	35,79%	27,47%
C5	40,39%	39,91%	31,87%
HH	0,0410	0,0395	0,0325

Alberta







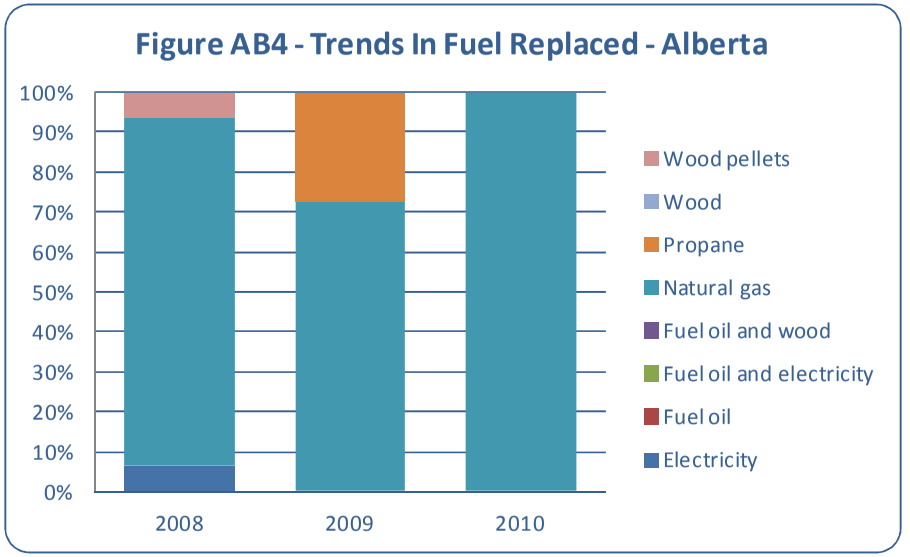


Table AB1

Heat Pump Market Share by Brand - AB

	2008	2009	2010
Brand 1	21,1%	24,2%	33,3%
Brand 2	21,1%	24,2%	33,3%
Brand 3	15,8%	33,3%	16,7%
Brand 4	0,0%	0,0%	16,7%
Brand 5	0,0%	9,1%	0,0%
Brand 6	0,0%	0,0%	0,0%
Brand 7	5,3%	3,0%	0,0%
Brand 8	26,3%	3,0%	0,0%
Brand 9	0,0%	3,0%	0,0%
Brand 10	0,0%	0,0%	0,0%
Brand 11	10,5%	0,0%	0,0%
Brand 12	0,0%	0,0%	0,0%
Brand 13	0,0%	0,0%	0,0%
Brand 14	0,0%	0,0%	0,0%
Brand 15	0,0%	0,0%	0,0%
All Others	0,0%	0,0%	0,0%
Total	100,0%	100,0%	100,0%

Table AB2

Concentration Indexes by Brand - AB

	2008	2009	2010
C4	84,3%	90,8%	100,0%
C5	94,8%	93,8%	100,0%
HH	0,1967	0,2397	0,2778

Table AB3

Market Share by Installation Company - AB

	2008	2009	2010
Company No. 1	11,76%	0,00%	33,33%
Company No. 2	17,65%	39,29%	16,67%
Company No. 3	17,65%	14,29%	16,67%
Company No. 4	0,00%	0,00%	16,67%
Company No. 5	0,00%	0,00%	16,67%
Company No. 6	0,00%	17,86%	0,00%
Company No. 7	29,41%	0,00%	0,00%
Company No. 8	5,88%	10,71%	0,00%
Company No. 9	0,00%	3,57%	0,00%
Company No. 10	5,88%	0,00%	0,00%
Company No. 11	5,88%	0,00%	0,00%
Company No. 12	5,88%	0,00%	0,00%
Company No. 13	0,00%	0,00%	0,00%
Company No. 14	0,00%	0,00%	0,00%
Company No. 15	0,00%	3,57%	0,00%
All Others	0,00%	10,71%	0,00%
Total	100,00%	100,00%	100,00%

Table AB4

Concentration Indexes - Installation Companies - AB

	2008	2009	2010
C4	76,47%	82,15%	83,33%
C5	82,35%	85,72%	100,00%
HH	0,1765	0,2207	0,2222

Saskatchewan

Figure SK1 - Residential Systems by Loop Type Saskatchewan (2008-2010)

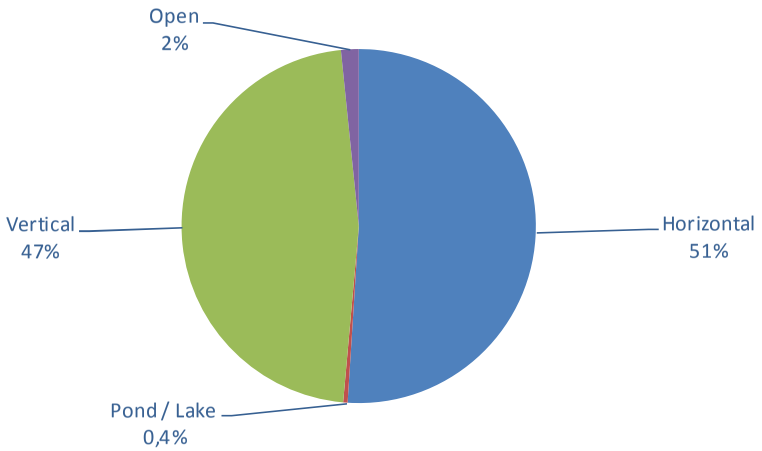


Figure SK3 - Fuel Replaced Saskatchewan (2008-2010)

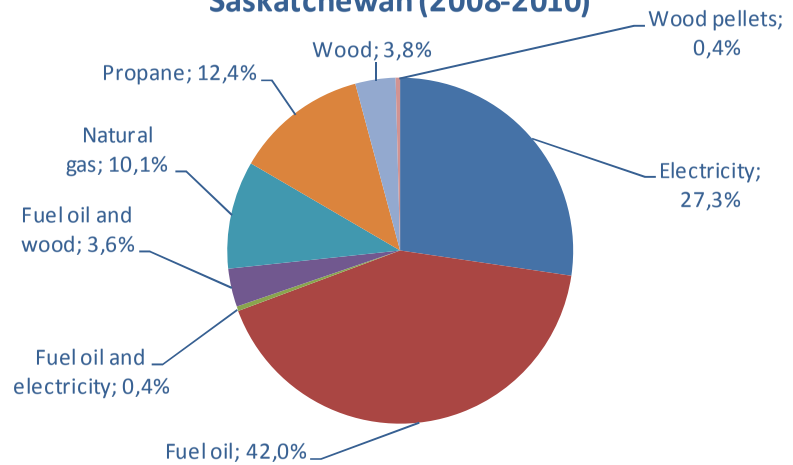


Figure SK2 - Residential Systems by Loop Type Saskatchewan

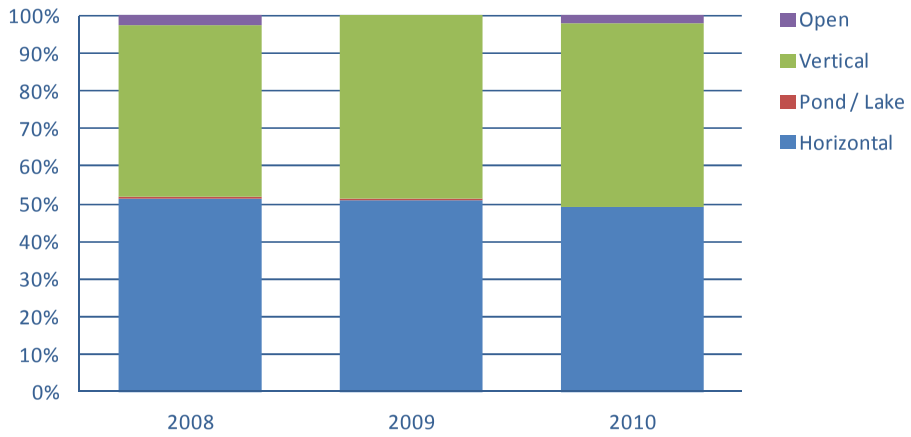


Figure SK4 - Trends In Fuel Replaced Saskatchewan

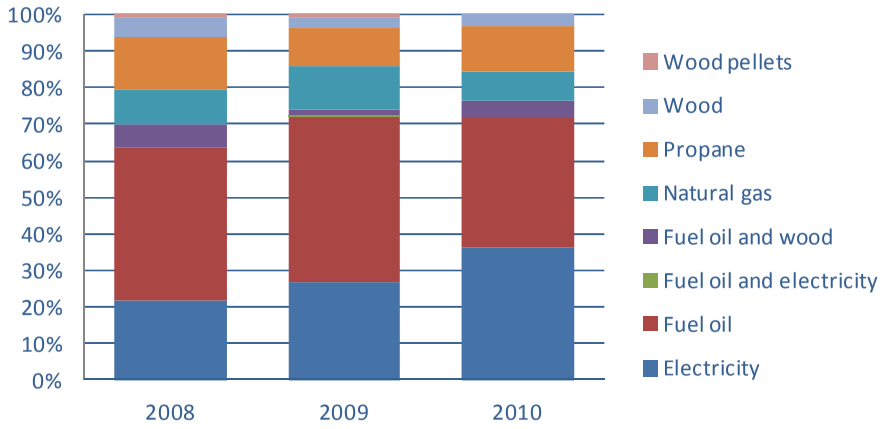


Table SK1

Heat Pump Market Share by Brand - SK

	2008	2009	2010
Brand 1	44,4%	46,3%	50,0%
Brand 2	26,3%	18,6%	15,1%
Brand 3	12,3%	11,8%	11,6%
Brand 4	7,0%	3,6%	8,9%
Brand 5	1,8%	0,8%	3,4%
Brand 6	0,0%	1,1%	2,7%
Brand 7	3,5%	1,1%	2,7%
Brand 8	1,8%	3,0%	2,1%
Brand 9	0,0%	0,0%	2,1%
Brand 10	0,0%	0,0%	0,7%
Brand 11	0,0%	0,0%	0,7%
Brand 12	0,0%	10,4%	0,0%
Brand 13	0,0%	1,4%	0,0%
Brand 14	1,2%	0,8%	0,0%
Brand 15	0,0%	0,8%	0,0%
All Others	1,8%	0,3%	0,0%
Total	100,0%	100,0%	100,0%

Table SK2

Concentration Indexes by Brand - SK

	2008	2009	2010
C4	90,0%	87,1%	85,6%
C5	93,5%	90,7%	89,0%
HH	0,2891	0,2766	0,2978

Table SK3

Market Share by Installation Company - SK

	2008	2009	2010
Company No. 1	34,32%	29,78%	41,10%
Company No. 2	8,88%	13,79%	8,90%
Company No. 3	14,20%	10,66%	7,53%
Company No. 4	0,59%	4,70%	4,79%
Company No. 5	3,55%	1,25%	2,74%
Company No. 6	1,78%	3,45%	2,74%
Company No. 7	0,00%	0,94%	2,74%
Company No. 8	0,59%	0,63%	2,74%
Company No. 9	0,00%	3,45%	2,05%
Company No. 10	3,55%	0,63%	2,05%
Company No. 11	1,18%	1,57%	2,05%
Company No. 12	0,00%	0,31%	2,05%
Company No. 13	0,00%	0,00%	2,05%
Company No. 14	1,78%	2,51%	1,37%
Company No. 15	2,37%	0,94%	1,37%
All Others	0,00%	25,39%	13,70%
Total	72,78%	100,00%	100,00%

Table SK4

Concentration Indexes - Installation Companies - SK

	2008	2009	2010
C4	60,95%	58,93%	62,33%
C5	64,50%	62,38%	65,07%
HH	0,1497	0,1250	0,1903

Manitoba

Figure MB1 - Residential Systems by Loop Type Manitoba (2008-2010)

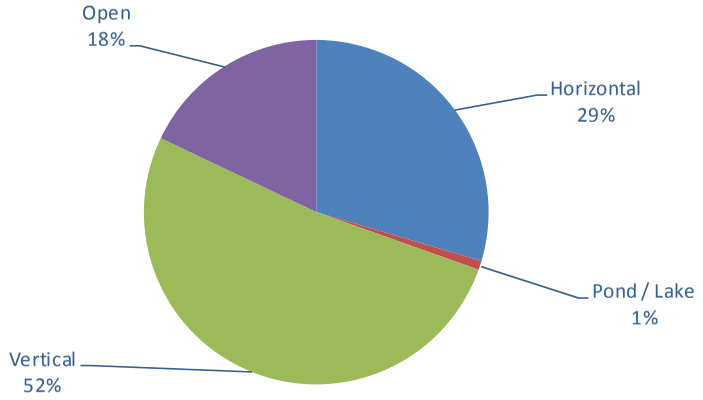


Figure MB2 - Residential Systems by Loop Type Manitoba

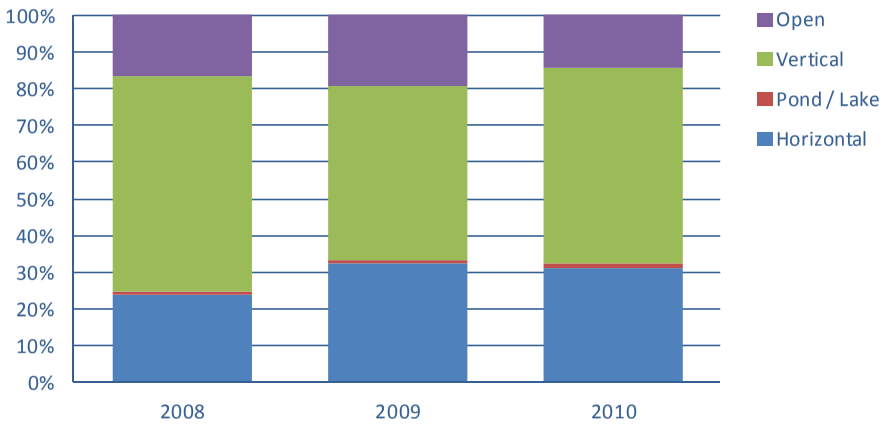


Figure MB3 - Fuel Replaced Manitoba (2008-2010)

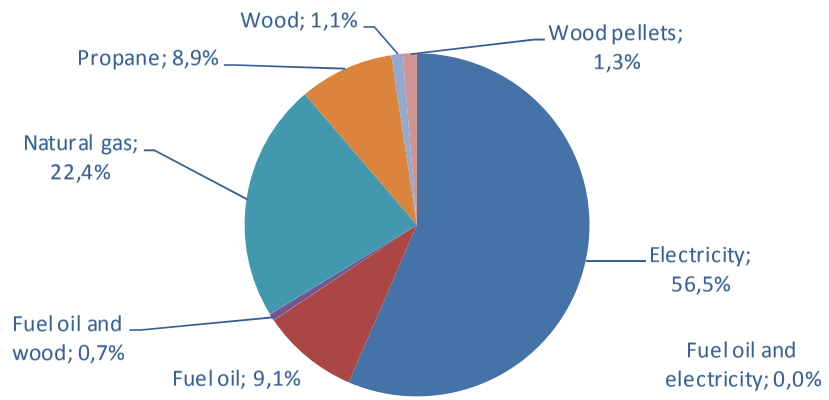


Figure MB4 - Trends In Fuel Replaced - Manitoba

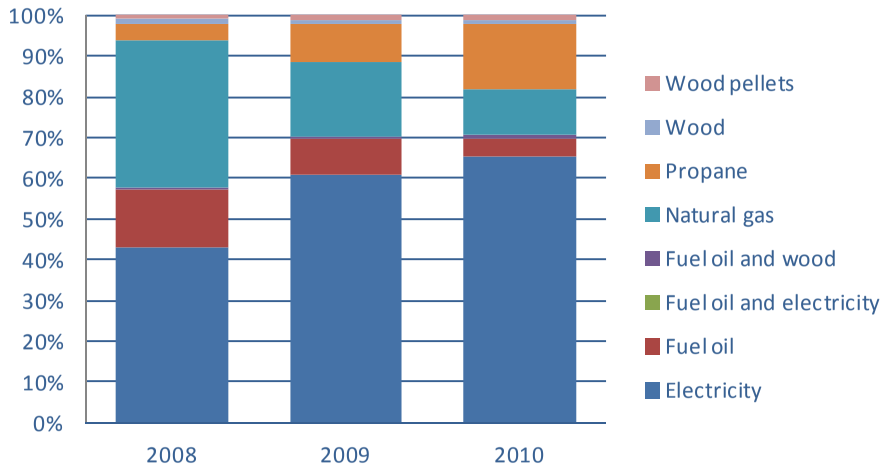


Table MB1

Heat Pump Market Share by Brand - MB

	2008	2009	2010
Brand 1	32,2%	33,1%	27,1%
Brand 2	15,4%	13,1%	15,6%
Brand 3	10,7%	18,3%	13,5%
Brand 4	5,4%	5,4%	12,5%
Brand 5	8,7%	11,0%	9,4%
Brand 6	2,7%	3,5%	9,4%
Brand 7	0,0%	3,5%	4,2%
Brand 8	2,7%	3,1%	4,2%
Brand 9	16,8%	4,5%	2,1%
Brand 10	0,0%	0,7%	1,0%
Brand 11	1,3%	0,5%	1,0%
Brand 12	0,0%	0,0%	0,0%
Brand 13	0,7%	1,4%	0,0%
Brand 14	0,0%	0,7%	0,0%
Brand 15	2,0%	0,7%	0,0%
All Others	1,3%	0,5%	0,0%
Total	100,0%	100,0%	100,0%

Table MB2

Concentration Indexes by Brand - MB

	2008	2009	2010
C4	75,1%	75,5%	68,8%
C5	83,8%	80,9%	78,1%
HH	0,1802	0,1812	0,1534

Table MB3

Market Share by Installation Company - MB

	2008	2009	2010
Company No. 1	12,41%	14,95%	10,53%
Company No. 2	0,00%	2,84%	8,42%
Company No. 3	6,21%	7,73%	6,32%
Company No. 4	1,38%	2,84%	6,32%
Company No. 5	2,07%	2,32%	5,26%
Company No. 6	9,66%	5,15%	4,21%
Company No. 7	2,07%	7,22%	4,21%
Company No. 8	3,45%	3,09%	4,21%
Company No. 9	1,38%	3,35%	4,21%
Company No. 10	2,07%	2,58%	4,21%
Company No. 11	2,07%	2,32%	4,21%
Company No. 12	7,59%	2,84%	3,16%
Company No. 13	2,76%	4,38%	3,16%
Company No. 14	7,59%	1,03%	3,16%
Company No. 15	2,07%	2,58%	3,16%
All Others	37,24%	34,79%	25,26%
Total	100,00%	100,00%	100,00%

Table MB4

Concentration Indexes - Installation Companies - MB

	2008	2009	2010
C4	37,25%	35,05%	31,58%
C5	43,46%	39,43%	36,84%
HH	0,0446	0,0451	0,0435

Ontario

Figure ON1 - Residential Systems by Loop Type Ontario (2008-2010)

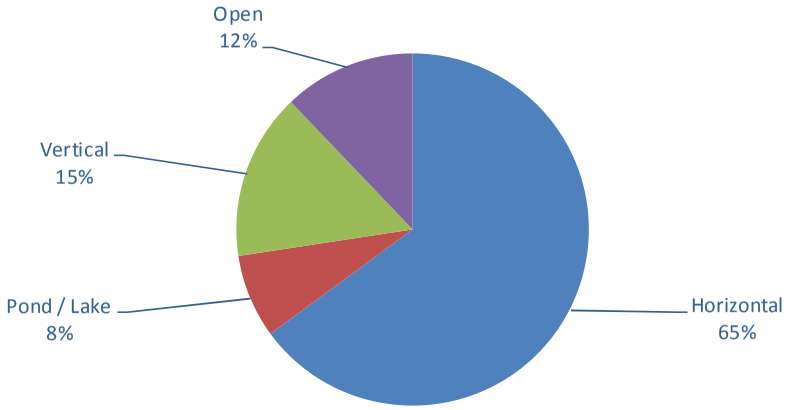


Figure ON2 - Residential Systems by Loop Type Ontario

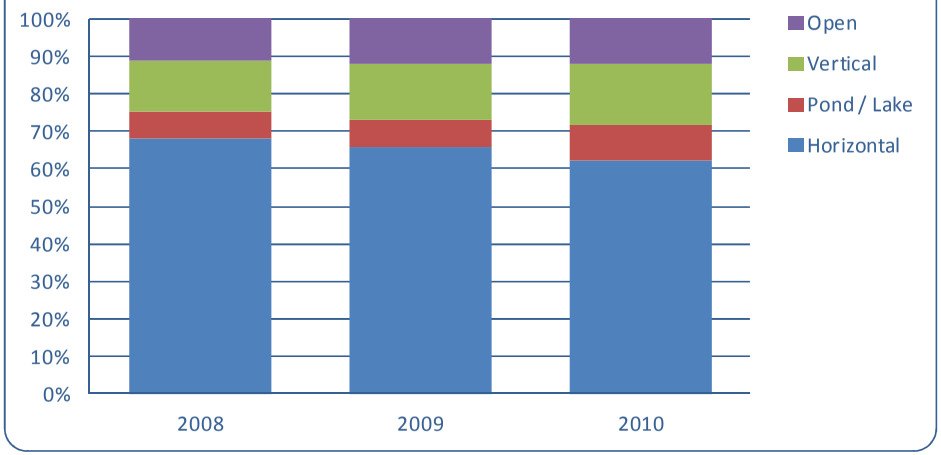


Figure ON3 - Fuel Replaced Ontario (2008-2010)

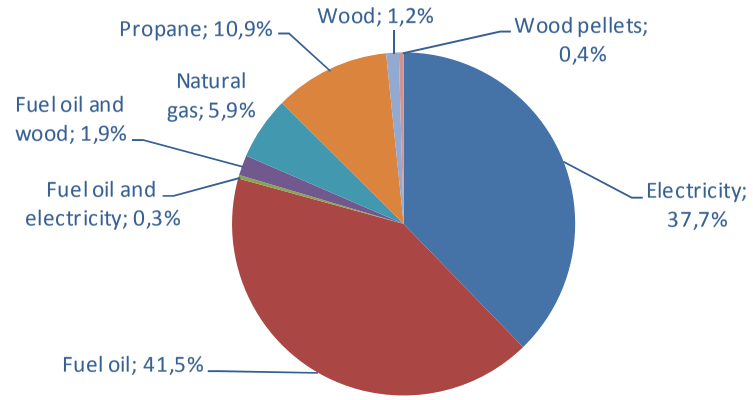


Figure ON4 - Trends In Fuel Replaced - Ontario

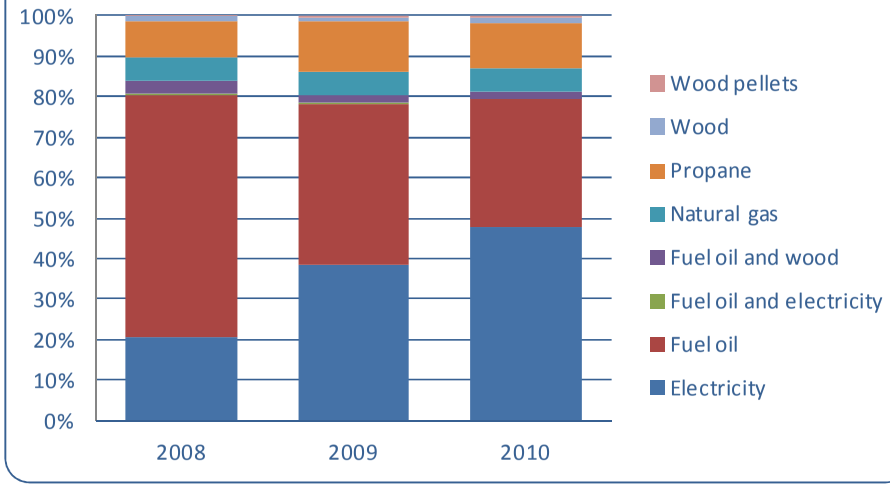


Table ON1

Heat Pump Market Share by Brand - ON

	2008	2009	2010
Brand 1	32,8%	33,5%	34,7%
Brand 2	38,4%	31,0%	22,2%
Brand 3	13,2%	13,7%	14,6%
Brand 4	0,2%	3,3%	7,8%
Brand 5	3,4%	4,6%	4,6%
Brand 6	1,2%	1,9%	2,7%
Brand 7	3,9%	3,6%	2,4%
Brand 8	1,2%	0,8%	1,8%
Brand 9	0,4%	0,2%	1,4%
Brand 10	0,3%	1,2%	1,2%
Brand 11	1,2%	1,8%	1,0%
Brand 12	1,3%	1,2%	0,9%
Brand 13	0,9%	0,8%	0,8%
Brand 14	0,5%	0,7%	0,6%
Brand 15	0,3%	0,2%	0,5%
All Others	1,0%	1,4%	2,9%
Total	**100,0%**	**100,0%**	**100,0%**

Table ON2

Concentration Indexes by Brand - ON

	2008	2009	2010
C4	88,3%	82,8%	79,2%
C5	91,7%	86,4%	83,8%
HH	0,2753	0,2334	0,2019

Table ON3

Market Share by Installation Company - ON

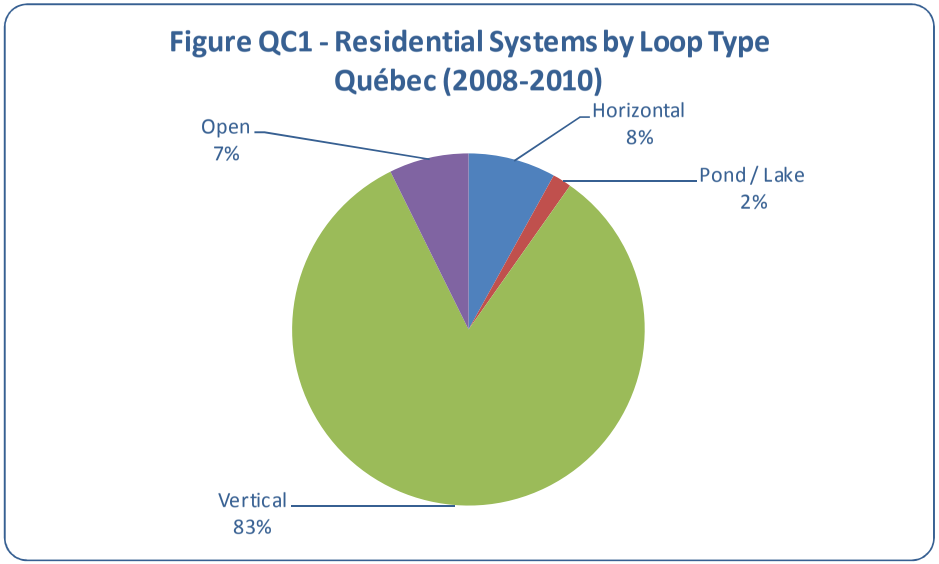
	2008	2009	2010
Company No. 1	3,28%	2,61%	3,89%
Company No. 2	3,91%	4,41%	3,62%
Company No. 3	3,36%	3,62%	3,36%
Company No. 4	2,66%	3,82%	3,24%
Company No. 5	0,08%	0,11%	2,90%
Company No. 6	4,89%	4,35%	2,45%
Company No. 7	0,12%	0,85%	2,34%
Company No. 8	2,07%	2,56%	2,23%
Company No. 9	0,23%	1,14%	2,07%
Company No. 10	1,49%	1,36%	1,47%
Company No. 11	2,93%	2,12%	1,40%
Company No. 12	1,13%	1,42%	1,32%
Company No. 13	1,45%	1,97%	1,24%
Company No. 14	2,27%	2,31%	1,21%
Company No. 15	0,35%	0,34%	1,13%
All Others	69,78%	67,02%	66,13%
Total	100,00%	100,00%	100,00%

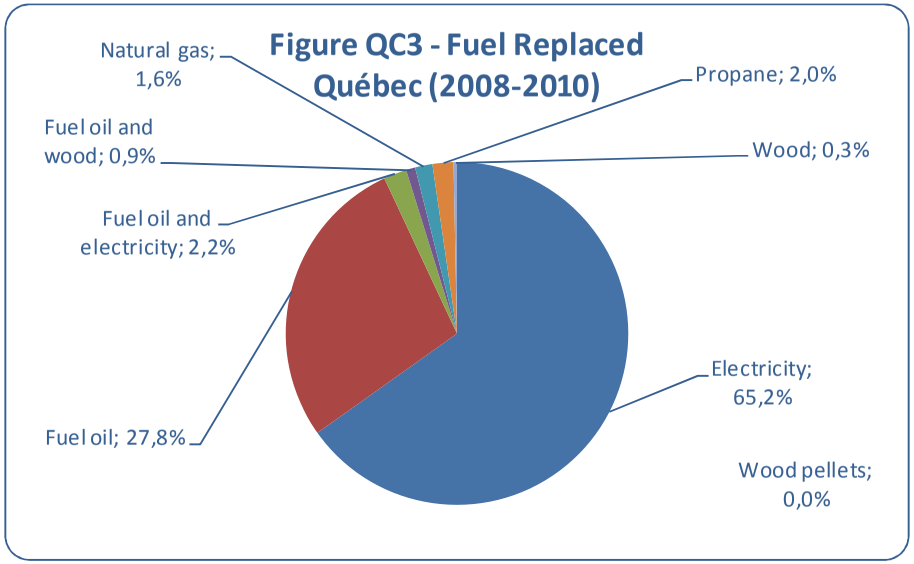
Table ON4

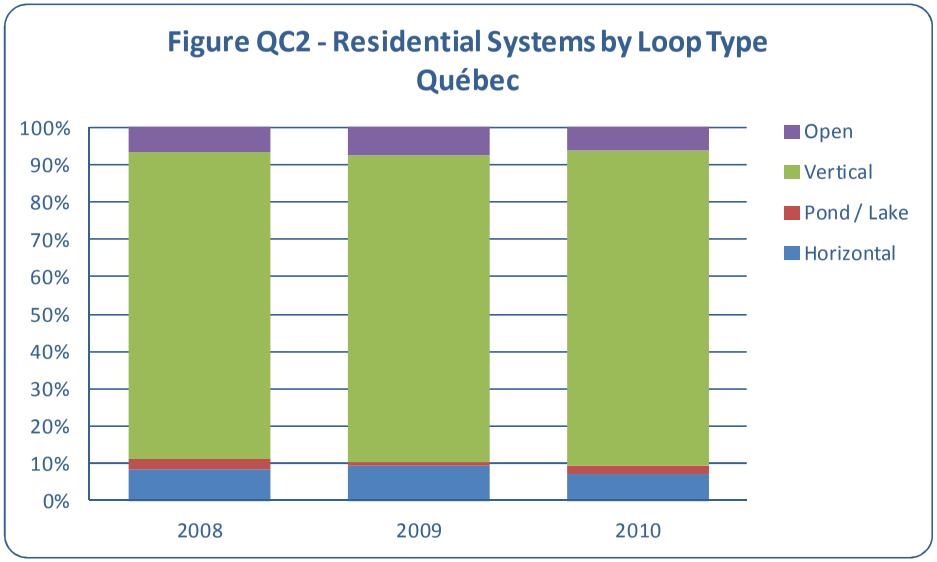
Concentration Indexes - Installation Companies - ON

	2008	2009	2010
C4	15,44%	16,20%	14,11%
C5	18,10%	18,81%	17,01%
HH	0,0092	0,0099	0,0089

Québec







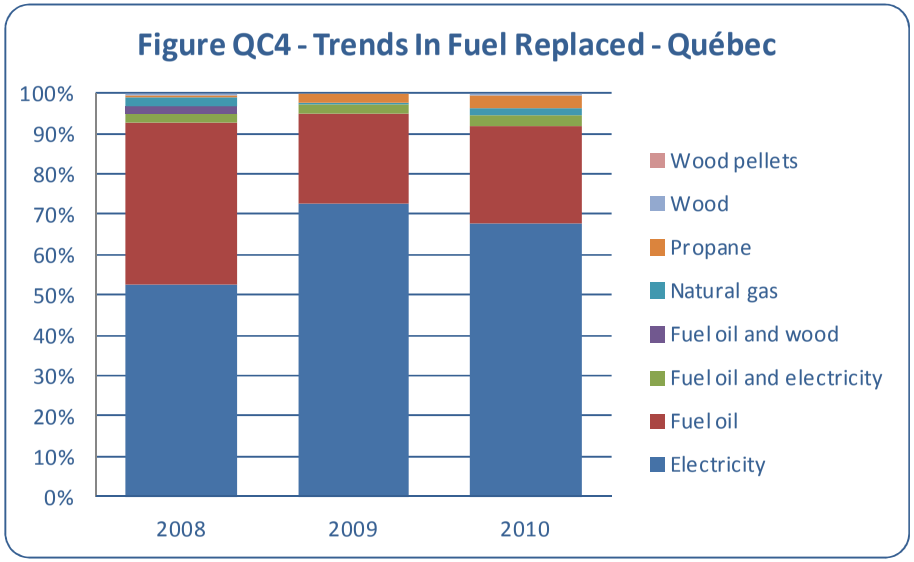


Table QC1

Heat Pump Market Share by Brand - QC

	2008	2009	2010
Brand 1	54,5%	47,5%	43,1%
Brand 2	5,9%	7,6%	12,1%
Brand 3	5,3%	5,9%	10,1%
Brand 4	5,0%	10,0%	9,1%
Brand 5	5,3%	6,4%	6,2%
Brand 6	1,6%	4,1%	4,7%
Brand 7	6,9%	6,2%	3,9%
Brand 8	3,2%	3,2%	3,2%
Brand 9	0,9%	0,3%	2,7%
Brand 10	0,2%	0,3%	2,0%
Brand 11	5,5%	4,8%	1,5%
Brand 12	1,1%	1,1%	0,7%
Brand 13	3,0%	0,8%	0,2%
Brand 14	0,2%	0,3%	0,2%
Brand 15	0,5%	0,3%	0,0%
All Others	0,9%	1,1%	0,2%
Total	100,0%	100,0%	100,0%

Table QC2

Concentration Indexes by Brand - QC

	2008	2009	2010
C4	72,8%	71,5%	74,4%
C5	78,1%	77,7%	80,5%
HH	0,3185	0,2585	0,2288

Table QC3

Market Share by Installation Company - QC

	2008	2009	2010
Company No. 1	20,00%	17,75%	15,76%
Company No. 2	6,74%	10,42%	9,36%
Company No. 3	3,49%	4,72%	6,16%
Company No. 4	13,26%	6,35%	4,93%
Company No. 5	1,40%	1,30%	4,93%
Company No. 6	3,95%	5,70%	4,43%
Company No. 7	0,47%	0,65%	3,20%
Company No. 8	5,12%	2,93%	2,96%
Company No. 9	3,02%	3,42%	2,96%
Company No. 10	1,63%	2,12%	2,71%
Company No. 11	0,93%	1,30%	2,71%
Company No. 12	0,00%	3,26%	2,22%
Company No. 13	0,00%	0,98%	1,97%
Company No. 14	1,40%	0,81%	1,97%
Company No. 15	3,02%	1,79%	1,72%
All Others	35,58%	36,48%	32,02%
Total	100,00%	100,00%	100,00%

Table QC4

Concentration Indexes - Installation Companies - QC

	2008	2009	2010
C4	45,12%	40,22%	36,21%
C5	49,07%	44,94%	41,13%
HH	0,0701	0,0563	0,0500

New Brunswick

Figure NB1 - Residential Systems by Loop Type
New Brunswick (2008-2010)

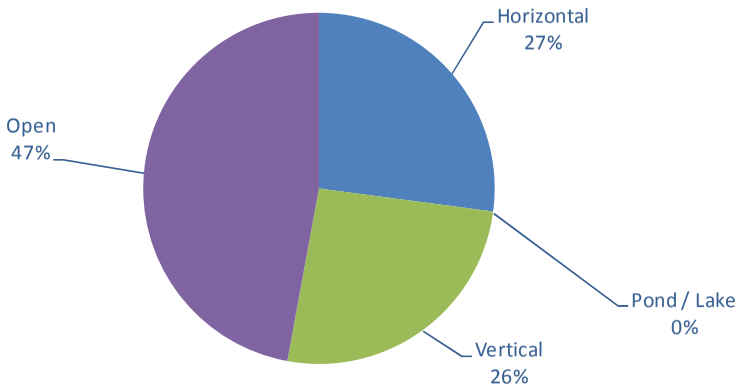


Figure NB2 - Residential Systems by Loop Type
New Brunswick

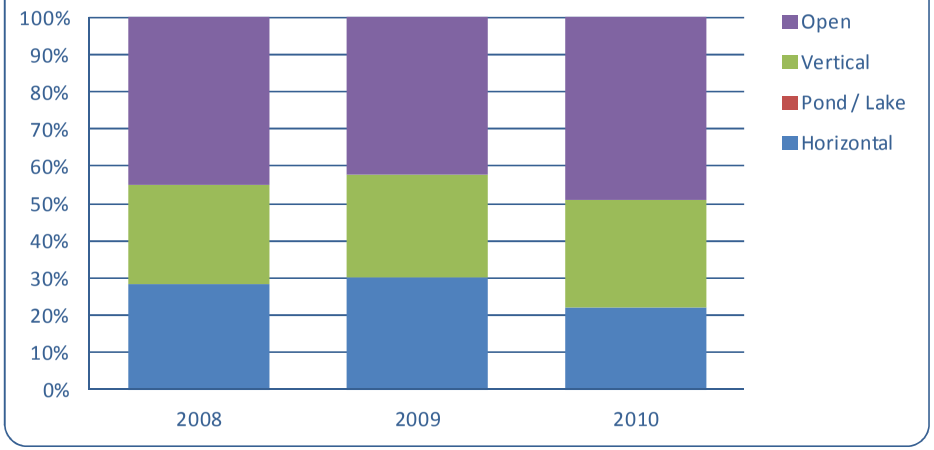


Figure NB3 - Fuel Replaced
New Brunswick (2008-2010)

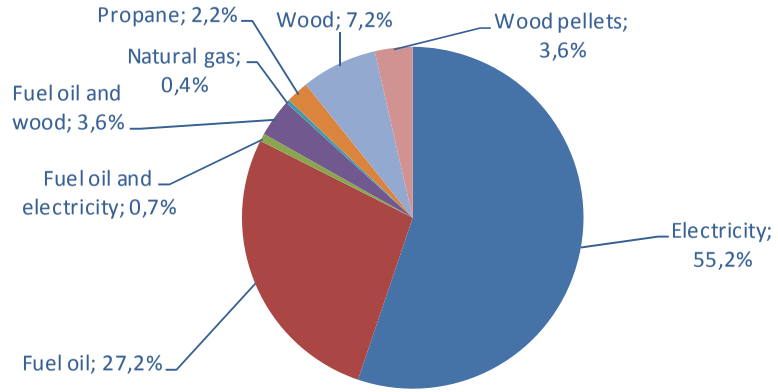


Figure NB4 - Trends In Fuel Replaced
New Brunswick

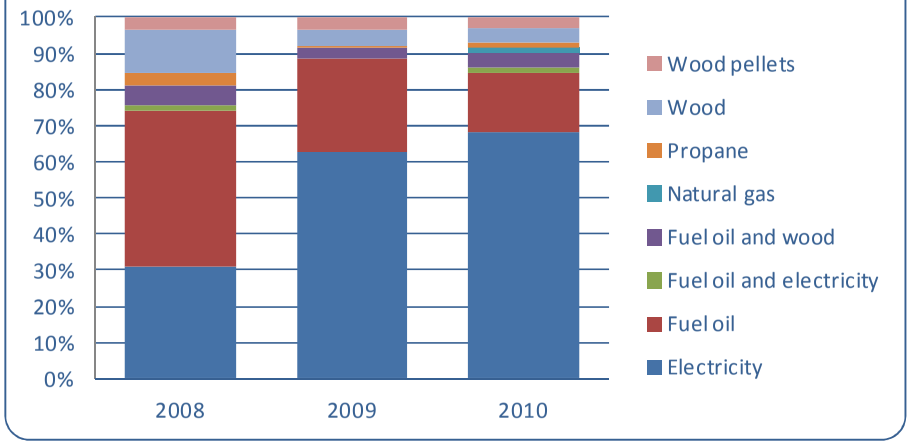


Table NB1			
Heat Pump Market Share by Brand - NB			
	2008	**2009**	**2010**
Brand 1	60,0%	56,1%	40,8%
Brand 2	30,0%	28,1%	26,3%
Brand 3	4,3%	6,5%	11,8%
Brand 4	0,0%	7,9%	9,2%
Brand 5	0,0%	0,7%	7,9%
Brand 6	0,0%	0,0%	2,6%
Brand 7	0,0%	0,0%	1,3%
Brand 8	4,3%	0,7%	0,0%
Brand 9	0,0%	0,0%	0,0%
Brand 10	1,4%	0,0%	0,0%
Brand 11	0,0%	0,0%	0,0%
Brand 12	0,0%	0,0%	0,0%
Brand 13	0,0%	0,0%	0,0%
Brand 14	0,0%	0,0%	0,0%
Brand 15	0,0%	0,0%	0,0%
All Others	0,0%	0,0%	0,0%
Total	**100,0%**	**100,0%**	**100,0%**

Table NB2			
Concentration Indexes by Brand - NB			
	2008	**2009**	**2010**
C4	98,6%	98,6%	88,2%
C5	100,0%	99,3%	96,1%
HH	0,4539	0,4042	0,2652

Table NB3			
Market Share by Installation Company - NB			
	2008	**2009**	**2010**
Company No. 1	26,98%	22,96%	14,29%
Company No. 2	1,59%	3,70%	10,39%
Company No. 3	1,59%	2,22%	9,09%
Company No. 4	9,52%	5,93%	7,79%
Company No. 5	0,00%	5,19%	7,79%
Company No. 6	1,59%	5,19%	5,19%
Company No. 7	0,00%	1,48%	5,19%
Company No. 8	12,70%	10,37%	3,90%
Company No. 9	0,00%	2,22%	3,90%
Company No. 10	1,59%	2,96%	3,90%
Company No. 11	0,00%	0,00%	3,90%
Company No. 12	15,87%	11,11%	2,60%
Company No. 13	6,35%	5,19%	2,60%
Company No. 14	0,00%	2,96%	2,60%
Company No. 15	0,00%	2,22%	1,30%
All Others	22,22%	16,30%	15,58%
Total	100,00%	100,00%	100,00%

Table NB4			
Concentration Indexes - Installation Companies - NB			
	2008	**2009**	**2010**
C4	65,07%	50,37%	41,56%
C5	71,42%	55,56%	49,35%
HH	0,1282	0,0922	0,0653

Nova Scotia

Figure NS1 - Residential Systems by Loop Type Nova Scotia (2008-2010)

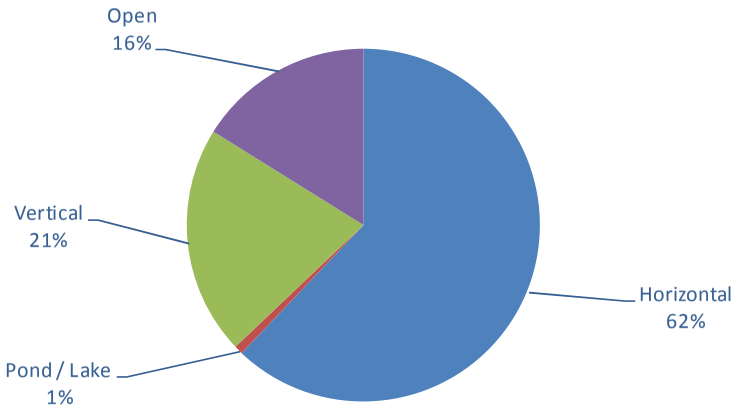


Figure NS3 - Fuel Replaced Nova Scotia (2008-2010)

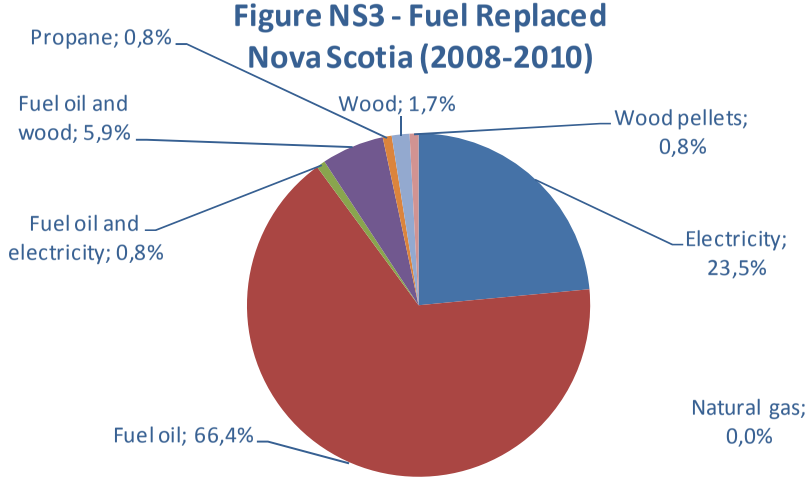


Figure NS2 - Residential Systems by Loop Type Nova Scotia

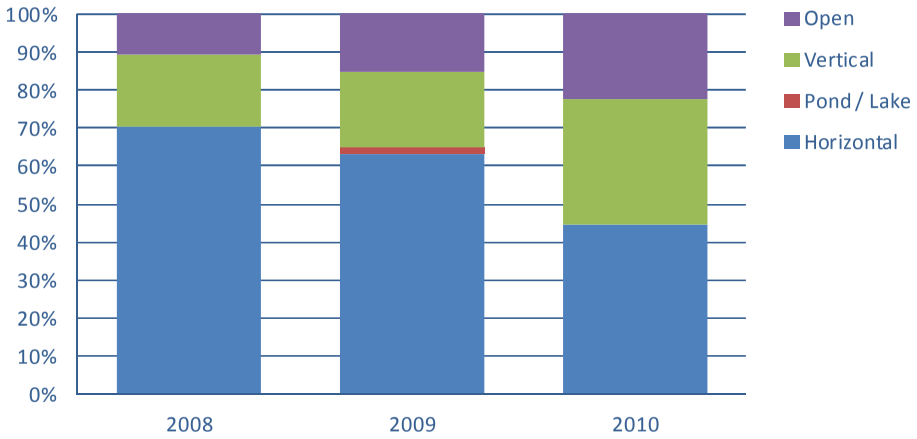


Figure NS4 - Trends In Fuel Replaced - Nova Scotia

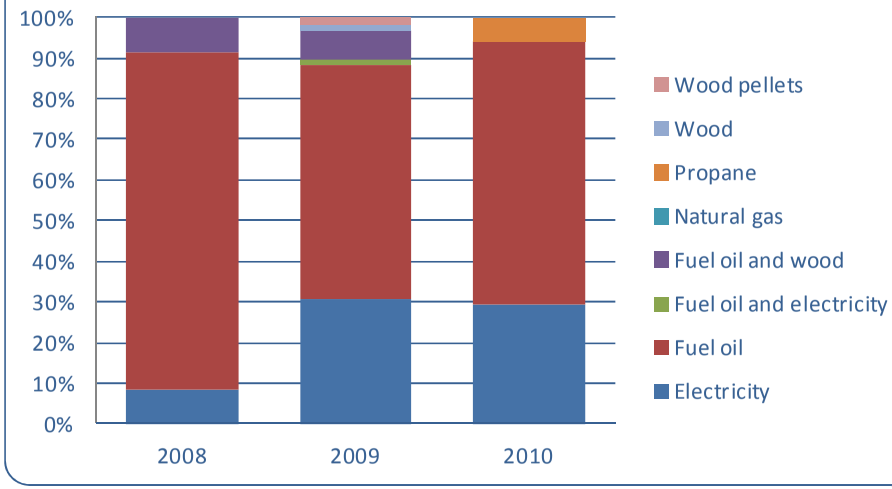


Table NS1			
Heat Pump Market Share by Brand - NS			
	2008	2009	2010
Brand 1	21,6%	29,7%	42,1%
Brand 2	45,9%	37,8%	36,8%
Brand 3	10,8%	4,1%	10,5%
Brand 4	16,2%	12,2%	5,3%
Brand 5	0,0%	4,1%	5,3%
Brand 6	2,7%	8,1%	0,0%
Brand 7	0,0%	1,4%	0,0%
Brand 8	0,0%	1,4%	0,0%
Brand 9	2,7%	1,4%	0,0%
Brand 10	0,0%	0,0%	0,0%
Brand 11	0,0%	0,0%	0,0%
Brand 12	0,0%	0,0%	0,0%
Brand 13	0,0%	0,0%	0,0%
Brand 14	0,0%	0,0%	0,0%
Brand 15	0,0%	0,0%	0,0%
All Others	0,0%	0,0%	0,0%
Total	100,0%	100,0%	100,0%

Table NS2			
Concentration Indexes by Brand - NS			
	2008	2009	2010
C4	94,5%	87,8%	94,7%
C5	97,2%	91,9%	100,0%
HH	0,2973	0,2568	0,3296

Table NS3			
Market Share by Installation Company - NS			
	2008	2009	2010
Company No. 1	5,56%	18,06%	21,05%
Company No. 2	13,89%	15,28%	21,05%
Company No. 3	13,89%	9,72%	10,53%
Company No. 4	5,56%	4,17%	10,53%
Company No. 5	22,22%	11,11%	5,26%
Company No. 6	2,78%	13,89%	5,26%
Company No. 7	13,89%	5,56%	5,26%
Company No. 8	2,78%	2,78%	5,26%
Company No. 9	0,00%	1,39%	5,26%
Company No. 10	0,00%	1,39%	5,26%
Company No. 11	0,00%	0,00%	5,26%
Company No. 12	11,11%	9,72%	0,00%
Company No. 13	5,56%	1,39%	0,00%
Company No. 14	0,00%	0,00%	0,00%
Company No. 15	0,00%	1,39%	0,00%
All Others	2,78%	4,17%	0,00%
Total	100,00%	100,00%	100,00%

Table NS4			
Concentration Indexes - Installation Companies - NS			
	2008	2009	2010
C4	63,89%	58,34%	63,16%
C5	75,00%	68,06%	68,42%
HH	0,1304	0,1128	0,1302

Prince Edward Island

Figure PE1 - Residential Systems by Loop Type Prince Edward Island (2008-2010)

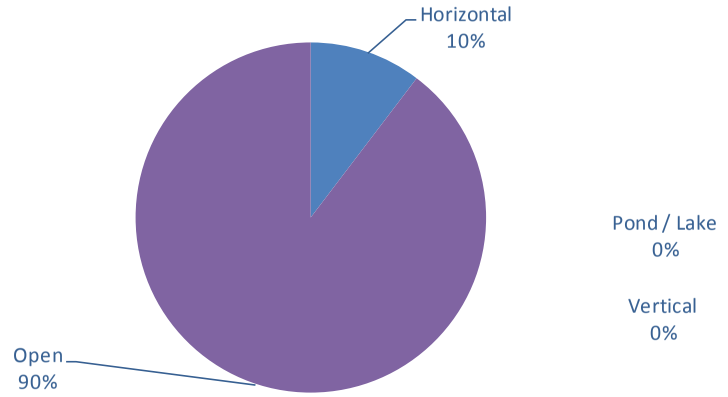


Figure PE3 - Fuel Replaced Prince Edward Island (2008-2010)

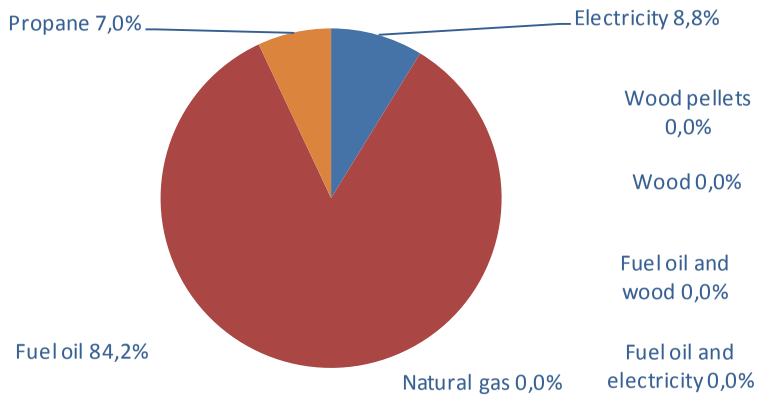


Figure PE2- Residential Systems by Loop Type Prince Edward Island

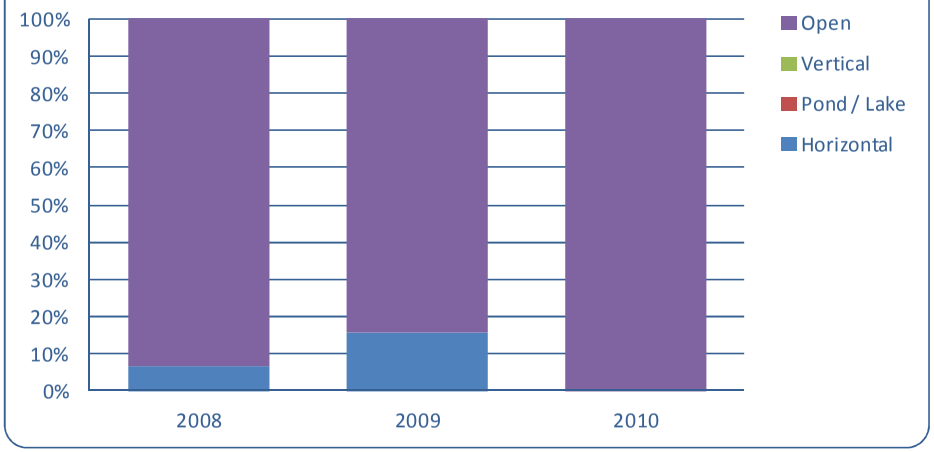


Figure PE4 - Trends In Fuel Replaced - Prince Edward Island

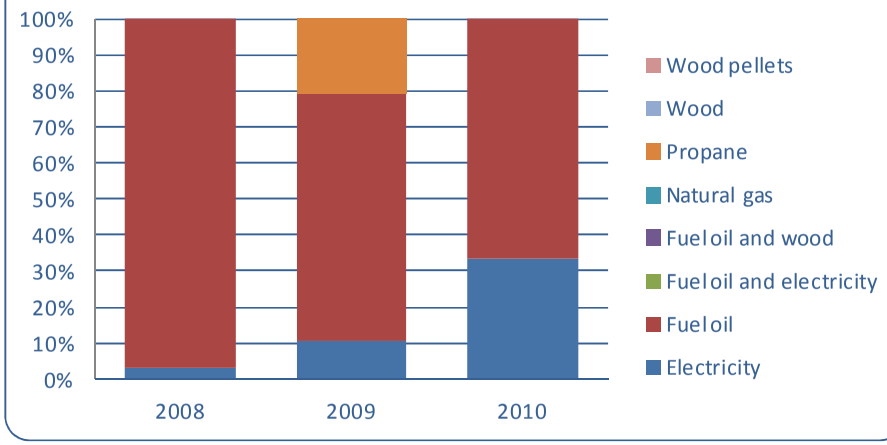


Table PE1			
Heat Pump Market Share by Brand - PEI			
	2008	2009	2010
Brand 1	95,8%	68,2%	100,0%
Brand 2	0,0%	18,2%	0,0%
Brand 3	0,0%	4,5%	0,0%
Brand 4	4,2%	4,5%	0,0%
Brand 5	0,0%	4,5%	0,0%
Brand 6	0,0%	0,0%	0,0%
Brand 7	0,0%	0,0%	0,0%
Brand 8	0,0%	0,0%	0,0%
Brand 9	0,0%	0,0%	0,0%
Brand 10	0,0%	0,0%	0,0%
Brand 11	0,0%	0,0%	0,0%
Brand 12	0,0%	0,0%	0,0%
Brand 13	0,0%	0,0%	0,0%
Brand 14	0,0%	0,0%	0,0%
Brand 15	0,0%	0,0%	0,0%
All Others	0,0%	0,0%	0,0%
Total	100,0%	100,0%	100,0%

Table PE2			
Concentration Indexes by Brand - PEI			
	2008	2009	2010
C4	100,0%	95,5%	100,0%
C5	100,0%	100,0%	100,0%
HH	0,9201	0,5041	1,0000

Table PE3			
Market Share by Installation Company - PEI			
	2008	2009	2010
Company No. 1	68,97%	54,17%	66,67%
Company No. 2	6,90%	12,50%	16,67%
Company No. 3	3,45%	16,67%	16,67%
Company No. 4	13,79%	0,00%	0,00%
Company No. 5	3,45%	4,17%	0,00%
Company No. 6	3,45%	0,00%	0,00%
Company No. 7	0,00%	4,17%	0,00%
Company No. 8	0,00%	4,17%	0,00%
Company No. 9	0,00%	4,17%	0,00%
Company No. 10	0,00%	0,00%	0,00%
Company No. 11	0,00%	0,00%	0,00%
Company No. 12	0,00%	0,00%	0,00%
Company No. 13	0,00%	0,00%	0,00%
Company No. 14	0,00%	0,00%	0,00%
Company No. 15	0,00%	0,00%	0,00%
All Others	0,00%	0,00%	0,00%
Total	100,00%	100,00%	100,00%

Table PE4			
Concentration Indexes - Installation Companies - PEI			
	2008	2009	2010
C4	93,10%	87,51%	100,00%
C5	96,55%	91,58%	100,00%
HH	0,5030	0,3438	0,5000

Newfoundland & Labrador

Figure NF1 - Residential Systems by Loop Type Newfoundland & Labrador (2008-2010)

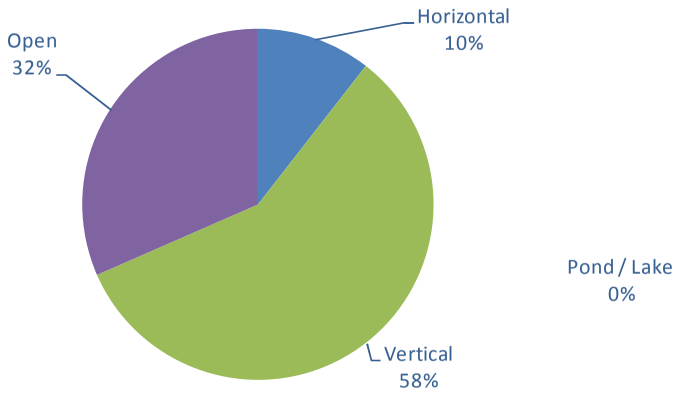


Figure NF3 - Fuel Replaced Newfoundland & Labrador (2008-2010)

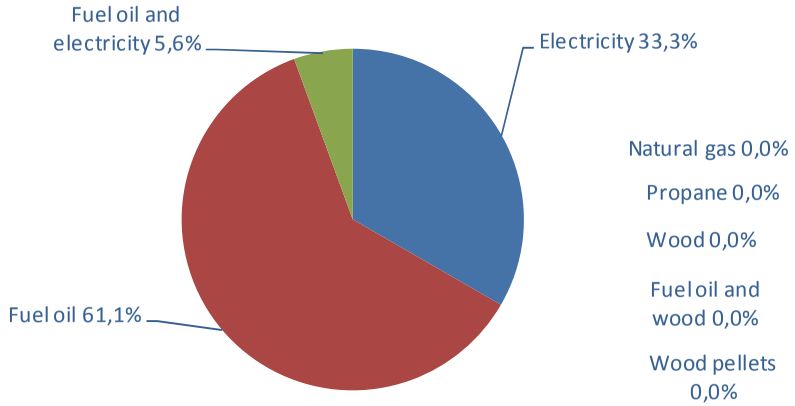


Figure NF2 - Residential Systems by Loop Type Newfoundland & Labrador

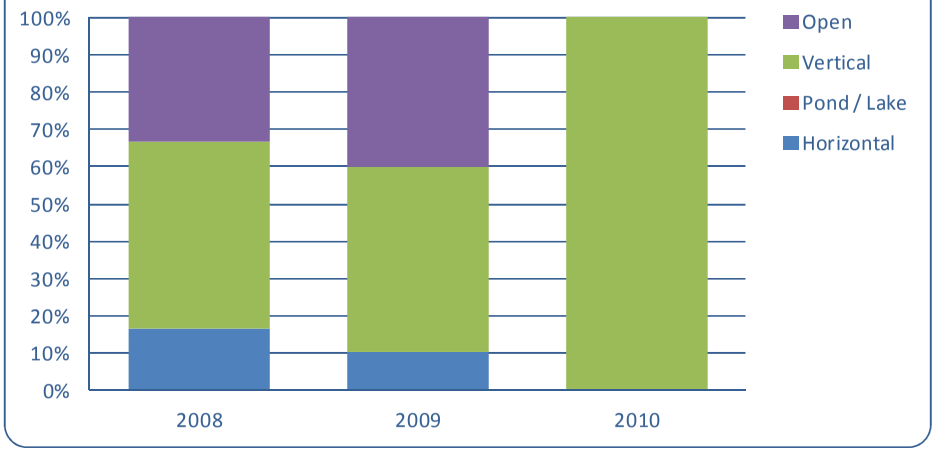


Figure NF4 - Trends In Fuel Replaced Newfoundland & Labrador

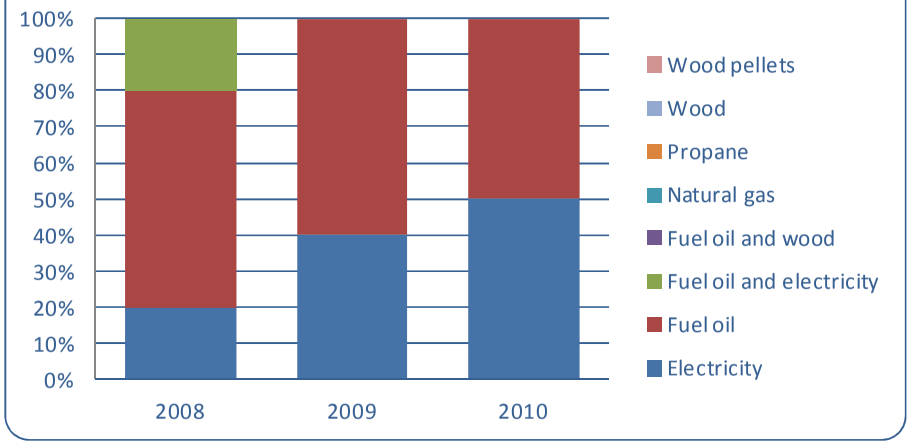


Table NF1			
Heat Pump Market Share by Brand - NFL			
	2008	2009	2010
Brand 1	66,7%	70,0%	50,0%
Brand 2	16,7%	10,0%	50,0%
Brand 3	16,7%	20,0%	0,0%
Brand 4	0,0%	0,0%	0,0%
Brand 5	0,0%	0,0%	0,0%
Brand 6	0,0%	0,0%	0,0%
Brand 7	0,0%	0,0%	0,0%
Brand 8	0,0%	0,0%	0,0%
Brand 9	0,0%	0,0%	0,0%
Brand 10	0,0%	0,0%	0,0%
Brand 11	0,0%	0,0%	0,0%
Brand 12	0,0%	0,0%	0,0%
Brand 13	0,0%	0,0%	0,0%
Brand 14	0,0%	0,0%	0,0%
Brand 15	0,0%	0,0%	0,0%
All Others	0,0%	0,0%	0,0%
Total	100,0%	100,0%	100,0%

Table NF2			
Concentration Indexes by Brand - NFL			
	2008	2009	2010
C4	100,0%	100,0%	100,0%
C5	100,0%	100,0%	100,0%
HH	0,5000	0,5400	0,5000

Table NF3			
Market Share by Installation Company - NF			
	2008	2009	2010
Company No. 1	50,00%	70,00%	50,00%
Company No. 2	0,00%	10,00%	50,00%
Company No. 3	33,33%	0,00%	0,00%
Company No. 4	0,00%	10,00%	0,00%
Company No. 5	16,67%	0,00%	0,00%
Company No. 6	0,00%	10,00%	0,00%
Company No. 7	0,00%	0,00%	0,00%
Company No. 8	0,00%	0,00%	0,00%
Company No. 9	0,00%	0,00%	0,00%
Company No. 10	0,00%	0,00%	0,00%
Company No. 11	0,00%	0,00%	0,00%
Company No. 12	0,00%	0,00%	0,00%
Company No. 13	0,00%	0,00%	0,00%
Company No. 14	0,00%	0,00%	0,00%
Company No. 15	0,00%	0,00%	0,00%
All Others	0,00%	0,00%	0,00%
Total	100,00%	100,00%	100,00%

Table NF4			
Concentration Indexes - Installation Companies - NF			
	2008	2009	2010
C4	100,00%	100,00%	100,00%
C5	100,00%	100,00%	100,00%
HH	0,3889	0,5200	0,5000

CGC RESEARCH UNIT
Industry Information Paper
CGC-RU-IIP-2012/01E

CBA INTERROGATORY #1

INTERROGATORY

1. New Business Activities

1.1. Should the new business activity – RNG Enabling Program – be considered as part of the utility's regulated business?

REF: Exhibit B/Tab 1 Schedule 1 page 9

PREAMBLE:

Both programs over their respective lifetimes will reduce the number of Cap and Trade allowances that the Company will need to procure and hence lower the compliance costs for its existing and forecasted customers.

How will the RNG Enabling Program reduce EGD's need for Cap and Trade allowances absent the procurement of RNG gas injected into EGD distribution system by EGD for consumption by EGD and its customers?

RESPONSE

Natural gas distributors, including Enbridge, are required to purchase Cap and Trade compliance instruments based on the GHG emissions reported to the Ministry of Environment and Climate Change ("MOECC"). GHG emissions are calculated based on the MOECC's Guideline for Quantification, Reporting and Verification of Greenhouse Gas Emissions, which require the distributor to calculate the emissions from the natural gas it distributes based on a series of calculations. All calculations are based on quantities of natural gas, "excluding any natural gas derived from biomass or gas that does not contain any carbon.[1]" Therefore, all volumes of RNG are exempt from a compliance obligation under the Cap and Trade program. The RNG Enabling program will support the injection of RNG into Enbridge's distribution system, thereby reducing the Company's obligation and need to buy Cap and Trade compliance instruments.

[1] Guideline for Quantification, Reporting and Verification of Greenhouse Gas Emissions, Effective November 2017

CBA INTERROGATORY #2

INTERROGATORY

1. New Business Activities

1.1. Should the new business activity – RNG Enabling Program – be considered as part of the utility's regulated business?

REF: Exhibit B/Tab 1 Schedule 1 page 7

PREAMBLE:

*Over the course of the past eighteen months, the Company has conducted discussions with several municipalities and other potential RNG producers with respect to the services Enbridge could provide to accelerate the development of RNG production capacity in its service area. Enbridge believes this will support the growth of RNG production which will facilitate lower cost RNG to supply market demand***.**

a) Please provide more detail as to:

i) how the RNG Enabling Program will facilitate lower cost RNG Supply for the Company and other consumers,
ii) how the RNG Enabling Program will increase RNG production, and
iii) how the RNG Enabling Program will benefit RNG producers relative to the status quo.

RESPONSE

i) At present there is only one RNG production facility operating in Ontario with the capability to deliver pipeline quality RNG into the province's gas delivery system. It can be expected that increasing the supply of a commodity will reduce the price of that commodity. The introduction of the Company's RNG enabling programs will facilitate the growth of RNG production by multiple suppliers. This is expected to support price competition in the RNG market. That will lead to lower RNG costs to ratepayers or a reduced need for other subsidies to mitigate the cost of RNG supply.

ii) Enbridge's RNG enabling programs will support increased RNG production by providing a safe and reliable means of bringing RNG production to the Ontario energy market.

iii) The status quo in Ontario is that there is no ability to inject into Enbridge's system and very limited upgrading capacity. As a result, there is virtually no pipeline quality RNG production. As explained above, the RNG Enabling Program will support the growth of RNG production.

CBA INTERROGATORY #3

INTERROGATORY

1. New Business Activities

1.1. Should the new business activity – RNG Enabling Program – be considered as part of the utility's regulated business?

REF: Exhibit B/Tab 1 Schedule 1 page 10

PREAMBLE:

While these programs will be part of the Company's regulated business activities and constitute carbon abatement activities, the best methodology to address their utility revenue requirement implications over their asset lives will be to treat the annual utility revenue sufficiencies and deficiencies associated with these programs as credits or debits to the cost of carbon or costs of carbon abatement.

Please confirm that the environmental attributes associated with RNG supply that is upgraded by EGD and/or injected into the EGD system stay with the RNG producer. If not confirmed, please explain why the environmental attributes would be transferred and to whom.

RESPONSE

Under the Company's RNG enabling programs, as proposed, the environmental attributes associated with RNG supply that is upgraded by Enbridge and injected into the Company's gas distribution system would remain with the biogas producer.

ENERGY PROBE INTERROGATORY #1

INTERROGATORY

Issue 1 – New Business Activities

Ref: No Reference

Preamble: On April 27, 2018, EGD advised the Board (EB-2017-0224 Transcript Volume 2) that it had been notified by the Government that any funding for the RNG procurement Program (commodity) was on hold pending the Provincial Election in June.

a) Please provide a copy of this notification.

b) Please provide the implications for this application, including whether the RNG Enabling Program is also on hold, whether the application is suspended or withdrawn.

c) Please clarify if there any effect on the proposed GESP and whether this part of the application still proceeding.

RESPONSE

a) Please see Attachment 1 to this response.

b) and c) The notification by the Province that the funding expected to support the Company's RNG procurement plan will be delayed has no implications for this application. The RNG Enabling Program and Geothermal Energy Services Program are not dependent on the procurement of the RNG by the Company. Enbridge is prepared to continue with the implementation of both programs, and is proceeding with the EB-2017-0319 application as filed.

Ministry of Energy

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Ontario

APR 25 2018

MC-2018-439

Ms Cynthia Hansen
Executive Vice President, Utilities and Power Operations
Enbridge Inc.
500 Consumers Road
North York ON M2J 1P8

Dear Ms Hansen: Cynthia,

I am writing to provide you with an update on the government's policy direction regarding renewable natural gas (RNG).

The government continues to support the development of RNG in Ontario as well as the introduction of RNG into the province's natural gas supply.

Enbridge Gas and Union Gas have been tremendous partners in the government's policy efforts to reduce greenhouse gas (GHG) emissions. I want to personally thank you and your teams for your support. In particular, I appreciate the recent Request for Proposal (RFP) that was conducted to identify potential RNG providers, and for all the work put forth to reach workable solutions for the upgrading of the RNG and its subsequent injection into the pipeline system. The results of this RFP have helped signal the readiness of the market and the municipal, agricultural, and waste sectors' capacity to both produce and introduce RNG content into Ontario's natural gas supply, with government support.

You may be aware of the province's Municipal GHG Challenge Fund, a Climate Change Action Plan initiative that recently provided funding to the City of Toronto to support the use of green bin waste to create a local RNG supply. This is one example of our support for RNG; however, we know there is more to do.

As I indicated in my February 22, 2018 letter to you, the government's plan to provide funding to support the procurement of RNG is contingent on various approvals, including that of Treasury Board. I am writing to let you know that we do not anticipate these approvals will be possible before the election period begins.

Our government remains committed to further developing RNG in Ontario. Our intention is to return to working on this file when government is reformed in June 2018.

Thank you again for your support, and I look forward to working with you on the introduction of RNG into Ontario's natural gas supply network.

Sincerely,

Glenn Thibeault
Minister

ENERGY PROBE INTERROGATORY #2

INTERROGATORY

Issue 1 – New Business Activities

Ref: Exhibit B / Tab 1 / Schedule 1 / p. 4 #11 and 12

Preamble: Energy Probe wishes to understand the legislative/regulatory framework for this application.

a) Please provide in tabular format, the sections of the Act, Rules, Guidelines, legislative and other regulatory requirements that pertain to the specific relief requested in this application. Provide evidentiary references that relate to each.

b) Specifically, please provide a detailed explanation why and how the Board's objects for rational expansion of the natural gas distribution, storage and transmission system apply to each of
   i) The RNG Enabling Program and
   ii) The Geothermal Energy Services Program

c) Please explain, for each of these proposed activities how it fits within the Board's mandate to regulate monopoly natural gas supply and distribution services.

RESPONSE

a) to c) This response explains key reasons why the Board has the necessary jurisdiction and authority to approve Enbridge's proposal to include the assets, revenues and costs associated with the RNG Enabling Program and the Geothermal Energy Services Program as part of the regulated utility, and to approve fees, charges or rates for these activities. As explained on the following pages, the key provisions of the OEB Act that Enbridge relies upon are sections 2 (objectives) and 36 (ratemaking). The Company also relies upon the Board's Cap and Trade Framework for Natural Gas Utilities and RRFE, and the Government's 2017 LTEP and climate change initiatives.

In this answer, Enbridge has endeavoured to be responsive to the numerous interrogatories asked on this topic. However, given the relatively short time available, and the fact that interrogatory responses are not ideally suited to legal and policy submissions, Enbridge requests the opportunity to make further submissions

about this topic before the Board makes any preliminary or final determination on any associated issue(s).

In 2006 and 2009, the Undertakings between the Province and Enbridge were amended to enable, inter alia, Enbridge to provide services that would assist the Government of Ontario in achieving its goals in energy conservation. This included the promotion of cleaner energy sources, alternative energy sources and renewable energy sources.

Based on *the Climate Change Mitigation and Low-carbon Economy Act, 2016* ("Climate Change Act"), the Natural Gas Utilities are under a legal obligation to account for and cover their emissions (including the emissions of most of their customers) through the procurement of financial instruments as a requirement of the Cap and Trade program. The Board in its Cap and Trade Framework, outlines several ways in which the utilities may propose to meet their Cap and Trade obligations which includes in addition to financial instruments (e.g., allowances, offsets): customer abatement (e.g., renewable natural gas ("RNG"), energy efficiency, fuel switching such as geothermal, new technologies), and facilities abatement (e.g., distribution system upgrades).

It is clear to the Company that decarbonizing gas utility service is now an inherent component of utility business, resulting from the Board's statement that that responsibility for GHG emissions related to gas delivery is an *"ongoing business obligation of a natural gas distributor under the Climate Change Act"*[1] and *"part of the Utilities' cost of providing distribution service similar to other delivery costs."*[2]

There are several regulatory and legal precedents recognizing that the Board's rate setting power under section 36 of the OEB Act is broad, and that it must be determined and applied with reference to the Board's objectives as well as Government and public policy. This is seen from the majority decision in Enbridge's 2007 rate case (in relation to the issue of rate affordability programs)[3], and in the majority decision regarding the subsequent appeal to the Divisional Court (the ACTO case).[4]

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[1] Cap and Trade Framework for Natural Gas Utilities – Early Determination regarding Billing of Cap and Trade Related Costs and Customer Outreach - File No.: EB-2015-0363, page 5.
[2] Cap and Trade Framework for Natural Gas Utilities – Early Determination regarding Billing of Cap and Trade Related Costs and Customer Outreach - File No.: EB-2015-0363, page 6
[3] EB-2006-0034, Decision- Rate Affordability Programs, April 26, 2007 (the OEB Rate Affordability Programs Decision).
[4] *Advocacy Centre for Tenants-Ontario v. Ontario Energy Board*, 2008 CanLII 23487 (ON S.C.D.C.) (the ACTO case).

In the Ontario Energy Board Rate Affordability Programs Decision in Enbridge's 2007 rate case, the majority noted that:

> The Board was created and made operational through legislation. The Board has a responsibility to operate to the full depth and breadth of the authority granted to it in its governing statute. The limits or boundaries of its authority need not, nor should, be a bright line. This would require near unachievable foresight by the legislators to consider all of the possible eventualities. The objectives provided in the [OEB] Act are intended to be broad enough to allow the Board to operate with discretion in an ever changing environment and focused enough to ensure that the Board operates within the government's policy framework. Determinations on jurisdiction should be guided solely by the question of what can reasonably be considered to have been intended by the legislators in the scoping and crafting of the Board's mandate. There should be no predestining bias based on a desire by the regulator to include or exclude any particular issue.[5]

The OEB's majority decision was appealed to the Divisional Court. Although the Divisional Court did not agree with the OEB's majority decision in Enbridge's 2007 rate case, the Court did not disagree with the OEB's view of the importance of considering its statutory objectives when considering the scope of the Board's jurisdiction. In the Divisional Court's reasons allowing the appeal of the Board decision (the ACTO case), the majority indicated that:

> …[T]he legislation involves economic regulation of energy resources, including setting prices for energy which are fair and reasonable to the distributors and the suppliers, while at the same time are a reasonable cost for the consumer to pay. This will frequently engage the balancing of competing interests, as well as consideration of broad public policy.[6]

From these passages, it is clear that when considering its own jurisdiction and setting rates, it is appropriate for the Board to take its statutory objectives as well as public policy into account. As a result of public policy, it is also now clear that the economic regulation of energy resources includes the cost of carbon associated with current and future energy consumption.

The Board highlighted the importance of "*Public Policy Responsiveness"* in the Renewed Regulatory Framework (which applies to gas distributors as well as electricity utilities), noting this as one of the four outcomes to be achieved by distributors.[7]

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[5] OEB Rate Affordability Programs Decision, at page 5.
[6] ACTO case, at para. 35, quoting from *Enbridge Gas Distribution Inc. v. Ontario Energy Board* (2005), 75 O.R. (3d) 72, [2005] O.J. No. 756 at para. 24.
[7] Report of the Board: Renewed Regulatory Framework for Electricity Distributors: A Performance-Based Approach, October 18, 2012, at page 6.

More recently, the Board has recognized its responsibility to take public policy into account in its draft Framework for the Assessment of Gas Distributor Gas Supply Plans, issued April 12, 2018. In this document the Board has identified three principles to guide it in its consideration of utility gas supply plans that are "consistent with its legislative mandate", one of which is to ensure that gas supply plans are "*aligned with public policy in relation to climate change and expansion of natural gas service where appropriate*".[8]

The 2017 LTEP sets out the Government's energy policies and plans for the coming years, and "builds on the province's leading role in the global fight against climate change". The 2017 LTEP includes a number of plans and initiatives to encourage innovation and new technologies, and assist in meeting climate change goals. Several of these are directly relevant to this Application, including:

- A direction to build a *"culture of innovation"* in the energy sector and look for ways to allow utilities to make non-traditional and "non-wires" investments and work with customers in scenarios where each party owns part of an energy system.[9]

- A plan to have RNG become part of the Ontario supply mix: *"Ontario is looking at using renewable natural gas to lower the carbon intensity of the natural gas that people burn. …. As an added benefit, it can use the existing natural gas distribution system and replace the use of conventional natural gas in today's stoves and furnaces."*[10]

- A goal to increase the number of geothermal energy systems used for low carbon space and water heating in homes and buildings across Ontario. The 2017 LTEP indicates that *"Natural gas will continue to play a critical role in space and water heating, but we must use it as efficiently as possible and supplement it with the next generation of clean energy technologies, such as ground-source and air-source heat pumps. Proceeds from cap and trade auctions will help fund the further application of these technologies."*[11]

It is clear from the LTEP, that government policy encourages supplementing natural gas use with the adoption of efficient technologies with a lower carbon footprint.

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[8] Draft Report of the Ontario Energy Board - Framework for the Assessment of Distributor Gas Supply Plans, page 6.
[9] Ontario's Long-Term Energy Plan 2017: Delivering Fairness and Choice ("2017 LTEP"), at pages 69-70.
[10] 2017 LTEP, at page 114.
[11] 2017 LTEP, at pages 109 and 115.

The Company's proposal creates a pathway for the Board to approve geothermal and RNG services that further the Government's climate change and clean energy policy and priorities.

There are seven objectives set out in section 2 of the OEB Act that apply when the Board carries out its responsibilities in relation to gas. The third of these objectives is as follows:

> To facilitate rational expansion of the transmission and distribution systems.

The Board has provided guidance on many occasions on how to assess the rational expansion of distribution systems, such that new customers do not create an undue burden on existing customers. Because of the desire to limit absolute carbon emissions, market transformation initiatives such as geothermal and the RNG enabling services reduce the burden of escalating carbon prices on existing customers from the expansion of distribution systems to serve future customers. These programs do so by managing total emissions associated with current and future customers that would otherwise have chosen natural gas for home heating. In addition, these services also adhere to EBO 188 guidelines by requiring a profitability index of 1.0 or greater to ensure no undue cross subsidy from existing gas rate payers to the users of these services.

The fifth of the Board's objectives as it relates to gas is as follows:

> To promote energy conservation and energy efficiency in accordance with the policies of the Government of Ontario, including having regard to the consumer's economic circumstances.

It is important to note the use of the word "energy" in this statutory objective. The wording of the objective does not refer to "gas" conservation or "gas" efficiency; it refers to "energy" in both contexts, namely, conservation and efficiency. In order for the Board to give due consideration to the most efficient utilization of energy resources, as well as to conservation of energy, it must be the case that the Board has jurisdiction to approve, in a gas utility proceeding, abatement initiatives such as those proposed by Enbridge.

The fact that the Board should take a broad view of its ratemaking powers can also be seen in the Board decision in an NRG case considering contributions in aid of construction (CIAC).[12] In that decision, the Board confirmed that it can approve charges under section 36 of the OEB Act even where those charges do not lend themselves to fixed charges within a rate tariff. This is consistent with the wide

[12] EB-2012-0396 Decision with Reasons, February 7, 2013.

definition of "rate" found in the OEB Act.[13] The following excerpt from the Board's decision in the NRG proceeding makes clear that utilities charge many rates (in the form of CIAC) that are not individually approved by the Board:

> The Board recognizes that, as a practical matter, the setting of a rate for a capital contribution cannot be conducted in the same manner as the rates set out in a utility's rate tariff. The amount owing for any capital contribution is fact specific, and will be different depending on the capital costs of the assets and the revenues that the utility is expected to receive through ordinary rates. The need for a capital contribution may arise at any time, and seldom will be the case where the timing allows the Board to review the proposed contribution through a routine rate case. Indeed many projects requiring capital contributions (especially in the electricity sector) will not even be attached to a leave to construct. Under these circumstances the Board has established the formula for calculating the capital contribution. In cases where the parties cannot agree on the appropriate amount (which are rare), the Board will intervene to settle the dispute and ensure that a just and reasonable rate is established.[14]

All of the items described above point in favour of the Board taking a broad view of its ratemaking powers, to include charges associated with abatement programs where such activities are aimed at reducing the Company's overall compliance obligations. Taken together, these items lead to the conclusion that the Board has jurisdiction under the provisions of the OEB Act to allow Enbridge to conduct abatement activities such as geothermal energy services and RNG enabling programs within the regulated utility.

Finally, Enbridge asserts that even if the Board should find that it does not have express jurisdiction to permit including the abatement activities described in this application within the regulated utility, this should be permitted under the doctrine of necessary implication. The seminal decision of the Supreme Court of Canada in *ATCO Gas and Pipelines Ltd. v. Alberta (Energy and Utilities Board)*[15] addressed the approach to statutory interpretation that is to be taken in determining the jurisdiction of a regulatory tribunal. The Court made clear that a tribunal's jurisdiction is not limited to the powers explicitly conferred by the governing legislation. Rather, as stated by the Supreme Court, "the powers conferred by an enabling statute are construed to include not only those expressly granted but also, by implication, all powers which are practically necessary for the accomplishment of the object intended to be secured by the statutory regime". This is the doctrine of jurisdiction by necessary implication.

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[13] The definition of "rate" in section 3 of the OEB Act is "a rate, charge or other consideration and includes a penalty for late payment."
[14] EB-2012-0396 Decision with Reasons, February 7, 2013, at page 15.
[15] ATCO Gas and Pipelines Ltd. v. Alberta (Energy and Utilities Board), [2006] 1 S.C.R. 140 (S.C.C.).

Under the doctrine of necessary implication, the Board has, in addition to its express mandate, all powers that are practically necessary for the accomplishment of the object intended to be secured by the statutory regime. The object intended to be secured by the statutory regime is the regulation of energy matters. The statute guides the Board to regulate in accordance with the public interest and public policy. Specific mention is made of energy efficiency and conservation. The clear intent of Ontario Government public policy is to encourage carbon abating activities, with specific mention and support being given to RNG adoption and geothermal systems for homeowners. Taking all of this together, Enbridge asserts that the doctrine of necessary implication provides the Board with jurisdiction to permit a gas utility to undertake abatement programs like the RNG Enabling Program and the Geothermal Energy Services Program as abatement programs within the regulated utility.

ENERGY PROBE INTERROGATORY #3

INTERROGATORY

Issue 1 – New Business Activities

Ref: Exhibit B / Tab 1 / Schedule 1

Preamble: Under the RNG Injection Service, EGD will build a pipeline to attach a producer to its distribution system, odourize the bio-methane, measure the gas volumes and energy content of the gas, manage pressures and ensure that the gas meets required specifications. Energy Probe wishes to understand and compare this proposed RNG injection service relative that provided to Ontario Gas Producers.

a) Does EGD provide a similar service for Ontario natural gas production?

b) Please provide details of how the non-commodity Ontario gas production costs are allocated to the producer and the utility.

c) Are Ontario gas producers required to use EGD's assets and injection service, or can they self-provide these?

d) Does EGD have a specific rate for Ontario gas production injection/upgrading service? If so please provide details and how this rate is calculated?

e) Does EGD have specific quality specifications/requirements for Ontario gas production? If so, please provide a copy of these.

f) Comment on the major differences between Ontario gas production and RNG.

RESPONSE

a) Enbridge does not currently purchase any Ontario natural gas production. Enbridge currently owns and operates one gas custody transfer station where natural gas produced in Ontario is injected into the Company's gas distribution system for transportation to Dawn.

b) Enbridge does not currently purchase any Ontario natural gas production.

c) Yes, Ontario gas producers are required to use Enbridge's assets to inject natural gas into the Company's gas distribution system.

d) Enbridge does not currently acquire Ontario natural gas production volumes as part of its system supply portfolio, and does not have a specific injection rate for such production. Ontario production is currently transported to Dawn for one counterparty subject to gas exchange agreements with the fees being based on the transportation cost differential between Dawn and the Delivery Area (CDA or EDA) where the gas volumes were received by the Company.

e) Enbridge does not have any current Ontario gas production. However, all parties that inject volumes of natural gas into the North American natural gas transmission and distribution system must provide documentation confirming that such gas meets minimum standards in terms of its chemical composition and heating value.

f) Natural gas is a naturally occurring gas mixture, consisting mainly of methane. The gas supplied to Enbridge comes from western Canada and the United States (and could include Ontario producers). While the gas from these sources has a similar composition, it is not necessarily entirely the same. However, all parties that inject volumes of natural gas into the North American natural gas transmission and distribution system must provide documentation confirming that such gas meets minimum standards in terms of its chemical composition and heating value.

Biogas, the feedstock for the production of biomethane or RNG like natural gas consists mainly of methane, which is the substance that provides both gases with their heating value. Raw biogas, however, has a lower heat content than natural gas because its methane content is lower. Natural gas has between 90% to 99% methane content where most raw biogas will typically have a methane content of 50% to 80%. To make biogas more comparable to natural gas, the impurities such as CO_2, H2S, siloxanes etc. need to be removed. Given that biogas can be produced from several different sources (landfills, waste water, source sorted organics, agricultural waste etc.) different processes are used to clean and upgrade biogas into RNG. Given the degree of variation of biogas sources the risk of substandard RNG entering the Company's gas distribution system is higher relative to traditional natural gas supply sources. Enbridge has developed a standard for RNG entering its distribution system. Please see attachment 1 to this response.

Renewable Natural Gas (RNG) Pipeline Gas Quality Specifications

Purpose

This document outlines gas quality specifications for the composition of renewable natural gas (RNG) for injection into the Enbridge gas distribution system. These specifications ensure that RNG to be injected into the system is within expected operating parameters and interchangeable with natural gas.

This document is intended to be used as a guide for evaluating RNG business opportunities or contracting new RNG supply.

Scope

This document covers the pipeline gas quality specifications for RNG for injection into the Enbridge gas distribution system, without respect to biogas sources.

It does not include procedures or standards for designing, constructing or operating biogas or biomethane facilities.

Specifications

RNG composition must meet the specifications outlined in Table 1. The values shown in Table 1 represent maximum levels, unless a range of values is indicated. Minimum and maximum pressures will be set for each RNG facility on a case-by-case basis.

In summary, in order to be injected into the Enbridge gas distribution system, RNG must:

- Not contain any contaminants, particles, or other impurities at a concentration that are known as a threat to the integrity of the system, human health, or the environment.
- Have an energy content no lower than 36.0 MJ/m^3 and no higher than 41.3 MJ/m^3.
- Have a Wobbe Index during normal operation no lower than 47.2 MJ/m^3 and no higher than 51.1 MJ/m^3.
- Not contain more than 2% by volume of carbon dioxide.
- Not contain more than 0.4% by volume of oxygen.
- Not contain more than 4% by volume of total inerts.
- Not contain more than 35 mg/m^3 of water content.
- Not contain more than 0.1% by volume of hydrogen.
- Not contain more than 6 mg/m^3 of hydrogen sulphide.
- Not contain more than 23 mg/m^3 of total sulphur.
- Not contain more than 3 mg/m^3 of ammonia.
- Not contain more than 1 mg/m^3 of total siloxanes.
- Not contain more than 10 mg/m^3 of halocarbons and organochlorinated compounds.
- Be technically free of volatile organic compound, bacteria, particles, and dust.
- Not form liquid hydrocarbons at temperatures of −10°C or higher at the delivery pressure.
- Be delivered at a maximum temperature of 30°C.

Table 1: Renewable Natural Gas – Pipeline Gas Quality Specifications

		Value	Unit	Monitoring Frequency*	Recommended Test
Heating Value	HV	36.0 to 41.3	MJ/m^3	Continuous	D1945 / D7164
Wobbe Index	WN	47.2 to 51.1	MJ/m^3	Continuous	D1945 / D7164
Carbon Dioxide	CO_2	2	% vol	Continuous	D1945
Oxygen	O_2	0.4	% vol	Continuous	D1945
Total Inerts		4	% vol	Continuous	D1945
Water Content	H_2O	35	mg/m^3	Continuous	D1142 / D5454 / D3588
Hydrogen	H_2	0.1	% vol	Periodic	D1945
Hydrogen Sulfide	H_2S	6	mg/m^3	Continuous	D4084 / D6228 / D4468 / D5504 / D7166
Total Sulphur	S	23	mg/m^3	Periodic	D4084 / D6228 / D4468 / D5504 / D7166
Ammonia	NH_3	3	mg/m^3	Periodic	D1945
Siloxanes	Si	1	mg/m^3	Periodic	E.g., Gas Chromatography (ELCD, AED, MS)
Halocarbons and organochlorinated compounds		10	mg/m^3	Periodic	E.g., Gas Chromatography / Electrolytic Conductivity Detector
Volatile organic compound	VOCs	Site-specific		Periodic	E.g., Gas Chromatography / Mass Spectrometry (GC/MS)
Bacteria		Technically free of		Periodic	E.g., Most Probable Number Determination of Total Live Bacteria (MPN), others
Particles, dust, etc.		Technically free of		Continuous	E.g., Environmental recommendations 0.1µm filters
Hydrocarbon Dew Point		−10	°C	Continuous	D5504 / D1142
Delivery Temperature (plastic pipe)		< 30	°C	Continuous	

** In this document, continuous monitoring means real-time or near-real time. Periodic monitoring could be seasonal, semi-annually, or annually. Final monitoring frequency will be defined for each RNG facility.*

Control and Maintenance

For document control and maintenance purposes, the following table captures important information related to this document.

Owned by	Engineering.
Review	Annually or as needed.
Distribution	Enbridge Gas Distribution employees.
Regulations	N/A
Related Documents	N/A

History of Changes

Changes made to this document are tracked in the following table.

REVISION DATE	SUMMARY	PREPARED BY	APPROVERS
2017-Apr-26	V1.0	Johana Gomez, Sr. Engineering Project Manager	Roddi Bassermann, Manager, Stns Telemetry & Controls Gonzalo Juarez, Manager, Engineering Construction and Maintenance Michael Wagle, Chief Engineer

ENERGY PROBE INTERROGATORY #4

INTERROGATORY

Issue 1 – New Business Activities

Ref: Exhibit B / Tab 1 / Schedule 1 / p. 8 #23

Preamble: On December 13, 2017, the Ontario government announced new rebates from the GreenON fund for ground source heat pumps (home geothermal). Homeowners will be eligible for rebates of up to $20,000 for ENERGY STAR certified ground source heat pumps. This will offset the customer's costs under Enbridge's proposed Geothermal Energy Service program.

a) Given the cited recent government announcement, why is the EGD GESP still required? Please explain.

b) Please provide a DCF analysis for a typical GES from a homeowner perspective, including the government incentive. Include and discuss the assumptions and provide the resulting payback period.

c) Please indicate the results of any discussions EGD has held with IESO for a cooperative GES program, using government incentives and potential incentives under IESOs demand management or other programs.

RESPONSE

a) The Green Ontario Fund will provide:
   - $2,000/loop ton up to $15,000 contribution towards the installation of a horizontal closed-loop heat pump system.
   - $2,000/loop ton up to $15,000 contribution towards the installation of a horizontal pond closed-loop heat pump system.
   - $3,000/loop ton up to $20,000 contribution towards the installation of a vertical closed-loop heat pump system.

   Enbridge anticipates that most homes will require 4 tons of system capacity at an average cost of approximately $28,000 to $32,000

   For example given that the GreenOn subsidy for a 4 ton system will amount to $12,000, which means that the homeowner will still need an additional $16,000 to

$20,000 to cover the full cost of a vertical closed loop heat pump system. A typical natural gas furnace, water heating and electric central air conditioning system will cost approximately $8,000. This means that the natural gas based system is still significantly less expensive than the vertical closed loop heat pump system even with the GreenOn subsidy taken into account. In this example the Enbridge Geothermal Energy Service would reduce the upfront cost of the geothermal system by about $12,000 making the geothermal solution much more attractive to the homeowner. The Company maintains that its Geothermal Energy Service proposal is complementary to the GreenOn program and will result in many more homeowners pursuing the ground source heat pump option. The long life nature of the underground geothermal loops makes them appropriate for the Company to own and for the Board to apply a utility model to service fees. Additionally, the Company will own, maintain and implement uniform standards of installation and commissioning.

b) Please see response to Board Staff Interrogatory #10 c) filed at Exhibit I.2.EGDI.STAFF.10.

c) The Company has had discussions with GreenOn / IESO about how the Geothermal Energy Service would complement the GreenOn geothermal rebate program. The Company has also discussed with GreenON / IESO regarding how the launch of a new construction rebate program similar to the retrofit market rebate program would increase adoption of geothermal energy systems.

ENERGY PROBE INTERROGATORY #5

INTERROGATORY

Issue 1 – New Business Activities

Refs: Application Exhibit A Paragraph 8; Exhibit B / Tab 1 / Schedule 1 / p. 4 #11

Preamble: The Geothermal Energy Service Program (GESP) is intended to allow Enbridge to own and maintain geothermal loops to encourage homeowners to choose and use geothermal energy systems for their home heating and cooling requirements as an alternative to natural gas and other fossil fuels.

a) Please provide any and all precedents where EGD (regulated utility) owns, leases or rents rate base assets not required to deliver and meter regulated natural gas distribution services on customer premises.

b) Please provide the risk analysis for the proposed estimated $237 million investment (Appendix11) including, but not limited to the following
   - Capital risk
   - Revenue risk
   - Stranded assets
   - Government Policy

RESPONSE

a) Enbridge currently has rental agreements in place for the provision of Natural Gas Vehicle refueling facilities which are rate base assets not required to deliver and meter regulated natural gas distribution services which are located on customer premises.

b) In general the risks associated with the Geothermal Energy Service are similar to those risks inherent in the Company's core gas distribution business. Specifics on the individual risks identified in this interrogatory are set out below.

   Capital risk: Enbridge has estimated it's per unit capital costs based on the drilling costs of a pilot project for four new construction homes. These estimates have also been verified with Ontario Geothermal Association members as being reasonable.

Enbridge will contract for the installation of geothermal loops on a fixed cost type contracts to minimize capital cost escalation risk.

Revenue risk: The geothermal system once installed in the home is a necessity for heating and cooling and as such the risk of non-payment is similar to its current natural gas distribution system customers. Enbridge will implement similar non-payment and collections processes as it does for its existing business.

Stranded assets: Once the system is installed, the cost to switch systems is high and the stranded asset risk is relatively low. Enbridge expects that those customers electing to install a geothermal system will continue to use it for its useful life.

Government policy: A shift in Government policy and the discontinuation of the rebate program will lower customer adoption and limit the potential size of the program. A shift in Government policy and an increase in the funding for geothermal systems will improve market potential for this service.

ENWAVE INTERROGATORY #1

INTERROGATORY

Issue 1.2: Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?

Please confirm that regulated utility businesses are typically marked by market failure.

RESPONSE

Market failure is one reason why regulation may be required. More typically, regulation is required as a proxy for competition in instances where economics dictate that the duplication of costly infrastructure to serve the same market is impractical. Rate regulation may also be appropriate in situations where consumers are faced with only one viable provider of a product or service, effectively being captive customers of that service provider. Additionally, there are several other reasons where it is appropriate for regulated utilities to participate in a market: including direction by Government or a regulator, market transformation, efficiencies, application of uniform standards and provision of services and products to support or complement existing services.

ENWAVE INTERROGATORY #2

INTERROGATORY

Issue 1.2: Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?

Please identify the market failure that this Program is meant to solve.

RESPONSE

As discussed in the response to Enwave Interrogatory #1 filed at Exhibit I.1.EGDI.ENWAVE.1, market failure is not the only reason for regulation. Please see the response to Board Staff Interrogatory #2a) filed at Exhibit I.1.EGDI.STAFF.2 for the market barriers this program is meant to overcome and also the Company's response to SEC Interrogatory #11 filed at Exhibit I.1.EGDI.SEC.11.

ENWAVE INTERROGATORY #3

INTERROGATORY

Issue 1.2: Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?

Subsection 36(1) of the OEB Act, 1998 provides that the Board may "make orders approving or fixing just and reasonable rates for the sale of gas …and for the transmission, distribution and storage of gas." Please confirm that the imposition of a charge on customers to pay for the geothermal energy service program does not pay for the sale, transmission, distribution and storage of gas.

RESPONSE

Please see the Company's response to Energy Probe Interrogatory #2 file at Exhibit I.1.EGDI.EP.2.

ENWAVE INTERROGATORY #4

INTERROGATORY

Issue 1.2: Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?

Are there any other statutory provisions that Enbridge relies upon for the position that the Board can impose charges on Ontarians to pay for Enbridge's geothermal energy service program?

RESPONSE

Please see the Company's response to Energy Probe Interrogatory #2 filed at Exhibit I.1.EGDI.EP.2.

ENWAVE INTERROGATORY #5

INTERROGATORY

Issue 1.2: Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?

The evidence states that the geothermal market has experienced "low market penetration and less than desirable levels of customer satisfaction with this technology" (B-1-1, p.23).

i. Please confirm that geothermal is one technology for heating and cooling which competes with a number of other technologies, including air sourced heat pumps, solar heating, and other types of waste heat recovery systems which may be district based ("Competing Technologies)

ii. Please provide all materials that is relied upon to support the statement that the geothermal market has experienced "low market penetration and less than desirable levels of customer satisfaction with this technology"

iii. Please advise whether Enbridge has the same opinion with respect to Competing Technologies and provide all materials that Enbridge relies upon to support that opinion.

iv. Please provide evidence on low market penetration and, in particular, whether there is excess capacity among service providers. Please respond with reference to both geothermal and Competing Technologies.

v. Please provide any information, including internal studies, that addresses how Enbridge's rate-payer funded participation in this market will increase market penetration. Please respond with reference to both geothermal and Competing Technologies.

vi. Please provide all materials that Enbridge has with respect to the state of competition in the market and how this proposal is likely to impact competition. Please respond with reference to both geothermal and Competing Technologies.

vii. Please confirm that the market for geothermal services would be less competitive if commercial providers are unable to compete with Enbridge's rate-payer funded market offering and therefore will have to exit the market. Please respond with reference to both geothermal and Competing Technologies.

viii. Please advise whether Enbridge intends to participate in the geothermal market or the market for Competing Technologies through an unregulated affiliate.

ix. Please advise whether Enbridge or an affiliate has participated in an RFP or similar competitive processes for the provision of geothermal or other energy solutions using Competing Technologies.

x. Please advise how the Board can ensure that its proposal will not provide a competitive advantage to Enbridge or an unregulated affiliate through increased understanding/knowledge/experience or procurement advantage/leverage when participating in larger energy procurement processes that may include geothermal as a part of a solution other than for single family homes/loops?

xi. Please confirm that this scenario would be worse for customers of geothermal services. Please respond with reference to both geothermal and Competing Technologies.

xii. Please advise how Enbridge's rate-funded option would increase customer satisfaction with geothermal technology. Please respond with reference to both geothermal and Competing Technologies.

xiii. The evidence states that the "Program is initially targeted to single family homes (both new and retrofit). In the future, the Program may be expanded to multi-residential and commercial markets." (B-1-1,p. 28).

xiv. Please confirm that, if Enbridge did seek to enter into the multi-residential and commercial markets for geothermal services, it would have to seek specific Board approval for same.

xv. Please advise whether Enbridge is aware of geothermal solutions being pursued at a scale larger than single residential loops for single family home marketplace homes through district heating with, for example, community energy loops.

xvi. Please advise how, if the Board approves Enbridge's proposal, it can ensure that, Enbridge is not given a pricing or network advantage that disadvantages competing district heating alternatives.

RESPONSE

Enbridge's Geothermal Energy Services Program proposal clearly sets out the scope of approvals requested in this case. Enbridge's evidence, as well as many of the interrogatory responses being provided, set out the benefits that can be achieved from the proposal, and the reasons why it is an appropriate abatement program. Enbridge is not seeking any monopoly status or exclusive franchise for the provision of geothermal energy systems or geothermal energy loops. The industry association (OGA) is generally supportive of Enbridge's proposal.

In the event that Enbridge seeks in the future to extend its regulated Geothermal Energy Services offering to other market sectors (beyond the low-density residential sector) it will seek approval from the Board to the extent required to establish new or different service fees to these types of customers.

Enbridge is not seeking approvals to undertake any activities that might be described as "Competing Technologies" through the regulated utility. That would require a separate application.

As a non-utility or affiliate activity, Enbridge may offer geothermal energy services to customers who are not potential gas customers. Enbridge will meet all requirements set out in the Affiliates Relationship Code where applicable.

The details about activities that Enbridge may pursue as a non-utility or affiliate activity in relation to what is described as "Competing Technologies" are not relevant in this proceeding.

Enbridge is aware that other parties (including Enwave) may pursue community energy loops as a future line of business. Enbridge's view is that it would be appropriate for such services to be regulated, since consumers are faced with only one viable provider of heating and water heating, effectively becoming captive customers of that service provider over a long period of time. The Company is aware that in British Columbia the BCUC regulates the provision of energy from community energy systems. The Board or another regulator can provide appropriate customer protection. The Company acknowledges that this may require updates to the legislative and regulatory framework similar to those recently made to Section 78 of the Ontario Energy Board Act requiring the Board to approve the of rates applicable to sub-metered electricity. This could be an appropriate topic for the Board's Modernization Panel.

Under the Geothermal Energy Services Program, customers will pay cost-based fees over the life of the geothermal loops and will purchase their own heat pump systems. Customers can take advantage of available government funding. The same approach

can be used for community geothermal systems. The project proponent can charge cost-based fees, and the customers can take advantage of any available government funding. A main difference, however, is that Geothermal Energy Services Program customers will benefit from the consumer protection afforded by Board oversight, while (under current circumstances) there is no equivalent protection for customers of a community geothermal system.

ENWAVE INTERROGATORY #6

INTERROGATORY

Issue 1.2: Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?

The evidence states that Enbridge "will ensure uniform standards are applied to the safety, design, sizing and installation of geothermal systems to achieve a high level of quality assurance…"(B-1-1, p. 24).

Please confirm that there are government standard setting authorities and that market participants already comply with such standards.

RESPONSE

Confirmed. The Company is aware of government standards and industry guidelines concerning the installation of ground source heat pump systems. The Company cannot confirm that these standards have and are currently being adhered to by all industry participants.

FRPO INTERROGATORY #1

INTERROGATORY

Issue 1 – New Business Activities

REF: Exhibit B / Tab 1 / Schedule 1 / p. 4 #11 and 12

Preamble: In addition to Board Staff IR.1, we are interested in how EGD envisions this potential service as compared to Union Gas M13 and M16 services.

1) Please provide a comparison and/or contrast between EGD's proposed service and Union's M13 and M16 Rates. Please describe fully the similarities and differences.

RESPONSE

Union Gas' M13 rate pertains to a service that enables Ontario natural gas producers with a means to transport gas to Union Gas' Dawn Hub where it can be sold to any number of market participants. A corresponding balancing service takes the daily swing between production and market.

Union Gas' Rate M16 pertains to a bi-directional transportation service which provides third party, natural gas storage pool operators with transportation between their storage pool and Union Gas' Dawn Hub. The transport service allows the storage operator to offer their customers Dawn Hub based storage services.

Neither Union Gas' M13 nor M16 rate is comparable to the two rates Enbridge has asked the Board to approve in this proceeding. Enbridge's proposed Rate 400 pertains to a service the Company seeks to provide to parties wishing to upgrade raw biogas to pipeline quality renewable natural gas. Enbridge's proposed Rate 401 pertains to a service the Company seeks to provide enabling parties to inject pipeline quality renewable natural gas into its gas distribution system. As indicated in the Company's evidence at Exhibit B, Tab 1, Schedule 1, paragraph 50 "Once the RNG is in the Company's gas distribution system, Enbridge will enable the movement of that gas to a terminal location of the producer's choice through the various service offerings Enbridge provides its customers today." (Emphasis added).

OGA INTERROGATORY #1

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please confirm that the calculation of the profitability index for Enbridge's proposed geothermal project does not include avoided carbon costs.

RESPONSE

Confirmed.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #2

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, Appendix 11

Please provide an estimated breakdown of Enbridge's customer attachment forecast based on the fuel type that will be replaced by the geothermal installation.

It is understood that this will require a number of assumptions and caveats. Please undertake this analysis on a best efforts basis, make assumptions as necessary, state those assumptions, and state all necessary caveats.

RESPONSE

The Company estimates that of the 18,000 forecasted customer adds in 10 years, approximately 80% would be new construction customers who would have otherwise used natural gas.

The remaining 20% of forecasted customer adds are retrofit customers in EGD's existing natural gas area who are converting from other fuel sources, primarily propane or fuel oil.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #3

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please estimate the avoided natural gas volumes (m3), carbon emissions (tonnes CO2 equivalent), and carbon costs ($) expected to result from the forecast number of customers converting to geothermal. Please calculate the figures for the expected lifetimes of the geothermal loops to be installed. For the total avoided carbon costs, please (a) provide a nominal value, (b) an NPV figure, and (c) a breakdown of the avoided costs associated with decreased natural gas usage versus other fuels.

For the price of carbon, please use the Board's Long Term Carbon Price Forecast. For years beyond that forecast (i.e. 2028 onward), please use Enbridge's best estimate of the future carbon prices, and provide an explanation if different figures are used than those in Exhibit I.1.EGDI.ED.24 in EB-2017-0224.

It is understood that this will require a number of assumptions and caveats. Please undertake this analysis on a best efforts basis, make assumptions as necessary, state those assumptions, and state all necessary caveats.

RESPONSE

Please refer to the response to OGA Interrogatory #4, filed at Exhibit I.1.EGDI.OGA.4.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #4

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please complete the following table. Please provide a response by PDF and also in an electronic Excel spreadsheet.

It is understood that this will require a number of assumptions and caveats. Please undertake this analysis on a best efforts basis, make assumptions as necessary, state those assumptions, and state all necessary caveats. Please use the same assumptions as in Exhibit I.1.EGDI.ED.24 in EB-2017-0224, unless you believe that different assumptions are warranted, in which case please state so and explain why. Please adjust the table as necessary based on the method used by Enbridge to estimate the carbon reductions from switching from fuels other than natural gas,

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program					
	Year 1	Year 2	…	Last year of lifetime savings	Total for all years
Customer conversions (#)					
Natural Gas Conversions					
Conversions from NG (#)					
Forecast annual NG savings (m^3)					
Forecast annual GHG reduction from NG (t co2e)					
Forecast carbon price ($/tonne)					
Value of GHG reduction ($, nominal)					
Value of GHG reduction ($, NPV)					

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

Conversions From Other Fuels					
Conversions from other fuels (#)					
Est. avg. GHG savings rate – other fuels[2]					
Forecast annual GHG reduction from other fuels (t co2e)					
Forecast carbon price ($/tonne)					
Value of GHG reduction ($, nominal)					
Value of GHG reduction ($, NPV)					
Totals					
Value of GHG reduction ($, nominal)					
Value of GHG reduction ($, NPV)					

RESPONSE

Please see Attachment 1 for the completed table. As described in response to SEC Interrogatory #24 filed at Exhibit I.2.EGDI.SEC.24, Enbridge is not prepared to provide live spreadsheets.

It is not clear to Enbridge that an NPV calculation is relevant. However, the requested NPV values are provided and are consistent with the assumptions made in Exhibit I.1.EGDI.ED.24 in EB-2017-0224.

Please also note that the Company has not undertaken a breakdown of customer conversions by fuel type – the values in the spreadsheet assume conversions from natural gas. Where the actual conversion is from propane or heating oil, the GHG reductions will be higher.

[2] This figure could be estimated GHG reductions from a typical customer, averaged over the other fuel types. An estimate could be calculated based on figures available in EB-2016-0004.

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Retrofit Customers													
Conversions (#)	80	120	160	200	320	440	520	520	520	520	-	-	-
Cumulative number of customers (#)	80	200	360	560	880	1,320	1,840	2,360	2,880	3,400	3,400	3,400	3,400
Cumulative number of customers (#) [50% effective]	40	140	280	460	720	1,100	1,580	2,100	2,620	3,140	3,400	3,400	3,400
Forecast annual NG savings (m^3) [1]	96,000	336,000	672,000	1,104,000	1,728,000	2,640,000	3,792,000	5,040,000	6,288,000	7,536,000	8,160,000	8,160,000	8,160,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	180	630	1,260	2,070	3,239	4,949	7,109	9,448	11,788	14,127	15,297	15,297	15,297
Forecast carbon price ($/tonne)[3][4][5]	$ 17.00	$ 18.00	$ 18.00	$ 19.00	$ 20.00	$ 21.00	$ 31.00	$ 36.00	$ 43.00	$ 50.00	$ 57.00	$ 60.88	$ 65.02
Value of GHG reduction ($, nominal)	$ 3,059	$ 11,338	$ 22,675	$ 39,322	$ 64,787	$ 103,929	$ 220,366	$ 340,132	$ 506,869	$ 706,359	$ 871,927	$ 931,218	$ 994,540
Value of GHG reduction ($, NPV)	$ 10,000,100												
New Construction													
New Construction (#)	90	180	270	540	900	1,800	2,700	2,700	2,700	2,700	-	-	-
Cumulative number of customers (#)	90	270	540	1,080	1,980	3,780	6,480	9,180	11,880	14,580	14,580	14,580	14,580
Cumulative number of customers (#) [50% effective]	45	180	405	810	1,530	2,880	5,130	7,830	10,530	13,230	14,580	14,580	14,580
Forecast annual NG savings (m^3) [1]	99,000	396,000	891,000	1,782,000	3,366,000	6,336,000	11,286,000	17,226,000	23,166,000	29,106,000	32,076,000	32,076,000	32,076,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	186	742	1,670	3,341	6,310	11,878	21,157	32,292	43,428	54,563	60,131	60,131	60,131
Forecast carbon price ($/tonne)[3][4][5]	$ 17.00	$ 18.00	$ 18.00	$ 19.00	$ 20.00	$ 21.00	$ 31.00	$ 36.00	$ 43.00	$ 50.00	$ 57.00	$ 60.88	$ 65.02
Value of GHG reduction ($, nominal)	$ 3,155	$ 13,362	$ 30,065	$ 63,471	$ 126,200	$ 249,430	$ 655,868	$ 1,162,524	$ 1,867,387	$ 2,728,145	$ 3,427,441	$ 3,660,506	$ 3,909,421
Value of GHG reduction ($, NPV)	$ 39,010,274												
Totals													
Forecast annual NG savings (m^3)	195,000	732,000	1,563,000	2,886,000	5,094,000	8,976,000	15,078,000	22,266,000	29,454,000	36,642,000	40,236,000	40,236,000	40,236,000
Forecast annual GHG reduction from NG (t CO_2e)	366	1,372	2,930	5,410	9,549	16,827	28,266	41,740	55,215	68,690	75,427	75,427	75,427
Value of GHG reduction ($, nominal)	$ 6,214	$ 24,700	$ 52,741	$ 102,793	$ 190,987	$ 353,360	$ 876,234	$ 1,502,656	$ 2,374,256	$ 3,434,504	$ 4,299,367	$ 4,591,724	$ 4,903,961
Value of GHG reduction ($, NPV)	$ 49,010,374												

1. Avoided natural gas volume for conversion of existing customers is 2,400 m^3/yr and of new construction is 2,200 m^3/yr.

2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic meter of gas.

3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbon Price (Real 2017 CAD) per the "Long Term Carbon Price Forecast Report" (ICF, 2017).

4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 2017 CAD) esclated using the Minimum LTCPF methodology per the "Long Term Carbon Price Forecast Report" (ICF, 2017) of 5% annual growth

5. For 2034 and beyond, asssumes the carbon price is constant.

Value of Lifetime GHG Emissions Reductions fron

	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26
Retrofit Customers													
Conversions (#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400
Cumulative number of customers (#) [50% effective]	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400
Forecast annual NG savings (m^3) [1]	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297
Forecast carbon price ($/tonne)[3][4][5]	$ 69.44	$ 74.16	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 1,062,169	$ 1,134,397	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536
Value of GHG reduction ($, NPV)													
New Construction													
New Construction (#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580
Cumulative number of customers (#) [50% effective]	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580
Forecast annual NG savings (m^3) [1]	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131
Forecast carbon price ($/tonne)[3][4][5]	$ 69.44	$ 74.16	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 4,175,262	$ 4,459,179	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404
Value of GHG reduction ($, NPV)													
Totals													
Forecast annual NG savings (m^3)	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000
Forecast annual GHG reduction from NG (t CO_2e)	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427
Value of GHG reduction ($, nominal)	$ 5,237,431	$ 5,593,576	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939
Value of GHG reduction ($, NPV)													

Value of Lifetime GHG Emissions Reductions fron

	Year 27	Year 28	Year 29	Year 30	Year 31	Year 32	Year 33	Year 34	Year 35	Year 36	Year 37	Year 38	Year 39
Retrofit Customers													
Conversions (#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	3,400	3,400	3,400	3,400	3,320	3,200	3,040	2,840	2,520	2,080	1,560	1,040	520
Cumulative number of customers (#) [50% effective]	3,400	3,400	3,400	3,400	3,360	3,260	3,120	2,940	2,680	2,300	1,820	1,300	780
Forecast annual NG savings (m^3) [1]	8,160,000	8,160,000	8,160,000	8,160,000	8,064,000	7,824,000	7,488,000	7,056,000	6,432,000	5,520,000	4,368,000	3,120,000	1,872,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	15,297	15,297	15,297	15,297	15,117	14,667	14,037	13,227	12,058	10,348	8,188	5,849	3,509
Forecast carbon price ($/tonne)[3][4][5]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,211,536	$ 1,197,282	$ 1,161,649	$ 1,111,762	$ 1,047,622	$ 954,975	$ 819,568	$ 648,528	$ 463,234	$ 277,940
Value of GHG reduction ($, NPV)													
New Construction													
New Construction (#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	14,580	14,580	14,580	14,580	14,490	14,310	14,040	13,500	12,600	10,800	8,100	5,400	2,700
Cumulative number of customers (#) [50% effective]	14,580	14,580	14,580	14,580	14,535	14,400	14,175	13,770	13,050	11,700	9,450	6,750	4,050
Forecast annual NG savings (m^3) [1]	32,076,000	32,076,000	32,076,000	32,076,000	31,977,000	31,680,000	31,185,000	30,294,000	28,710,000	25,740,000	20,790,000	14,850,000	8,910,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	60,131	60,131	60,131	60,131	59,945	59,388	58,460	56,790	53,821	48,253	38,973	27,838	16,703
Forecast carbon price ($/tonne)[3][4][5]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,762,404	$ 4,747,705	$ 4,703,608	$ 4,630,115	$ 4,497,826	$ 4,262,645	$ 3,821,682	$ 3,086,743	$ 2,204,816	$ 1,322,890
Value of GHG reduction ($, NPV)													
Totals													
Forecast annual NG savings (m^3)	40,236,000	40,236,000	40,236,000	40,236,000	40,041,000	39,504,000	38,673,000	37,350,000	35,142,000	31,260,000	25,158,000	17,970,000	10,782,000
Forecast annual GHG reduction from NG (t CO_2e)	75,427	75,427	75,427	75,427	75,062	74,055	72,497	70,017	65,878	58,601	47,162	33,687	20,212
Value of GHG reduction ($, nominal)	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,973,939	$ 5,944,987	$ 5,865,257	$ 5,741,877	$ 5,545,447	$ 5,217,620	$ 4,641,250	$ 3,735,271	$ 2,668,051	$ 1,600,830
Value of GHG reduction ($, NPV)													

Value of Lifetime GHG Emissions Reductions fron

	Year 40	TOTAL
Retrofit Customers		
Conversions (#)	-	-
Cumulative number of customers (#)	-	-
Cumulative number of customers (#) [50% effective]	260	
Forecast annual NG savings (m^3) (1)	624,000	244,800,000
Forecast annual GHG reduction from NG (t CO_2e)(2)	1,170	458,909
Forecast carbon price ($/tonne)(3)(4)(5)	$ 79.20	-
Value of GHG reduction ($, nominal)	$ 92,647	$ 32,961,328
Value of GHG reduction ($, NPV)		
New Construction		
New Construction (#)	-	-
Cumulative number of customers (#)	-	-
Cumulative number of customers (#) [50% effective]	1,350	
Forecast annual NG savings (m^3) (1)	2,970,000	962,280,000
Forecast annual GHG reduction from NG (t CO_2e)(2)	5,568	1,803,916
Forecast carbon price ($/tonne)(3)(4)(5)	$ 79.20	-
Value of GHG reduction ($, nominal)	$ 440,963	$ 131,686,463
Value of GHG reduction ($, NPV)		
Totals		
Forecast annual NG savings (m^3)	3,594,000	1,207,080,000
Forecast annual GHG reduction from NG (t CO_2e)	6,737	2,262,825
Value of GHG reduction ($, nominal)	$ 533,610	$ 164,647,791
Value of GHG reduction ($, NPV)		

OGA INTERROGATORY #5

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please recalculate the profitability index for the proposed geothermal program including the benefits from avoided carbon emissions and costs.

Please provide two figures – one including all avoided carbon costs and another including only the avoided carbon costs associated with reduced natural gas usage.

RESPONSE

Enbridge does not believe that this is an appropriate way to calculate a profitability index under the approach set out in EBO 188 as the avoided carbon costs are only attributable to GES program participants, and not to all ratepayers.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #6

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please discuss the potential benefits to natural gas customers from reduced carbon emissions resulting from customers switching from other fuels (e.g. heating oil) to geothermal, including, but not limited to, potential downward pressure on carbon prices.

RESPONSE

The cost of carbon is charged on a volumetric basis. When a customer reduces their use of fossil fuels – through switching from heating oil to geothermal for example - they also reduce their associated carbon costs. At a high level, the supply of carbon allowances in the market is determined by the provincial targets for GHG emission reductions. As such, by decreasing the demand for carbon allowances through actual emission reductions, the price for each allowance would decrease (or increase at a lower rate) all things being equal.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #7

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

If the cap and trade system is cancelled, please provide Enbridge's best estimates of the carbon price that would most likely come into force based on the federal carbon price backstop. If the federal government's "Technical Paper" regarding the backstop is the latest information in Enbridge's possession, please append a copy of that document.

RESPONSE

Enbridge's best estimate of the carbon price that would come into force should cap and trade be cancelled is the Federal carbon backstop price. The link to the "Technical Paper" is listed below.

https://www.canada.ca/en/services/environment/weather/climatechange/technical-paper-federal-carbon-pricing-backstop.html

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #8

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please provide a revised response to OGA interrogatory #4 inserting the federal carbon price backstop for the carbon prices (i.e. the carbon levy). Seeing as the federal carbon price backstop has only been forecast to 2022, please provide a best estimate of the prices beyond 2022 based on the best information available to Enbridge.[2]

Please also provide a revised response to OGA interrogatory #4 (regarding the profitability index) with the above-referenced revised assumptions.

RESPONSE

Please see Attachment 1 for the completed table. The same comments made in response to OGA Interrogatory #4 filed at Exhibit I.1.EGDI.OGA.4 apply here.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

[2] Enbridge may wish to use a similar inflation factor as was used in Exhibit I.1.EGDI.ED.24 in EB-2017-0224 to estimate carbon prices beyond the end of the Board's Long Term Carbon Price Forecast in 2028. However, we ask that Enbridge use whatever figures it believes are most appropriate.

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Retrofit Customers											
Conversions (#)	80	120	160	200	320	440	520	520	520	520	-
Cumulative number of customers (#)	80	200	360	560	880	1,320	1,840	2,360	2,880	3,400	3,400
Cumulative number of customers (#) [50% effective]	40	140	280	460	720	1,100	1,580	2,100	2,620	3,140	3,400
Forecast annual NG savings (m^3) [(1)]	96,000	336,000	672,000	1,104,000	1,728,000	2,640,000	3,792,000	5,040,000	6,288,000	7,536,000	8,160,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	180	630	1,260	2,070	3,239	4,949	7,109	9,448	11,788	14,127	15,297
Forecast carbon price ($/tonne)[(3)(4)]	$ 10.00	$ 20.00	$ 30.00	$ 40.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Value of GHG reduction ($, nominal)	$ 1,800	$ 12,597	$ 37,792	$ 82,784	$ 161,968	$ 247,451	$ 355,429	$ 472,406	$ 589,383	$ 706,359	$ 764,848
Value of GHG reduction ($, NPV)	$ 7,565,173										
New Construction											
New Construction (#)	90	180	270	540	900	1,800	2,700	2,700	2,700	2,700	-
Cumulative number of customers (#)	90	270	540	1,080	1,980	3,780	6,480	9,180	11,880	14,580	14,580
Cumulative number of customers (#) [50% effective]	45	180	405	810	1,530	2,880	5,130	7,830	10,530	13,230	14,580
Forecast annual NG savings (m^3) [(1)]	99,000	396,000	891,000	1,782,000	3,366,000	6,336,000	11,286,000	17,226,000	23,166,000	29,106,000	32,076,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	186	742	1,670	3,341	6,310	11,878	21,157	32,292	43,428	54,563	60,131
Forecast carbon price ($/tonne)[(3)(4)]	$ 10.00	$ 20.00	$ 30.00	$ 40.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Value of GHG reduction ($, nominal)	$ 1,856	$ 14,847	$ 50,109	$ 133,623	$ 315,500	$ 593,882	$ 1,057,852	$ 1,614,616	$ 2,171,380	$ 2,728,145	$ 3,006,527
Value of GHG reduction ($, NPV)	$ 28,721,852										
Totals											
Forecast annual NG savings (m^3)	195,000	732,000	1,563,000	2,886,000	5,094,000	8,976,000	15,078,000	22,266,000	29,454,000	36,642,000	40,236,000
Forecast annual GHG reduction from NG (t CO_2e)	366	1,372	2,930	5,410	9,549	16,827	28,266	41,740	55,215	68,690	75,427
Value of GHG reduction ($, nominal)	$ 3,656	$ 27,445	$ 87,901	$ 216,407	$ 477,467	$ 841,333	$ 1,413,281	$ 2,087,022	$ 2,760,763	$ 3,434,504	$ 3,771,375
Value of GHG reduction ($, NPV)	$ 36,287,025										

1. Avoided natural gas volume for conversion of existing customers is 2,400 m^3/yr and of new construction is 2,200 m^3/yr.
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic meter of gas.
3. For 2018 - 2022, assumes the Federal Carbon Pricing Backstop.
4. For 2023 and beyond, asssumes the carbon price is constant.

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program

	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22
Retrofit Customers											
Conversions (#)	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400
Cumulative number of customers (#) [50% effective]	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400
Forecast annual NG savings (m^3) [(1)]	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297
Forecast carbon price ($/tonne)[(3)(4)]	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Value of GHG reduction ($, nominal)	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848
Value of GHG reduction ($, NPV)											
New Construction											
New Construction (#)	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580
Cumulative number of customers (#) [50% effective]	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580
Forecast annual NG savings (m^3) [(1)]	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131
Forecast carbon price ($/tonne)[(3)(4)]	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Value of GHG reduction ($, nominal)	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527
Value of GHG reduction ($, NPV)											
Totals											
Forecast annual NG savings (m^3)	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000
Forecast annual GHG reduction from NG (t CO_2e)	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427
Value of GHG reduction ($, nominal)	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375
Value of GHG reduction ($, NPV)											

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2022, assumes the Federal Carbon Pricing Bac
4. For 2023 and beyond, asssumes the carbon price is const

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program

	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Year 31	Year 32	Year 33
Retrofit Customers											
Conversions (#)	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,320	3,200	3,040
Cumulative number of customers (#) [50% effective]	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,360	3,260	3,120
Forecast annual NG savings (m^3) [(1)]	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,160,000	8,064,000	7,824,000	7,488,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,297	15,117	14,667	14,037
Forecast carbon price ($/tonne)[(3)(4)]	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Value of GHG reduction ($, nominal)	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 764,848	$ 755,850	$ 733,354	$ 701,860
Value of GHG reduction ($, NPV)											
New Construction											
New Construction (#)	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,490	14,310	14,040
Cumulative number of customers (#) [50% effective]	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,580	14,535	14,400	14,175
Forecast annual NG savings (m^3) [(1)]	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	32,076,000	31,977,000	31,680,000	31,185,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	60,131	60,131	60,131	60,131	60,131	60,131	60,131	60,131	59,945	59,388	58,460
Forecast carbon price ($/tonne)[(3)(4)]	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00
Value of GHG reduction ($, nominal)	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 3,006,527	$ 2,997,247	$ 2,969,409	$ 2,923,012
Value of GHG reduction ($, NPV)											
Totals											
Forecast annual NG savings (m^3)	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,236,000	40,041,000	39,504,000	38,673,000
Forecast annual GHG reduction from NG (t CO_2e)	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,427	75,062	74,055	72,497
Value of GHG reduction ($, nominal)	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,771,375	$ 3,753,097	$ 3,702,763	$ 3,624,872
Value of GHG reduction ($, NPV)											

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2022, assumes the Federal Carbon Pricing Ba
4. For 2023 and beyond, asssumes the carbon price is const

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program

	Year 34	Year 35	Year 36	Year 37	Year 38	Year 39	Year 40	TOTAL
Retrofit Customers								
Conversions (#)	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	2,840	2,520	2,080	1,560	1,040	520	-	-
Cumulative number of customers (#) [50% effective]	2,940	2,680	2,300	1,820	1,300	780	260	260
Forecast annual NG savings (m^3) [(1)]	7,056,000	6,432,000	5,520,000	4,368,000	3,120,000	1,872,000	624,000	244,800,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	13,227	12,058	10,348	8,188	5,849	3,509	1,170	458,909
Forecast carbon price ($/tonne)[(3)(4)]	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	-
Value of GHG reduction ($, nominal)	$ 661,368	$ 602,880	$ 517,397	$ 409,419	$ 292,442	$ 175,465	$ 58,488	$ 22,873,449
Value of GHG reduction ($, NPV)								
New Construction								
New Construction (#)	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	13,500	12,600	10,800	8,100	5,400	2,700	-	-
Cumulative number of customers (#) [50% effective]	13,770	13,050	11,700	9,450	6,750	4,050	1,350	1,350
Forecast annual NG savings (m^3) [(1)]	30,294,000	28,710,000	25,740,000	20,790,000	14,850,000	8,910,000	2,970,000	962,280,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	56,790	53,821	48,253	38,973	27,838	16,703	5,568	1,803,916
Forecast carbon price ($/tonne)[(3)(4)]	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	$ 50.00	-
Value of GHG reduction ($, nominal)	$ 2,839,498	$ 2,691,027	$ 2,412,645	$ 1,948,675	$ 1,391,911	$ 835,146	$ 278,382	$ 90,099,298
Value of GHG reduction ($, NPV)								
Totals								
Forecast annual NG savings (m^3)	37,350,000	35,142,000	31,260,000	25,158,000	17,970,000	10,782,000	3,594,000	1,207,080,000
Forecast annual GHG reduction from NG (t CO_2e)	70,017	65,878	58,601	47,162	33,687	20,212	6,737	2,262,825
Value of GHG reduction ($, nominal)	$ 3,500,866	$ 3,293,907	$ 2,930,042	$ 2,358,093	$ 1,684,352	$ 1,010,611	$ 336,870	$ 112,972,746
Value of GHG reduction ($, NPV)								

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2022, assumes the Federal Carbon Pricing Ba
4. For 2023 and beyond, asssumes the carbon price is const

OGA INTERROGATORY #9

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please discuss the potential benefits to natural gas customers from Enbridge diversifying its regulated business offerings to include geothermal energy. Please discuss how this could help reduce customer rates in a future scenario where natural gas volumes must be reduced significantly to meet carbon reduction targets.

RESPONSE

As described in response to Board Staff Interrogatory #2 (referencing Energy Probe Interrogatory #2), filed at Exhibit I.1.EGDI.STAFF.2, the Board's Regulatory Framework for the Assessment of Costs of Natural Gas Utilities' Cap and Trade Activities provides several ways in which the Utilities can meet their Cap and Trade obligations, which includes assisting their customers in the abatement of GHG emissions. Decarbonizing gas utility service is now an inherent component of utility business. This is aligned with the Federal and Provincial policy for a lower carbon economy and the Provincial 2030 and 2050 GHG targets. Moreover the Cap and Trade program is based on a declining supply of carbon allowances, which may pose a risk to natural gas customers in future through exposure to elevated rates.

One of the ways for the Company to mitigate the business risk is to diversify its regulated offerings to include low carbon technology options such as geothermal. As discussed in response to OGA Interrogatory #6 filed at Exhibit I.1.EGDI.OGA.6, the adoption of geothermal technology will reduce or avoid natural gas volumes in the future and thus benefit natural gas customers regardless of potential changes in government carbon pricing policy.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #10

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Preamble:

The final report of the Board in EBO 188 states that: "A maximum 10 year forecast horizon will be utilized. For customer attachment periods of greater than 10 years an explanation of the extension of the period will be provided to the Board." See section 3.2.1.

Interrogatory:

Please recalculate Appendix 11 based on a 40 year customer forecast. Please make assumptions as needed, state all assumptions, and include any caveats as needed.

If Enbridge believes that a forecast in between 10 and 40 would be more reasonable (e.g. 20 or 30), please also recalculate Appendix 11 based on that longer period.

RESPONSE

Please see table below and the Attachment to this response. Enbridge has assumed a steady state of customer additions from years 11 to 40 and has kept the capital and O&M costs the same. The difference in service fee is minimal.

Enbridge does not believe that forecasting beyond 10 years of customer additions is appropriate for setting the service fee.

		Base Case	OGA-10	OGA-11
Customer Add forecast	[Years]	10	40	40
Customer Revenue Horizon	[Years]	30	30	30
Economic Feasibility Horizon	[Years]	40	70	70
Service Fee	[$/month/tonne]	$ 25.07	$ 25.07	$ 24.20
Profitability Index		1.10	1.13	1.10
Net Present Value		$ 16,679,865	$ 72,820,011	$ 54,148,141

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

ATTACHMENT 1

GEOTHERMAL

ECONOMIC FEASIBILITY

Geothermal
Economic Feasibility
Parameters and Results

Line No.	Col. 1 Description	Col. 2
FEASIBILITY PARAMETERS		
1.	Discount Rate	5.43%
2.	CCA Rate	50.00%
3.	Income Tax Rate	26.50%
4.	Customer Revenue Horizon (Years)	30
5.	Capital Investment (Dollars)	
6.	Geothermal Loops	1,498,819,133
7.	Total Capital Investment	1,498,819,133
8.	Working Capital (Days of Revenue)	30
FEASIBILITY RESULTS		
9.	Net Present Value (Dollars)	72,820,011
10.	Profitability Index	1.13

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 2 Year 1	Col. 3 Year 2	Col. 4 Year 3	Col. 5 Year 4	Col. 6 Year 5	Col. 7 Year 6	Col. 8 Year 7	Col. 9 Year 8	Col. 10 Year 9	Col. 11 Year 10
	Discount factors to project outset	0.9739	0.9237	0.8762	0.8310	0.7882	0.7476	0.7091	0.6726	0.6379	0.6051
	INCREMENTAL CAPITAL INVESTMENT										
1.	Geothermal Loops	(2,702,492)	(4,339,017)	(6,140,834)	(10,002,812)	(16,355,698)	(29,384,945)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(2,702,492)	(4,339,017)	(6,140,834)	(10,002,812)	(16,355,698)	(29,384,945)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital	(8,524)	(23,566)	(36,602)	(58,664)	(98,274)	(173,484)	(273,764)	(322,902)	(322,902)	(322,902)
5.	Total Investment	(2,711,016)	(4,362,582)	(6,177,436)	(10,061,476)	(16,453,973)	(29,558,429)	(42,329,451)	(42,378,588)	(42,378,588)	(42,378,588)
6.	PV Of Total Investment At Project Outset	(2,640,268)	(4,029,876)	(5,412,381)	(8,361,300)	(12,969,251)	(22,098,231)	(30,015,863)	(28,502,746)	(27,034,525)	(25,641,933)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(2,640,268)	(6,670,144)	(12,082,525)	(20,443,825)	(33,413,076)	(55,511,308)	(85,527,170)	(114,029,916)	(141,064,441)	(166,706,374)
	CCA TAX SHIELD										
8.	CCA Tax Shield	177,458	551,387	964,535	1,543,539	2,504,777	4,259,632	6,826,112	8,941,919	9,999,823	10,528,774
9.	PV Of CCA Tax Shield At Project Outset	172,827	509,336	845,081	1,282,714	1,974,301	3,184,551	4,840,404	6,014,104	6,379,176	6,370,626
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	172,827	682,163	1,527,243	2,809,957	4,784,258	7,968,808	12,809,212	18,823,317	25,202,492	31,573,118
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)										
11.	Geothermal Revenues	102,286	385,075	824,302	1,528,267	2,707,560	4,789,373	8,074,546	11,949,365	15,824,184	19,699,003
12.	O&M Expenses	(1,537,880)	(1,270,689)	(1,370,840)	(1,822,089)	(2,169,696)	(2,887,015)	(3,640,951)	(3,832,665)	(4,019,479)	(4,206,293)
13.	Net Operating Cash (Before Taxes)	(1,435,595)	(885,614)	(546,539)	(293,822)	537,864	1,902,358	4,433,595	8,116,700	11,804,705	15,492,710
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	(1,398,131)	(818,074)	(478,852)	(244,172)	423,952	1,422,225	3,143,867	5,459,083	7,530,562	9,374,145
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	(1,398,131)	(2,216,205)	(2,695,056)	(2,939,229)	(2,515,277)	(1,093,052)	2,050,816	7,509,899	15,040,461	24,414,606
	TAXES										
16.	Income Tax (Before Interest Tax Shield)	380,433	234,688	144,833	77,863	(142,534)	(504,125)	(1,174,903)	(2,150,925)	(3,128,247)	(4,105,568)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	380,433	234,688	144,833	77,863	(142,534)	(504,125)	(1,174,903)	(2,150,925)	(3,128,247)	(4,105,568)
19.	PV of Total Taxes At Project Outset	370,505	216,790	126,896	64,706	(112,347)	(376,890)	(833,125)	(1,446,657)	(1,995,599)	(2,484,148)
20.	**ACCUMULATED PV OF TOTAL TAXES**	370,505	587,294	714,190	778,896	666,548	289,659	(543,466)	(1,990,123)	(3,985,722)	(6,469,871)
	ACCUMULATED NPV AND PI										
21.	Net Present Value	(3,495,068)	(7,616,892)	(12,536,148)	(19,794,201)	(30,477,547)	(48,345,892)	(71,210,609)	(89,686,824)	(104,807,210)	(117,188,521)
22.	Profitability Index	(0.324)	(0.142)	(0.038)	0.032	0.088	0.129	0.167	0.213	0.257	0.297

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 12 Year 11	Col. 13 Year 12	Col. 14 Year 13	Col. 15 Year 14	Col. 16 Year 15	Col. 17 Year 16	Col. 18 Year 17	Col. 19 Year 18	Col. 20 Year 19	Col. 21 Year 20
	Discount factors to project outset	0.5739	0.5443	0.5163	0.4897	0.4645	0.4406	0.4179	0.3963	0.3759	0.3566
	INCREMENTAL CAPITAL INVESTMENT										
1.	Geothermal Loops	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)
5.	Total Investment	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)
6.	PV Of Total Investment At Project Outset	(24,321,077)	(23,068,259)	(21,879,977)	(20,752,904)	(19,683,889)	(18,669,941)	(17,708,223)	(16,796,044)	(15,930,853)	(15,110,230)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(191,027,451)	(214,095,710)	(235,975,687)	(256,728,592)	(276,412,481)	(295,082,422)	(312,790,645)	(329,586,689)	(345,517,542)	(360,627,772)
	CCA TAX SHIELD										
8.	CCA Tax Shield	10,793,250	10,925,488	10,991,607	11,024,667	11,041,197	11,049,461	11,053,594	11,055,660	11,056,693	11,057,210
9.	PV Of CCA Tax Shield At Project Outset	6,194,248	5,947,154	5,674,944	5,398,808	5,128,384	4,867,854	4,618,830	4,381,726	4,156,405	3,942,486
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	37,767,366	43,714,520	49,389,464	54,788,272	59,916,656	64,784,511	69,403,341	73,785,067	77,941,471	81,883,957
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)										
11.	Geothermal Revenues	23,573,822	27,448,642	31,323,461	35,198,280	39,073,099	42,947,918	46,822,738	50,697,557	54,572,376	58,447,195
12.	O&M Expenses	(4,393,107)	(4,579,921)	(4,766,735)	(4,953,549)	(5,140,364)	(5,541,917)	(5,748,105)	(5,954,294)	(6,160,482)	(6,366,670)
13.	Net Operating Cash (Before Taxes)	19,180,715	22,868,720	26,556,725	30,244,731	33,932,736	37,406,001	41,074,632	44,743,263	48,411,894	52,080,525
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	11,007,815	12,448,305	13,711,182	14,810,923	15,760,983	16,479,262	17,163,355	17,733,244	18,198,879	18,569,488
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	35,422,421	47,870,726	61,581,908	76,392,831	92,153,814	108,633,075	125,796,430	143,529,674	161,728,552	180,298,041
	TAXES										
16.	Income Tax (Before Interest Tax Shield)	(5,082,890)	(6,060,211)	(7,037,532)	(8,014,854)	(8,992,175)	(9,912,590)	(10,884,778)	(11,856,965)	(12,829,152)	(13,801,339)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(5,082,890)	(6,060,211)	(7,037,532)	(8,014,854)	(8,992,175)	(9,912,590)	(10,884,778)	(11,856,965)	(12,829,152)	(13,801,339)
19.	PV of Total Taxes At Project Outset	(2,917,071)	(3,298,801)	(3,633,463)	(3,924,895)	(4,176,661)	(4,367,004)	(4,548,289)	(4,699,310)	(4,822,703)	(4,920,914)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(9,386,942)	(12,685,742)	(16,319,206)	(20,244,100)	(24,420,761)	(28,787,765)	(33,336,054)	(38,035,364)	(42,858,066)	(47,778,981)
	ACCUMULATED NPV AND PI										
21.	Net Present Value	(127,224,606)	(135,196,207)	(141,323,521)	(145,791,589)	(148,762,771)	(150,452,601)	(150,926,928)	(150,307,312)	(148,705,585)	(146,224,755)
22.	Profitability Index	0.334	0.369	0.401	0.432	0.462	0.490	0.517	0.544	0.570	0.595

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 22 Year 21	Col. 23 Year 22	Col. 24 Year 23	Col. 25 Year 24	Col. 26 Year 25	Col. 27 Year 26	Col. 28 Year 27	Col. 29 Year 28	Col. 30 Year 29	Col. 31 Year 30
	Discount factors to project outset	0.3382	0.3208	0.3042	0.2886	0.2737	0.2596	0.2462	0.2336	0.2215	0.2101
	INCREMENTAL CAPITAL INVESTMENT										
1.	Geothermal Loops	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)
5.	Total Investment	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)	(42,378,588)
6.	PV Of Total Investment At Project Outset	(14,331,878)	(13,593,620)	(12,893,391)	(12,229,232)	(11,599,285)	(11,001,787)	(10,435,068)	(9,897,541)	(9,387,703)	(8,904,127)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(374,959,650)	(388,553,270)	(401,446,661)	(413,675,893)	(425,275,178)	(436,276,965)	(446,712,033)	(456,609,574)	(465,997,277)	(474,901,404)
	CCA TAX SHIELD										
8.	CCA Tax Shield	11,057,468	11,057,597	11,057,662	11,057,694	11,057,710	11,057,718	11,057,722	11,057,724	11,057,725	11,057,726
9.	PV Of CCA Tax Shield At Project Outset	3,739,489	3,546,904	3,364,217	3,190,930	3,026,565	2,870,663	2,722,792	2,582,537	2,449,507	2,323,329
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	85,623,447	89,170,350	92,534,567	95,725,497	98,752,062	101,622,725	104,345,517	106,928,054	109,377,561	111,700,890
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)										
11.	Geothermal Revenues	62,322,014	66,196,834	70,071,653	73,946,472	77,821,291	81,696,110	85,570,930	89,445,749	93,320,568	97,195,387
12.	O&M Expenses	(6,572,858)	(6,779,046)	(6,985,235)	(7,196,623)	(7,402,811)	(7,603,799)	(7,809,987)	(8,016,176)	(8,222,364)	(8,428,552)
13.	Net Operating Cash (Before Taxes)	55,749,156	59,417,787	63,086,418	66,749,849	70,418,480	74,092,311	77,760,942	81,429,573	85,098,204	88,766,835
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	18,853,627	19,059,220	19,193,605	19,262,072	19,273,979	19,234,899	19,147,422	19,017,919	18,850,950	18,650,721
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	199,151,668	218,210,888	237,404,492	256,666,564	275,940,543	295,175,442	314,322,864	333,340,782	352,191,733	370,842,454
	TAXES										
16.	Income Tax (Before Interest Tax Shield)	(14,773,526)	(15,745,714)	(16,717,901)	(17,688,710)	(18,660,897)	(19,634,462)	(20,606,650)	(21,578,837)	(22,551,024)	(23,523,211)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(14,773,526)	(15,745,714)	(16,717,901)	(17,688,710)	(18,660,897)	(19,634,462)	(20,606,650)	(21,578,837)	(22,551,024)	(23,523,211)
19.	PV of Total Taxes At Project Outset	(4,996,211)	(5,050,693)	(5,086,305)	(5,104,449)	(5,107,604)	(5,097,248)	(5,074,067)	(5,039,748)	(4,995,502)	(4,942,441)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(52,775,192)	(57,825,885)	(62,912,190)	(68,016,639)	(73,124,244)	(78,221,492)	(83,295,559)	(88,335,307)	(93,330,809)	(98,273,250)
	ACCUMULATED NPV AND PI										
21.	Net Present Value	(142,959,727)	(138,997,917)	(134,419,792)	(129,300,471)	(123,706,817)	(117,700,290)	(111,339,211)	(104,676,044)	(97,758,792)	(90,631,311)
22.	Profitability Index	0.619	0.642	0.665	0.687	0.709	0.730	0.751	0.771	0.790	0.809

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Description	Col. 1	Col. 32	Col. 33	Col. 34	Col. 35	Col. 36	Col. 37	Col. 38	Col. 39	Col. 40	Col. 41
			Year 31	Year 32	Year 33	Year 34	Year 35	Year 36	Year 37	Year 38	Year 39	Year 40
	Discount factors to project outset		0.1993	0.1890	0.1793	0.1700	0.1613	0.1530	0.1451	0.1376	0.1305	0.1238
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops		(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction		-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital		(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital		(314,378)	(299,336)	(286,299)	(264,238)	(224,627)	(149,417)	(49,137)	-	-	-
5.	Total Investment		(42,370,064)	(42,355,022)	(42,341,986)	(42,319,924)	(42,280,314)	(42,205,104)	(42,104,824)	(42,055,686)	(42,055,686)	(42,055,686)
6.	PV Of Total Investment At Project Outset		(8,443,763)	(8,005,968)	(7,591,231)	(7,196,443)	(6,819,354)	(6,456,573)	(6,109,434)	(5,787,964)	(5,489,817)	(5,207,028)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**		(483,345,167)	(491,351,135)	(498,942,366)	(506,138,809)	(512,958,163)	(519,414,735)	(525,524,169)	(531,312,133)	(536,801,950)	(542,008,978)
	CCA TAX SHIELD											
8.	CCA Tax Shield		11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726
9.	PV Of CCA Tax Shield At Project Outset		2,203,651	2,090,137	1,982,471	1,880,351	1,783,491	1,691,620	1,604,482	1,521,833	1,443,441	1,369,087
10.	**ACCUMULATED PV OF CCA TAX SHIELD**		113,904,541	115,994,678	117,977,149	119,857,499	121,640,990	123,332,610	124,937,093	126,458,925	127,902,366	129,271,453
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues		100,967,921	104,559,950	107,995,543	111,166,397	113,861,923	115,654,930	116,244,576	116,244,576	116,244,576	116,244,576
12.	O&M Expenses		(8,629,297)	(8,820,438)	(9,003,253)	(9,171,982)	(9,315,417)	(9,410,827)	(9,442,204)	(9,442,204)	(9,442,204)	(9,442,204)
13.	Net Operating Cash (Before Taxes)		92,338,624	95,739,513	98,992,290	101,994,415	104,546,506	106,244,102	106,802,372	106,802,372	106,802,372	106,802,372
14.	PV of Net Operating Cash (Before Taxes) At Project Outset		18,401,800	18,096,732	17,747,711	17,344,005	16,862,212	16,253,313	15,497,084	14,698,805	13,941,646	13,223,490
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**		389,244,254	407,340,986	425,088,697	442,432,702	459,294,914	475,548,227	491,045,311	505,744,116	519,685,762	532,909,252
	TAXES											
16.	Income Tax (Before Interest Tax Shield)		(24,469,735)	(25,370,971)	(26,232,957)	(27,028,520)	(27,704,824)	(28,154,687)	(28,302,629)	(28,302,629)	(28,302,629)	(28,302,629)
17.	Municipal Tax		-	-	-	-	-	-	-	-	-	-
18.	Total Taxes		(24,469,735)	(25,370,971)	(26,232,957)	(27,028,520)	(27,704,824)	(28,154,687)	(28,302,629)	(28,302,629)	(28,302,629)	(28,302,629)
19.	PV of Total Taxes At Project Outset		(4,876,477)	(4,795,634)	(4,703,143)	(4,596,161)	(4,468,486)	(4,307,128)	(4,106,727)	(3,895,183)	(3,694,536)	(3,504,225)
20.	**ACCUMULATED PV OF TOTAL TAXES**		(103,149,727)	(107,945,361)	(112,648,505)	(117,244,666)	(121,713,152)	(126,020,280)	(130,127,008)	(134,022,191)	(137,716,727)	(141,220,952)
	ACCUMULATED NPV AND PI											
21.	Net Present Value		(83,346,100)	(75,960,833)	(68,525,025)	(61,093,274)	(53,735,411)	(46,554,178)	(39,668,773)	(33,131,282)	(26,930,549)	(21,049,225)
22.	Profitability Index		0.828	0.845	0.863	0.879	0.895	0.910	0.925	0.938	0.950	0.961

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 42 Year 41	Col. 43 Year 42	Col. 44 Year 43	Col. 45 Year 44	Col. 46 Year 45	Col. 47 Year 46	Col. 48 Year 47	Col. 49 Year 48	Col. 50 Year 49	Col. 51 Year 50	Col. 52 Year 51
	Discount factors to project outset	0.1174	0.1114	0.1056	0.1002	0.0950	0.0901	0.0855	0.0811	0.0769	0.0730	0.0692
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	-	-	-	-	-	-	-	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	-	-	-	-	-	-	-	-	-	-	-
4.	Working Capital	161,451	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
5.	Total Investment	161,451	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
6.	PV Of Total Investment At Project Outset	18,960	35,967	34,114	32,357	30,690	29,109	27,610	26,187	24,838	23,559	22,345
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(541,990,018)	(541,954,052)	(541,919,938)	(541,887,581)	(541,856,891)	(541,827,782)	(541,800,173)	(541,773,985)	(541,749,147)	(541,725,588)	(541,703,243)
	CCA TAX SHIELD											
8.	CCA Tax Shield	8,293,295	4,146,647	2,073,324	1,036,662	518,331	259,165	129,583	64,791	32,396	16,198	8,099
9.	PV Of CCA Tax Shield At Project Outset	973,922	461,877	219,042	103,880	49,264	23,363	11,080	5,255	2,492	1,182	560
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	130,245,376	130,707,253	130,926,295	131,030,175	131,079,439	131,102,802	131,113,882	131,119,137	131,121,629	131,122,811	131,123,371
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	114,307,166	110,432,347	106,557,528	102,682,709	98,807,890	94,933,070	91,058,251	87,183,432	83,308,613	79,433,794	75,558,974
12.	O&M Expenses	(6,469,939)	(6,247,650)	(6,041,462)	(5,835,274)	(5,629,086)	(5,422,898)	(5,216,709)	(5,010,521)	(4,804,333)	(4,598,145)	(4,391,957)
13.	Net Operating Cash (Before Taxes)	107,837,228	104,184,697	100,516,066	96,847,435	93,178,804	89,510,173	85,841,542	82,172,911	78,504,280	74,835,649	71,167,018
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	12,663,855	11,604,680	10,619,321	9,704,685	8,856,099	8,069,187	7,339,845	6,664,232	6,038,746	5,460,017	4,924,887
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	545,573,107	557,177,787	567,797,108	577,501,793	586,357,892	594,427,078	601,766,924	608,431,156	614,469,902	619,929,919	624,854,806
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(28,576,865)	(27,608,945)	(26,636,757)	(25,664,570)	(24,692,383)	(23,720,196)	(22,748,009)	(21,775,821)	(20,803,634)	(19,831,447)	(18,859,260)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(28,576,865)	(27,608,945)	(26,636,757)	(25,664,570)	(24,692,383)	(23,720,196)	(22,748,009)	(21,775,821)	(20,803,634)	(19,831,447)	(18,859,260)
19.	PV of Total Taxes At Project Outset	(3,355,922)	(3,075,240)	(2,814,120)	(2,571,741)	(2,346,866)	(2,138,334)	(1,945,059)	(1,766,021)	(1,600,268)	(1,446,905)	(1,305,095)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(144,576,873)	(147,652,114)	(150,466,234)	(153,037,975)	(155,384,841)	(157,523,176)	(159,468,235)	(161,234,256)	(162,834,524)	(164,281,429)	(165,586,524)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	(10,748,409)	(1,721,126)	6,337,232	13,606,411	20,195,598	26,178,923	31,612,398	36,542,051	41,007,860	45,045,713	48,688,411
22.	Profitability Index	0.980	0.997	1.012	1.025	1.037	1.048	1.058	1.067	1.076	1.083	1.090

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 53 Year 52	Col. 54 Year 53	Col. 55 Year 54	Col. 56 Year 55	Col. 57 Year 56	Col. 58 Year 57	Col. 59 Year 58	Col. 60 Year 59	Col. 61 Year 60	Col. 62 Year 61	Col. 63 Year 62
	Discount factors to project outset	0.0656	0.0623	0.0590	0.0560	0.0531	0.0504	0.0478	0.0453	0.0430	0.0408	0.0387
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	-	-	-	-	-	-	-	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	-	-	-	-	-	-	-	-	-	-	-
4.	Working Capital	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
5.	Total Investment	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
6.	PV Of Total Investment At Project Outset	21,194	20,103	19,067	18,085	17,153	16,270	15,432	14,637	13,883	13,168	12,489
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(541,682,048)	(541,661,946)	(541,642,879)	(541,624,794)	(541,607,641)	(541,591,371)	(541,575,939)	(541,561,302)	(541,547,420)	(541,534,252)	(541,521,763)
	CCA TAX SHIELD											
8.	CCA Tax Shield	4,049	2,025	1,012	506	253	127	63	32	16	8	4
9.	PV Of CCA Tax Shield At Project Outset	266	126	60	28	13	6	3	1	1	0	0
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	131,123,637	131,123,763	131,123,823	131,123,851	131,123,864	131,123,871	131,123,874	131,123,875	131,123,876	131,123,876	131,123,876
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	71,684,155	67,809,336	63,934,517	60,059,698	56,184,878	52,310,059	48,435,240	44,560,421	40,685,602	36,810,782	32,935,963
12.	O&M Expenses	(4,185,769)	(3,979,580)	(3,773,392)	(3,567,204)	(3,361,016)	(3,154,828)	(2,948,639)	(2,742,451)	(2,536,263)	(2,330,075)	(2,126,487)
13.	Net Operating Cash (Before Taxes)	67,498,387	63,829,756	60,161,125	56,492,494	52,823,863	49,155,232	45,486,601	41,817,970	38,149,339	34,480,708	30,809,477
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	4,430,400	3,973,789	3,552,463	3,163,999	2,806,130	2,476,734	2,173,828	1,895,556	1,640,185	1,406,093	1,191,665
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	629,285,206	633,258,995	636,811,458	639,975,457	642,781,587	645,258,322	647,432,150	649,327,706	650,967,891	652,373,984	653,565,649
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(17,887,072)	(16,914,885)	(15,942,698)	(14,970,511)	(13,998,324)	(13,026,136)	(12,053,949)	(11,081,762)	(10,109,575)	(9,137,388)	(8,164,511)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(17,887,072)	(16,914,885)	(15,942,698)	(14,970,511)	(13,998,324)	(13,026,136)	(12,053,949)	(11,081,762)	(10,109,575)	(9,137,388)	(8,164,511)
19.	PV of Total Taxes At Project Outset	(1,174,056)	(1,053,054)	(941,403)	(838,460)	(743,625)	(656,335)	(576,064)	(502,322)	(434,649)	(372,615)	(315,791)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(166,760,580)	(167,813,634)	(168,755,036)	(169,593,496)	(170,337,121)	(170,993,455)	(171,569,520)	(172,071,842)	(172,506,491)	(172,879,106)	(173,194,897)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	51,966,215	54,907,178	57,537,365	59,881,018	61,960,690	63,797,366	65,410,565	66,818,437	68,037,856	69,084,502	69,972,865
22.	Profitability Index	1.096	1.101	1.106	1.111	1.114	1.118	1.121	1.123	1.126	1.128	1.129

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 64 Year 63	Col. 65 Year 64	Col. 66 Year 65	Col. 67 Year 66	Col. 68 Year 67	Col. 69 Year 68	Col. 70 Year 69	Col. 71 Year 70
	Discount factors to project outset	0.0367	0.0348	0.0330	0.0313	0.0297	0.0282	0.0267	0.0257
	INCREMENTAL CAPITAL INVESTMENT								
1.	Geothermal Loops	-	-	-	-	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-
3.	Net Investment Capital	-	-	-	-	-	-	-	-
4.	Working Capital	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
5.	Total Investment	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
6.	PV Of Total Investment At Project Outset	11,846	11,236	10,657	10,108	9,587	9,094	8,625	8,290
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(541,509,917)	(541,498,681)	(541,488,024)	(541,477,916)	(541,468,328)	(541,459,235)	(541,450,610)	**(541,442,320)**
	CCA TAX SHIELD								
8.	CCA Tax Shield	2	1	0	0	0	0	0	0
9.	PV Of CCA Tax Shield At Project Outset	0	0	0	0	0	0	0	0
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	131,123,877	131,123,877	131,123,877	131,123,877	131,123,877	131,123,877	131,123,877	**131,123,877**
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)								
11.	Geothermal Revenues	29,061,144	25,186,325	21,311,506	17,436,686	13,561,867	9,687,048	5,812,229	1,937,410
12.	O&M Expenses	(1,922,898)	(1,719,310)	(1,515,722)	(1,312,134)	(1,108,546)	(904,957)	(701,369)	(312,138)
13.	Net Operating Cash (Before Taxes)	27,138,246	23,467,015	19,795,784	16,124,553	12,453,322	8,782,091	5,110,860	1,625,272
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	995,597	816,567	653,339	504,761	369,756	247,320	136,517	41,725
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	654,561,246	655,377,813	656,031,152	656,535,912	656,905,668	657,152,989	657,289,506	**657,331,231**
	TAXES								
16.	Income Tax (Before Interest Tax Shield)	(7,191,635)	(6,218,759)	(5,245,883)	(4,273,006)	(3,300,130)	(2,327,254)	(1,354,378)	(430,697)
17.	Municipal Tax	-	-	-	-	-	-	-	-
18.	Total Taxes	(7,191,635)	(6,218,759)	(5,245,883)	(4,273,006)	(3,300,130)	(2,327,254)	(1,354,378)	(430,697)
19.	PV of Total Taxes At Project Outset	(263,833)	(216,390)	(173,135)	(133,762)	(97,985)	(65,540)	(36,177)	(11,057)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(173,458,730)	(173,675,120)	(173,848,255)	(173,982,017)	(174,080,002)	(174,145,542)	(174,181,719)	**(174,192,776)**
	ACCUMULATED NPV AND PI								
21.	Net Present Value	70,716,475	71,327,888	71,818,749	72,199,856	72,481,214	72,672,088	72,781,054	**72,820,011**
22.	Profitability Index	1.131	1.132	1.133	1.133	1.134	1.134	1.134	**1.134**

Geothermal
Revenue and Revenue Requirement

Line No.	Description	Col. 1	Col. 2 Year 1	Col. 3 Year 2	Col. 4 Year 3	Col. 5 Year 4	Col. 6 Year 5	Col. 7 Year 6	Col. 8 Year 7	Col. 9 Year 8	Col. 10 Year 9	Col. 11 Year 10	Col. 12 Year 11
1	Number of Customers		170	300	430	740	1,220	2,240	3,220	3,220	3,220	3,220	3,220
2	Number of Cumulative Customers [50% Effective]		85	320	685	1,270	2,250	3,980	6,710	9,930	13,150	16,370	19,590
3	Number of Tonnes per Customer		4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes		340	1,280	2,740	5,080	9,000	15,920	26,840	39,720	52,600	65,480	78,360
5	Capital		2,702,492	4,339,017	6,140,834	10,002,812	16,355,698	29,384,945	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
6	**Rate Base**												
7	Balance, beginning		0	2,665,974	6,866,157	12,706,529	22,161,880	37,570,419	65,321,071	104,652,067	142,630,344	179,206,764	214,381,329
8	+ Additions		2,702,492	4,339,017	6,140,834	10,002,812	16,355,698	29,384,945	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
9	+ Working Capital Additions		8,524	23,566	36,602	58,664	98,274	173,484	273,764	322,902	322,902	322,902	322,902
10	- Depreciation		(45,042)	(162,400)	(337,064)	(606,125)	(1,045,433)	(1,807,778)	(2,998,455)	(4,400,311)	(5,802,167)	(7,204,023)	(8,605,880)
11	Balance, ending		2,665,974	6,866,157	12,706,529	22,161,880	37,570,419	65,321,071	104,652,067	142,630,344	179,206,764	214,381,329	248,154,037
12	Average Rate Base		1,332,987	4,766,066	9,786,343	17,434,204	29,866,149	51,445,745	84,986,569	123,641,205	160,918,554	196,794,047	231,267,683
13	**Revenue Requirement**												
14	Return on Rate Base		82,714	295,741	607,257	1,081,817	1,853,238	3,192,283	5,273,539	7,672,115	9,985,228	12,211,354	14,350,493
15	O&M		1,537,880	1,270,689	1,370,840	1,822,089	2,169,696	2,887,015	3,640,951	3,832,665	4,019,479	4,206,293	4,393,107
16	Municipal Taxes		-	-	-	-	-	-	-	-	-	-	-
17	Deprecation		45,042	162,400	337,064	606,125	1,045,433	1,807,778	2,998,455	4,400,311	5,802,167	7,204,023	8,605,880
18	Taxes		(209,419)	(635,210)	(1,074,910)	(1,675,123)	(2,677,364)	(4,534,591)	(7,200,034)	(9,115,638)	(9,608,222)	(9,397,740)	(8,844,022)
19	Revenue Requirement		1,456,216	1,093,620	1,240,251	1,834,909	2,391,003	3,352,484	4,712,910	6,789,453	10,198,652	14,223,931	18,505,457
20	**Revenue**												
21	Revenue per Tonne per Month		$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07
22	Geothermal Revenue		102,286	385,075	824,302	1,528,267	2,707,560	4,789,373	8,074,546	11,949,365	15,824,184	19,699,003	23,573,822
23	**Sufficiency / (Deficiency)**		**(1,353,931)**	**(708,545)**	**(415,950)**	**(306,642)**	**316,557**	**1,436,889**	**3,361,636**	**5,159,912**	**5,625,532**	**5,475,073**	**5,068,365**

Geothermal
Revenue and Revenue Requirement

Line No.	Description	Col. 1	Col. 13 Year 12	Col. 14 Year 13	Col. 15 Year 14	Col. 16 Year 15	Col. 17 Year 16	Col. 18 Year 17	Col. 19 Year 18	Col. 20 Year 19	Col. 21 Year 20	Col. 22 Year 21	Col. 23 Year 22
1	Number of Customers		3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220
2	Number of Cumulative Customers [50% Effective]		22,810	26,030	29,250	32,470	35,690	38,910	42,130	45,350	48,570	51,790	55,010
3	Number of Tonnes per Customer		4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes		91,240	104,120	117,000	129,880	142,760	155,640	168,520	181,400	194,280	207,160	220,040
5	Capital		42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
6	**Rate Base**												
7	Balance, beginning		248,154,037	280,524,890	311,493,886	341,061,025	369,226,309	395,989,736	421,351,307	445,311,022	467,868,881	489,024,883	508,779,030
8	+ Additions		42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
9	+ Working Capital Additions		322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902
10	- Depreciation		(10,007,736)	(11,409,592)	(12,811,448)	(14,213,304)	(15,615,161)	(17,017,017)	(18,418,873)	(19,820,729)	(21,222,585)	(22,624,442)	(24,026,298)
11	Balance, ending		280,524,890	311,493,886	341,061,025	369,226,309	395,989,736	421,351,307	445,311,022	467,868,881	489,024,883	508,779,030	527,131,320
12	Average Rate Base		264,339,464	296,009,388	326,277,455	355,143,667	382,608,023	408,670,522	433,331,165	456,589,952	478,446,882	498,901,957	517,955,175
13	**Revenue Requirement**												
14	Return on Rate Base		16,402,644	18,367,809	20,245,986	22,037,176	23,741,379	25,358,594	26,888,823	28,332,064	29,688,318	30,957,585	32,139,864
15	O&M		4,579,921	4,766,735	4,953,549	5,140,364	5,541,917	5,748,105	5,954,294	6,160,482	6,366,670	6,572,858	6,779,046
16	Municipal Taxes		-	-	-	-	-	-	-	-	-	-	-
17	Deprecation		10,007,736	11,409,592	12,811,448	14,213,304	15,615,161	17,017,017	18,418,873	19,820,729	21,222,585	22,624,442	24,026,298
18	Taxes		(8,126,985)	(7,336,586)	(6,517,804)	(5,693,128)	(4,873,804)	(4,065,453)	(3,270,887)	(2,491,512)	(1,728,029)	(980,791)	(249,973)
19	Revenue Requirement		22,863,316	27,207,550	31,493,180	35,697,716	40,024,653	44,058,263	47,991,102	51,821,763	55,549,544	59,174,094	62,695,235
20	**Revenue**												
21	Revenue per Tonne per Month		$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07
22	Geothermal Revenue		27,448,642	31,323,461	35,198,280	39,073,099	42,947,918	46,822,738	50,697,557	54,572,376	58,447,195	62,322,014	66,196,834
23	**Sufficiency / (Deficiency)**		**4,585,325**	**4,115,911**	**3,705,100**	**3,375,384**	**2,923,266**	**2,764,474**	**2,706,455**	**2,750,613**	**2,897,651**	**3,147,921**	**3,501,598**

Geothermal
Revenue and Revenue Requirement

Line No.	Col. 1 Description	Col. 24 Year 23	Col. 25 Year 24	Col. 26 Year 25	Col. 27 Year 26	Col. 28 Year 27	Col. 29 Year 28	Col. 30 Year 29	Col. 31 Year 30	Col. 32 Year 31	Col. 33 Year 32	Col. 34 Year 33
1	Number of Customers	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220
2	Number of Cumulative Customers [50% Effective]	58,230	61,450	64,670	67,890	71,110	74,330	77,550	80,770	83,905	86,890	89,745
3	Number of Tonnes per Customer	4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes	232,920	245,800	258,680	271,560	284,440	297,320	310,200	323,080	335,620	347,560	358,980
5	Capital	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
6	**Rate Base**											
7	Balance, beginning	527,131,320	544,081,754	559,630,331	573,777,053	586,521,918	597,864,927	607,806,080	616,345,376	623,482,817	629,254,919	633,727,481
8	+ Additions	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
9	+ Working Capital Additions	322,902	322,902	322,902	322,902	322,902	322,902	322,902	322,902	314,378	299,336	286,299
10	- Depreciation	(25,428,154)	(26,830,010)	(28,231,866)	(29,633,723)	(31,035,579)	(32,437,435)	(33,839,291)	(35,241,148)	(36,597,962)	(37,882,460)	(39,109,652)
11	Balance, ending	544,081,754	559,630,331	573,777,053	586,521,918	597,864,927	607,806,080	616,345,376	623,482,817	629,254,919	633,727,481	636,959,814
12	Average Rate Base	535,606,537	551,856,042	566,703,692	580,149,485	592,193,422	602,835,503	612,075,728	619,914,096	626,368,868	631,491,200	635,343,648
13	**Revenue Requirement**											
14	Return on Rate Base	33,235,157	34,243,462	35,164,780	35,999,111	36,746,455	37,406,811	37,980,180	38,466,562	38,867,090	39,184,938	39,423,988
15	O&M	6,985,235	7,196,623	7,402,811	7,603,799	7,809,987	8,016,176	8,222,364	8,428,552	8,629,297	8,820,438	9,003,253
16	Municipal Taxes	-	-	-	-	-	-	-	-	-	-	-
17	Deprecation	25,428,154	26,830,010	28,231,866	29,633,723	31,035,579	32,437,435	33,839,291	35,241,148	36,597,962	37,882,460	39,109,652
18	Taxes	464,336	1,162,094	1,843,278	2,507,877	3,155,885	3,787,300	4,402,121	5,000,346	5,565,952	6,089,711	6,577,776
19	Revenue Requirement	66,112,882	69,432,189	72,642,735	75,744,509	78,747,906	81,647,722	84,443,956	87,136,608	89,660,302	91,977,547	94,114,669
20	**Revenue**											
21	Revenue per Tonne per Month	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07
22	Geothermal Revenue	70,071,653	73,946,472	77,821,291	81,696,110	85,570,930	89,445,749	93,320,568	97,195,387	100,967,921	104,559,950	107,995,543
23	**Sufficiency / (Deficiency)**	**3,958,771**	**4,514,283**	**5,178,556**	**5,951,601**	**6,823,024**	**7,798,027**	**8,876,612**	**10,058,780**	**11,307,619**	**12,582,403**	**13,880,874**

Geothermal
Revenue and Revenue Requirement

Line No.	Description	Col. 1	Col. 35 Year 34	Col. 36 Year 35	Col. 37 Year 36	Col. 38 Year 37	Col. 39 Year 38	Col. 40 Year 39	Col. 41 Year 40	Col. 42 Year 41	Col. 43 Year 42	Col. 44 Year 43	Col. 45 Year 44
1	Number of Customers		3,220	3,220	3,220	3,220	3,220	3,220	3,220				
2	Number of Cumulative Customers [50% Effective]		92,380	94,620	96,110	96,600	96,600	96,600	96,600	94,990	91,770	88,550	85,330
3	Number of Tonnes per Customer		4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes		369,520	378,480	384,440	386,400	386,400	386,400	386,400	379,960	367,080	354,200	341,320
5	Capital		42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686				
6	**Rate Base**												
7	Balance, beginning		636,959,814	639,037,291	640,112,610	640,473,206	640,522,343	640,522,343	640,522,343	640,522,343	599,006,134	558,730,330	519,856,383
8	+ Additions		42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	-	-	-	-
9	+ Working Capital Additions		264,238	224,627	149,417	49,137	0	0	0	(161,451)	(322,902)	(322,902)	(322,902)
10	- Depreciation		(40,242,447)	(41,204,995)	(41,844,507)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(41,354,758)	(39,952,902)	(38,551,046)	(37,149,190)
11	Balance, ending		639,037,291	640,112,610	640,473,206	640,522,343	640,522,343	640,522,343	640,522,343	599,006,134	558,730,330	519,856,383	482,384,292
12	Average Rate Base		637,998,553	639,574,950	640,292,908	640,497,774	640,522,343	640,522,343	640,522,343	619,764,238	578,868,232	539,293,357	501,120,337
13	**Revenue Requirement**												
14	Return on Rate Base		39,588,729	39,686,547	39,731,097	39,743,809	39,745,334	39,745,334	39,745,334	38,457,263	35,919,607	33,463,929	31,095,239
15	O&M		9,171,982	9,315,417	9,410,827	9,442,204	9,442,204	9,442,204	9,442,204	6,469,939	6,247,650	6,041,462	5,835,274
16	Municipal Taxes		-	-	-	-	-	-	-	-	-	-	-
17	Deprecation		40,242,447	41,204,995	41,844,507	42,055,686	42,055,686	42,055,686	42,055,686	41,354,758	39,952,902	38,551,046	37,149,190
18	Taxes		7,017,629	7,383,332	7,622,404	7,700,968	7,701,259	7,701,259	7,701,259	10,963,929	15,616,046	17,462,955	17,916,035
19	Revenue Requirement		96,020,787	97,590,291	98,608,835	98,942,668	98,944,483	98,944,483	98,944,483	97,245,890	97,736,206	95,519,392	91,995,737
20	**Revenue**												
21	Revenue per Tonne per Month		$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07
22	Geothermal Revenue		111,166,397	113,861,923	115,654,930	116,244,576	116,244,576	116,244,576	116,244,576	114,307,166	110,432,347	106,557,528	102,682,709
23	**Sufficiency / (Deficiency)**		**15,145,610**	**16,271,632**	**17,046,094**	**17,301,908**	**17,300,093**	**17,300,093**	**17,300,093**	**17,061,277**	**12,696,141**	**11,038,136**	**10,686,971**

Geothermal
Revenue and Revenue Requirement

Line No.		Col. 1 Description	Col. 46 Year 45	Col. 47 Year 46	Col. 48 Year 47	Col. 49 Year 48	Col. 50 Year 49	Col. 51 Year 50	Col. 52 Year 51	Col. 53 Year 52	Col. 54 Year 53	Col. 55 Year 54	Col. 56 Year 55	Col. 57 Year 56
1		Number of Customers												
2		Number of Cumulative Customers [50% Effective]	82,110	78,890	75,670	72,450	69,230	66,010	62,790	59,570	56,350	53,130	49,910	46,690
3		Number of Tonnes per Customer	4	4	4	4	4	4	4	4	4	4	4	4
4		Total Number of Tonnes	328,440	315,560	302,680	289,800	276,920	264,040	251,160	238,280	225,400	212,520	199,640	186,760
5		Capital												
6		**Rate Base**												
7		Balance, beginning	482,384,292	446,314,057	411,645,678	378,379,155	346,514,489	316,051,679	286,990,725	259,331,627	233,074,386	208,219,000	184,765,471	162,713,799
8	+	Additions	-	-	-	-	-	-	-	-	-	-	-	-
9	+	Working Capital Additions	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)
10	-	Depreciation	(35,747,333)	(34,345,477)	(32,943,621)	(31,541,765)	(30,139,909)	(28,738,052)	(27,336,196)	(25,934,340)	(24,532,484)	(23,130,627)	(21,728,771)	(20,326,915)
11		Balance, ending	446,314,057	411,645,678	378,379,155	346,514,489	316,051,679	286,990,725	259,331,627	233,074,386	208,219,000	184,765,471	162,713,799	142,063,982
12		Average Rate Base	464,349,174	428,979,867	395,012,417	362,446,822	331,283,084	301,521,202	273,161,176	246,203,007	220,646,693	196,492,236	173,739,635	152,388,890
13		**Revenue Requirement**												
14		Return on Rate Base	28,813,535	26,618,818	24,511,089	22,490,347	20,556,592	18,709,825	16,950,044	15,277,251	13,691,445	12,192,626	10,780,795	9,455,950
15		O&M	5,629,086	5,422,898	5,216,709	5,010,521	4,804,333	4,598,145	4,391,957	4,185,769	3,979,580	3,773,392	3,567,204	3,361,016
16		Municipal Taxes	-	-	-	-	-	-	-	-	-	-	-	-
17		Deprecation	35,747,333	34,345,477	32,943,621	31,541,765	30,139,909	28,738,052	27,336,196	25,934,340	24,532,484	23,130,627	21,728,771	20,326,915
18		Taxes	17,680,499	17,108,953	16,377,700	15,574,891	14,744,603	13,908,872	13,078,718	12,259,651	11,454,425	10,664,418	9,890,318	9,132,470
19		Revenue Requirement	87,870,453	83,496,146	79,049,120	74,617,524	70,245,437	65,954,894	61,756,916	57,657,011	53,657,934	49,761,064	45,967,088	42,276,350
20		**Revenue**												
21		Revenue per Tonne per Month	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07
22		Geothermal Revenue	98,807,890	94,933,070	91,058,251	87,183,432	83,308,613	79,433,794	75,558,974	71,684,155	67,809,336	63,934,517	60,059,698	56,184,878
23		**Sufficiency / (Deficiency)**	**10,937,436**	**11,436,924**	**12,009,132**	**12,565,908**	**13,063,176**	**13,478,900**	**13,802,059**	**14,027,144**	**14,151,402**	**14,173,453**	**14,092,610**	**13,908,528**

Geothermal
Revenue and Revenue Requirement

Line No.		Col. 1 Description	Col. 58 Year 57	Col. 59 Year 58	Col. 60 Year 59	Col. 61 Year 60	Col. 62 Year 61	Col. 63 Year 62	Col. 64 Year 63	Col. 65 Year 64	Col. 66 Year 65	Col. 67 Year 66	Col. 68 Year 67	Col. 69 Year 68	Col. 70 Year 69
1		Number of Customers													
2		Number of Cumulative Customers [50% Effective]	43,470	40,250	37,030	33,810	30,590	27,370	24,150	20,930	17,710	14,490	11,270	8,050	4,830
3		Number of Tonnes per Customer	4	4	4	4	4	4	4	4	4	4	4	4	4
4		Total Number of Tonnes	173,880	161,000	148,120	135,240	122,360	109,480	96,600	83,720	70,840	57,960	45,080	32,200	19,320
5		Capital													
6		**Rate Base**													
7		Balance, beginning	142,063,982	122,816,021	104,969,917	88,525,669	73,483,277	59,842,742	47,604,062	36,767,239	27,332,272	19,299,161	12,667,907	7,438,509	3,610,966
8	+	Additions	-	-	-	-	-	-	-	-	-	-	-	-	-
9	+	Working Capital Additions	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)	(322,902)
10	-	Depreciation	(18,925,059)	(17,523,203)	(16,121,346)	(14,719,490)	(13,317,634)	(11,915,778)	(10,513,922)	(9,112,065)	(7,710,209)	(6,308,353)	(4,906,497)	(3,504,641)	(2,102,784)
11		Balance, ending	122,816,021	104,969,917	88,525,669	73,483,277	59,842,742	47,604,062	36,767,239	27,332,272	19,299,161	12,667,907	7,438,509	3,610,966	1,185,281
12		Average Rate Base	132,440,002	113,892,969	96,747,793	81,004,473	66,663,010	53,723,402	42,185,651	32,049,756	23,315,717	15,983,534	10,053,208	5,524,737	2,398,123
13		**Revenue Requirement**													
14		Return on Rate Base	8,218,093	7,067,223	6,003,340	5,026,444	4,136,536	3,333,614	2,617,680	1,988,733	1,446,774	991,801	623,816	342,818	148,807
15		O&M	3,154,828	2,948,639	2,742,451	2,536,263	2,330,075	2,126,487	1,922,898	1,719,310	1,515,722	1,312,134	1,108,546	904,957	701,369
16		Municipal Taxes	-	-	-	-	-	-	-	-	-	-	-	-	-
17		Deprecation	18,925,059	17,523,203	16,121,346	14,719,490	13,317,634	11,915,778	10,513,922	9,112,065	7,710,209	6,308,353	4,906,497	3,504,641	2,102,784
18		Taxes	8,391,045	7,666,130	6,957,768	6,265,980	5,590,778	4,932,166	4,290,148	3,664,723	3,055,895	2,463,662	1,888,024	1,328,983	786,537
19		Revenue Requirement	38,689,024	35,205,195	31,824,905	28,548,178	25,375,022	22,308,045	19,344,648	16,484,833	13,728,600	11,075,950	8,526,883	6,081,399	3,739,498
20		**Revenue**													
21		Revenue per Tonne per Month	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07	$ 25.07
22		Geothermal Revenue	52,310,059	48,435,240	44,560,421	40,685,602	36,810,782	32,935,963	29,061,144	25,186,325	21,311,506	17,436,686	13,561,867	9,687,048	5,812,229
23		**Sufficiency / (Deficiency)**	**13,621,035**	**13,230,045**	**12,735,515**	**12,137,424**	**11,435,760**	**10,627,918**	**9,716,496**	**8,701,492**	**7,582,906**	**6,360,737**	**5,034,985**	**3,605,649**	**2,072,731**

Geothermal
Revenue and Revenue Requirement

		Col. 1	Col. 71
Line No.		Description	Year 70
1		Number of Customers	
2		Number of Cumulative Customers [50% Effective]	1,610
3		Number of Tonnes per Customer	4
4		Total Number of Tonnes	6,440
5		Capital	
6		**Rate Base**	
7		Balance, beginning	1,185,281
8	+	Additions	-
9	+	Working Capital Additions	(322,902)
10	-	Depreciation	(700,928)
11		Balance, ending	161,451
12		Average Rate Base	673,366
13		**Revenue Requirement**	
14		Return on Rate Base	41,783
15		O&M	312,138
16		Municipal Taxes	-
17		Deprecation	700,928
18		Taxes	260,687
19		Revenue Requirement	1,315,536
20		**Revenue**	
21		Revenue per Tonne per Month	$ 25.07
22		Geothermal Revenue	1,937,410
23		**Sufficiency / (Deficiency)**	**621,873**

OGA INTERROGATORY #11

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Preamble:

The final report of the Board in EBO 188 states that: "A maximum 10 year forecast horizon will be utilized. For customer attachment periods of greater than 10 years an explanation of the extension of the period will be provided to the Board." See section 3.2.1.

Interrogatory:

Please recalculate the profitability index and proposed service fee based on a 40 year customer forecast. Please make assumptions as needed, state all assumptions, and include any caveats as needed.

If Enbridge believes that a forecast in between 10 and 40 would be more reasonable (e.g. 20 or 30), please also recalculate Appendix 11 based on that longer period.

RESPONSE

Please see response to OGA Interrogatory #10 filed at Exhibit I.1.EGDI.OGA.10 and the Attachment to this response.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

ATTACHMENT 1

GEOTHERMAL

ECONOMIC FEASIBILITY

Geothermal
Economic Feasibility
Parameters and Results

Line No.	Col. 1 Description	Col. 2
FEASIBILITY PARAMETERS		
1.	Discount Rate	5.43%
2.	CCA Rate	50.00%
3.	Income Tax Rate	26.50%
4.	Customer Revenue Horizon (Years)	30
5.	Capital Investment (Dollars)	
6.	Geothermal Loops	1,498,819,133
7.	Total Capital Investment	1,498,819,133
8.	Working Capital (Days of Revenue)	30
FEASIBILITY RESULTS		
9.	Net Present Value (Dollars)	54,148,141
10.	Profitability Index	1.10

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 2 Year 1	Col. 3 Year 2	Col. 4 Year 3	Col. 5 Year 4	Col. 6 Year 5	Col. 7 Year 6	Col. 8 Year 7	Col. 9 Year 8	Col. 10 Year 9	Col. 11 Year 10	Col. 12 Year 11
	Discount factors to project outset	0.9739	0.9237	0.8762	0.8310	0.7882	0.7476	0.7091	0.6726	0.6379	0.6051	0.5739
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	(2,702,492)	(4,339,017)	(6,140,834)	(10,002,812)	(16,355,698)	(29,384,945)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(2,702,492)	(4,339,017)	(6,140,834)	(10,002,812)	(16,355,698)	(29,384,945)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital	(8,228)	(22,748)	(35,332)	(56,628)	(94,864)	(167,464)	(264,264)	(311,696)	(311,696)	(311,696)	(311,696)
5.	Total Investment	(2,710,720)	(4,361,765)	(6,176,166)	(10,059,440)	(16,450,562)	(29,552,409)	(42,319,950)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)
6.	PV Of Total Investment At Project Outset	(2,639,980)	(4,029,121)	(5,411,268)	(8,359,608)	(12,966,563)	(22,093,730)	(30,009,126)	(28,495,210)	(27,027,376)	(25,635,153)	(24,314,646)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(2,639,980)	(6,669,101)	(12,080,369)	(20,439,977)	(33,406,540)	(55,500,270)	(85,509,396)	(114,004,606)	(141,031,982)	(166,667,135)	(190,981,781)
	CCA TAX SHIELD											
8.	CCA Tax Shield	177,458	551,387	964,535	1,543,539	2,504,777	4,259,632	6,826,112	8,941,919	9,999,823	10,528,774	10,793,250
9.	PV Of CCA Tax Shield At Project Outset	172,827	509,336	845,081	1,282,714	1,974,301	3,184,551	4,840,404	6,014,104	6,379,176	6,370,626	6,194,248
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	172,827	682,163	1,527,243	2,809,957	4,784,258	7,968,808	12,809,212	18,823,317	25,202,492	31,573,118	37,767,366
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	98,736	371,712	795,696	1,475,232	2,613,600	4,623,168	7,794,336	11,534,688	15,275,040	19,015,392	22,755,744
12.	O&M Expenses	(1,537,863)	(1,270,622)	(1,370,697)	(1,821,824)	(2,169,226)	(2,886,184)	(3,639,550)	(3,830,591)	(4,016,733)	(4,202,875)	(4,389,017)
13.	Net Operating Cash (Before Taxes)	(1,439,127)	(898,910)	(575,001)	(346,592)	444,374	1,736,984	4,154,786	7,704,097	11,258,307	14,812,517	18,366,727
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	(1,401,571)	(830,356)	(503,789)	(288,025)	350,262	1,298,590	2,946,164	5,181,577	7,181,999	8,962,582	10,540,667
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	(1,401,571)	(2,231,927)	(2,735,716)	(3,023,742)	(2,673,480)	(1,374,890)	1,571,274	6,752,851	13,934,849	22,897,432	33,438,098
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	381,369	238,211	152,375	91,847	(117,759)	(460,301)	(1,101,018)	(2,041,586)	(2,983,451)	(3,925,317)	(4,867,183)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	381,369	238,211	152,375	91,847	(117,759)	(460,301)	(1,101,018)	(2,041,586)	(2,983,451)	(3,925,317)	(4,867,183)
19.	PV of Total Taxes At Project Outset	371,416	220,044	133,504	76,327	(92,819)	(344,126)	(780,733)	(1,373,118)	(1,903,230)	(2,375,084)	(2,793,277)
20.	**ACCUMULATED PV OF TOTAL TAXES**	371,416	591,461	724,965	801,292	708,472	364,346	(416,388)	(1,789,505)	(3,692,735)	(6,067,819)	(8,861,096)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	(3,497,308)	(7,627,404)	(12,563,877)	(19,852,470)	(30,587,290)	(48,542,006)	(71,545,298)	(90,217,944)	(105,587,376)	(118,264,405)	(128,637,413)
22.	Profitability Index	(0.325)	(0.144)	(0.040)	0.029	0.084	0.125	0.163	0.209	0.251	0.290	0.326

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 13 Year 12	Col. 14 Year 13	Col. 15 Year 14	Col. 16 Year 15	Col. 17 Year 16	Col. 18 Year 17	Col. 19 Year 18	Col. 20 Year 19	Col. 21 Year 20	Col. 22 Year 21	Col. 23 Year 22
	Discount factors to project outset	0.5443	0.5163	0.4897	0.4645	0.4406	0.4179	0.3963	0.3759	0.3566	0.3382	0.3208
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)
5.	Total Investment	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)
6.	PV Of Total Investment At Project Outset	(23,062,160)	(21,874,191)	(20,747,417)	(19,678,685)	(18,665,004)	(17,703,540)	(16,791,603)	(15,926,641)	(15,106,234)	(14,328,088)	(13,590,026)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(214,043,941)	(235,918,132)	(256,665,549)	(276,344,234)	(295,009,238)	(312,712,779)	(329,504,382)	(345,431,022)	(360,537,257)	(374,865,345)	(388,455,371)
	CCA TAX SHIELD											
8.	CCA Tax Shield	10,925,488	10,991,607	11,024,667	11,041,197	11,049,461	11,053,594	11,055,660	11,056,693	11,057,210	11,057,468	11,057,597
9.	PV Of CCA Tax Shield At Project Outset	5,947,154	5,674,944	5,398,808	5,128,384	4,867,854	4,618,830	4,381,726	4,156,405	3,942,486	3,739,489	3,546,904
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	43,714,520	49,389,464	54,788,272	59,916,656	64,784,511	69,403,341	73,785,067	77,941,471	81,883,957	85,623,447	89,170,350
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	26,496,096	30,236,448	33,976,800	37,717,152	41,457,504	45,197,856	48,938,208	52,678,560	56,418,912	60,159,264	63,899,616
12.	O&M Expenses	(4,575,159)	(4,761,300)	(4,947,442)	(5,133,584)	(5,527,013)	(5,731,857)	(5,936,700)	(6,141,544)	(6,346,387)	(6,551,231)	(6,756,074)
13.	Net Operating Cash (Before Taxes)	21,920,937	25,475,148	29,029,358	32,583,568	35,930,491	39,465,999	43,001,508	46,537,016	50,072,525	53,608,033	57,143,542
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	11,932,391	13,152,766	14,215,752	15,134,326	15,829,224	16,491,175	17,042,928	17,494,079	17,853,529	18,129,528	18,329,719
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	45,370,489	58,523,255	72,739,007	87,873,333	103,702,556	120,193,731	137,236,659	154,730,738	172,584,268	190,713,795	209,043,514
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(5,809,048)	(6,750,914)	(7,692,780)	(8,634,646)	(9,521,580)	(10,458,490)	(11,395,400)	(12,332,309)	(13,269,219)	(14,206,129)	(15,143,039)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(5,809,048)	(6,750,914)	(7,692,780)	(8,634,646)	(9,521,580)	(10,458,490)	(11,395,400)	(12,332,309)	(13,269,219)	(14,206,129)	(15,143,039)
19.	PV of Total Taxes At Project Outset	(3,162,084)	(3,485,483)	(3,767,174)	(4,010,596)	(4,194,744)	(4,370,161)	(4,516,376)	(4,635,931)	(4,731,185)	(4,804,325)	(4,857,375)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(12,023,180)	(15,508,663)	(19,275,837)	(23,286,433)	(27,481,177)	(31,851,339)	(36,367,715)	(41,003,646)	(45,734,831)	(50,539,156)	(55,396,531)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	(136,982,111)	(143,514,076)	(148,414,107)	(151,840,678)	(154,003,349)	(154,967,045)	(154,850,370)	(153,762,458)	(151,803,863)	(149,067,259)	(145,638,038)
22.	Profitability Index	0.360	0.392	0.422	0.451	0.478	0.504	0.530	0.555	0.579	0.602	0.625

Geothermal
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Line No.	Col. 1 Description	Col. 24 Year 23	Col. 25 Year 24	Col. 26 Year 25	Col. 27 Year 26	Col. 28 Year 27	Col. 29 Year 28	Col. 30 Year 29	Col. 31 Year 30	Col. 32 Year 31	Col. 33 Year 32	Col. 34 Year 33
	Discount factors to project outset	0.3042	0.2886	0.2737	0.2596	0.2462	0.2336	0.2215	0.2101	0.1993	0.1890	0.1793
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)
4.	Working Capital	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(303,468)	(288,948)	(276,364)
5.	Total Investment	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,367,382)	(42,359,154)	(42,344,634)	(42,332,050)
6.	PV Of Total Investment At Project Outset	(12,889,982)	(12,225,998)	(11,596,218)	(10,998,878)	(10,432,309)	(9,894,924)	(9,385,221)	(8,901,773)	(8,441,589)	(8,004,005)	(7,589,450)
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(401,345,352)	(413,571,351)	(425,167,569)	(436,166,447)	(446,598,756)	(456,493,679)	(465,878,900)	(474,780,673)	(483,222,262)	(491,226,267)	(498,815,716)
	CCA TAX SHIELD											
8.	CCA Tax Shield	11,057,662	11,057,694	11,057,710	11,057,718	11,057,722	11,057,724	11,057,725	11,057,726	11,057,726	11,057,726	11,057,726
9.	PV Of CCA Tax Shield At Project Outset	3,364,217	3,190,930	3,026,565	2,870,663	2,722,792	2,582,537	2,449,507	2,323,329	2,203,651	2,090,137	1,982,471
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	92,534,567	95,725,497	98,752,062	101,622,725	104,345,517	106,928,054	109,377,561	111,700,890	113,904,541	115,994,678	117,977,149
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	67,639,968	71,380,320	75,120,672	78,861,024	82,601,376	86,341,728	90,082,080	93,822,432	97,464,048	100,931,424	104,247,792
12.	O&M Expenses	(6,960,918)	(7,170,961)	(7,375,805)	(7,575,448)	(7,780,292)	(7,985,135)	(8,189,979)	(8,394,822)	(8,594,259)	(8,784,152)	(8,965,776)
13.	Net Operating Cash (Before Taxes)	60,679,050	64,209,359	67,744,867	71,285,576	74,821,084	78,356,593	81,892,101	85,427,610	88,869,789	92,147,272	95,282,016
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	18,461,180	18,528,960	18,542,194	18,506,250	18,423,528	18,300,222	18,140,735	17,949,119	17,710,510	17,417,725	17,082,519
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	227,504,693	246,033,653	264,575,848	283,082,098	301,505,625	319,805,848	337,946,582	355,895,701	373,606,211	391,023,936	408,106,455
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(16,079,948)	(17,015,480)	(17,952,390)	(18,890,678)	(19,827,587)	(20,764,497)	(21,701,407)	(22,638,317)	(23,550,494)	(24,419,027)	(25,249,734)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(16,079,948)	(17,015,480)	(17,952,390)	(18,890,678)	(19,827,587)	(20,764,497)	(21,701,407)	(22,638,317)	(23,550,494)	(24,419,027)	(25,249,734)
19.	PV of Total Taxes At Project Outset	(4,892,213)	(4,910,174)	(4,913,682)	(4,904,156)	(4,882,235)	(4,849,559)	(4,807,295)	(4,756,517)	(4,693,285)	(4,615,697)	(4,526,868)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(60,288,744)	(65,198,918)	(70,112,600)	(75,016,756)	(79,898,991)	(84,748,550)	(89,555,844)	(94,312,361)	(99,005,646)	(103,621,343)	(108,148,211)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	(141,594,836)	(137,011,119)	(131,952,259)	(126,478,380)	(120,646,604)	(114,508,327)	(108,110,601)	(101,496,443)	(94,717,156)	(87,828,996)	(80,880,323)
22.	Profitability Index	0.647	0.669	0.690	0.710	0.730	0.749	0.768	0.786	0.804	0.821	0.838

Geothermal
Economic Feasibility - 70 year Horizon
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Line No.	Col. 1 Description	Col. 35 Year 34	Col. 36 Year 35	Col. 37 Year 36	Col. 38 Year 37	Col. 39 Year 38	Col. 40 Year 39	Col. 41 Year 40	Col. 42 Year 41	Col. 43 Year 42	Col. 44 Year 43	Col. 45 Year 44
	Discount factors to project outset	0.1700	0.1613	0.1530	0.1451	0.1376	0.1305	0.1238	0.1174	0.1114	0.1056	0.1002
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	-	-	-	-
4.	Working Capital	(255,068)	(216,832)	(144,232)	(47,432)	-	-	-	155,848	311,696	311,696	311,696
5.	Total Investment	(42,310,754)	(42,272,518)	(42,199,918)	(42,103,118)	(42,055,686)	(42,055,686)	(42,055,686)	155,848	311,696	311,696	311,696
6.	PV Of Total Investment At Project Outset	(7,194,884)	(6,818,097)	(6,455,779)	(6,109,186)	(5,787,964)	(5,489,817)	(5,207,028)	18,302	34,718	32,930	31,234
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(506,010,600)	(512,828,696)	(519,284,476)	(525,393,662)	(531,181,626)	(536,671,443)	(541,878,471)	(541,860,169)	(541,825,451)	(541,792,521)	(541,761,287)
	CCA TAX SHIELD											
8.	CCA Tax Shield	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	11,057,726	8,293,295	4,146,647	2,073,324	1,036,662
9.	PV Of CCA Tax Shield At Project Outset	1,880,351	1,783,491	1,691,620	1,604,482	1,521,833	1,443,441	1,369,087	973,922	461,877	219,042	103,880
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	119,857,499	121,640,990	123,332,610	124,937,093	126,458,925	127,902,366	129,271,453	130,245,376	130,707,253	130,926,295	131,030,175
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	107,308,608	109,910,592	111,641,376	112,210,560	112,210,560	112,210,560	112,210,560	110,340,384	106,600,032	102,859,680	99,119,328
12.	O&M Expenses	(9,133,404)	(9,275,904)	(9,370,692)	(9,401,864)	(9,401,864)	(9,401,864)	(9,401,864)	(6,430,271)	(6,209,327)	(6,004,484)	(5,799,640)
13.	Net Operating Cash (Before Taxes)	98,175,204	100,634,688	102,270,684	102,808,696	102,808,696	102,808,696	102,808,696	103,910,113	100,390,705	96,855,196	93,319,688
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	16,694,554	16,231,279	15,645,456	14,917,600	14,149,170	13,420,324	12,729,022	12,202,675	11,182,084	10,232,558	9,351,184
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	424,801,009	441,032,288	456,677,744	471,595,343	485,744,514	499,164,838	511,893,860	524,096,534	535,278,618	545,511,176	554,862,359
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(26,016,429)	(26,668,192)	(27,101,731)	(27,244,305)	(27,244,305)	(27,244,305)	(27,244,305)	(27,536,180)	(26,603,537)	(25,666,627)	(24,729,717)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(26,016,429)	(26,668,192)	(27,101,731)	(27,244,305)	(27,244,305)	(27,244,305)	(27,244,305)	(27,536,180)	(26,603,537)	(25,666,627)	(24,729,717)
19.	PV of Total Taxes At Project Outset	(4,424,057)	(4,301,289)	(4,146,046)	(3,953,164)	(3,749,530)	(3,556,386)	(3,373,191)	(3,233,709)	(2,963,252)	(2,711,628)	(2,478,064)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(112,572,267)	(116,873,556)	(121,019,602)	(124,972,766)	(128,722,296)	(132,278,682)	(135,651,873)	(138,885,582)	(141,848,834)	(144,560,462)	(147,038,525)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	(73,924,359)	(67,028,975)	(60,293,724)	(53,833,992)	(47,700,483)	(41,882,921)	(36,365,031)	(26,403,841)	(17,688,414)	(9,915,511)	(2,907,278)
22.	Profitability Index	0.854	0.869	0.884	0.898	0.910	0.922	0.933	0.951	0.967	0.982	0.995

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Line No.	Col. 1 Description	Col. 46 Year 45	Col. 47 Year 46	Col. 48 Year 47	Col. 49 Year 48	Col. 50 Year 49	Col. 51 Year 50	Col. 52 Year 51	Col. 53 Year 52	Col. 54 Year 53	Col. 55 Year 54	Col. 56 Year 55
	Discount factors to project outset	0.0950	0.0901	0.0855	0.0811	0.0769	0.0730	0.0692	0.0656	0.0623	0.0590	0.0560
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	-	-	-	-	-	-	-	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	-	-	-	-	-	-	-	-	-	-	-
4.	Working Capital	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696
5.	Total Investment	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696
6.	PV Of Total Investment At Project Outset	29,625	28,099	26,651	25,279	23,976	22,741	21,570	20,459	19,405	18,405	17,457
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(541,731,662)	(541,703,563)	(541,676,912)	(541,651,633)	(541,627,657)	(541,604,915)	(541,583,345)	(541,562,887)	(541,543,482)	(541,525,076)	(541,507,619)
	CCA TAX SHIELD											
8.	CCA Tax Shield	518,331	259,165	129,583	64,791	32,396	16,198	8,099	4,049	2,025	1,012	506
9.	PV Of CCA Tax Shield At Project Outset	49,264	23,363	11,080	5,255	2,492	1,182	560	266	126	60	28
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	131,079,439	131,102,802	131,113,882	131,119,137	131,121,629	131,122,811	131,123,371	131,123,637	131,123,763	131,123,823	131,123,851
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	95,378,976	91,638,624	87,898,272	84,157,920	80,417,568	76,677,216	72,936,864	69,196,512	65,456,160	61,715,808	57,975,456
12.	O&M Expenses	(5,594,797)	(5,389,953)	(5,185,110)	(4,980,266)	(4,775,423)	(4,570,579)	(4,365,736)	(4,160,892)	(3,956,049)	(3,751,205)	(3,546,362)
13.	Net Operating Cash (Before Taxes)	89,784,179	86,248,671	82,713,162	79,177,654	75,642,145	72,106,637	68,571,128	65,035,620	61,500,111	57,964,603	54,429,094
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	8,533,460	7,775,168	7,072,354	6,421,316	5,818,584	5,260,908	4,745,247	4,268,751	3,828,754	3,422,760	3,048,434
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	563,395,819	571,170,987	578,243,342	584,664,658	590,483,242	595,744,150	600,489,397	604,758,148	608,586,902	612,009,662	615,058,096
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(23,792,808)	(22,855,898)	(21,918,988)	(20,982,078)	(20,045,169)	(19,108,259)	(18,171,349)	(17,234,439)	(16,297,530)	(15,360,620)	(14,423,710)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(23,792,808)	(22,855,898)	(21,918,988)	(20,982,078)	(20,045,169)	(19,108,259)	(18,171,349)	(17,234,439)	(16,297,530)	(15,360,620)	(14,423,710)
19.	PV of Total Taxes At Project Outset	(2,261,367)	(2,060,419)	(1,874,174)	(1,701,649)	(1,541,925)	(1,394,141)	(1,257,490)	(1,131,219)	(1,014,620)	(907,031)	(807,835)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(149,299,892)	(151,360,312)	(153,234,486)	(154,936,134)	(156,478,059)	(157,872,200)	(159,129,690)	(160,260,909)	(161,275,529)	(162,182,560)	(162,990,395)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	3,443,704	9,209,915	14,445,827	19,196,027	23,499,155	27,389,845	30,899,732	34,057,989	36,891,654	39,425,848	41,683,932
22.	Profitability Index	1.006	1.017	1.027	1.035	1.043	1.051	1.057	1.063	1.068	1.073	1.077

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Line No.	Col. 1 Description	Col. 57 Year 56	Col. 58 Year 57	Col. 59 Year 58	Col. 60 Year 59	Col. 61 Year 60	Col. 62 Year 61	Col. 63 Year 62	Col. 64 Year 63	Col. 65 Year 64	Col. 66 Year 65	Col. 67 Year 66
	Discount factors to project outset	0.0531	0.0504	0.0478	0.0453	0.0430	0.0408	0.0387	0.0367	0.0348	0.0330	0.0313
	INCREMENTAL CAPITAL INVESTMENT											
1.	Geothermal Loops	-	-	-	-	-	-	-	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-	-	-	-	-	-	-	-
3.	Net Investment Capital	-	-	-	-	-	-	-	-	-	-	-
4.	Working Capital	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696
5.	Total Investment	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696
6.	PV Of Total Investment At Project Outset	16,558	15,705	14,896	14,129	13,401	12,711	12,056	11,435	10,846	10,287	9,757
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(541,491,061)	(541,475,356)	(541,460,460)	(541,446,331)	(541,432,930)	(541,420,219)	(541,408,163)	(541,396,728)	(541,385,883)	(541,375,595)	(541,365,838)
	CCA TAX SHIELD											
8.	CCA Tax Shield	253	127	63	32	16	8	4	2	1	0	0
9.	PV Of CCA Tax Shield At Project Outset	13	6	3	1	1	0	0	0	0	0	0
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	131,123,864	131,123,871	131,123,874	131,123,875	131,123,876	131,123,876	131,123,876	131,123,877	131,123,877	131,123,877	131,123,877
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)											
11.	Geothermal Revenues	54,235,104	50,494,752	46,754,400	43,014,048	39,273,696	35,533,344	31,792,992	28,052,640	24,312,288	20,571,936	16,831,584
12.	O&M Expenses	(3,341,518)	(3,136,674)	(2,931,831)	(2,726,987)	(2,522,144)	(2,317,300)	(2,115,057)	(1,912,813)	(1,710,570)	(1,508,326)	(1,306,083)
13.	Net Operating Cash (Before Taxes)	50,893,586	47,358,078	43,822,569	40,287,061	36,751,552	33,216,044	29,677,935	26,139,827	22,601,718	19,063,610	15,525,501
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	2,703,589	2,386,183	2,094,303	1,826,162	1,580,089	1,354,521	1,147,899	958,969	786,458	629,174	486,008
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	617,761,685	620,147,868	622,242,171	624,068,333	625,648,422	627,002,943	628,150,841	629,109,810	629,896,268	630,525,443	631,011,451
	TAXES											
16.	Income Tax (Before Interest Tax Shield)	(13,486,800)	(12,549,891)	(11,612,981)	(10,676,071)	(9,739,161)	(8,802,252)	(7,864,653)	(6,927,054)	(5,989,455)	(5,051,857)	(4,114,258)
17.	Municipal Tax	-	-	-	-	-	-	-	-	-	-	-
18.	Total Taxes	(13,486,800)	(12,549,891)	(11,612,981)	(10,676,071)	(9,739,161)	(8,802,252)	(7,864,653)	(6,927,054)	(5,989,455)	(5,051,857)	(4,114,258)
19.	PV of Total Taxes At Project Outset	(716,451)	(632,339)	(554,990)	(483,933)	(418,724)	(358,948)	(304,193)	(254,127)	(208,411)	(166,731)	(128,792)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(163,706,846)	(164,339,185)	(164,894,175)	(165,378,108)	(165,796,832)	(166,155,780)	(166,459,973)	(166,714,100)	(166,922,511)	(167,089,242)	(167,218,034)
	ACCUMULATED NPV AND PI											
21.	Net Present Value	43,687,642	45,457,198	47,011,410	48,367,769	49,542,536	50,550,820	51,406,582	52,122,859	52,711,751	53,184,482	53,551,455
22.	Profitability Index	1.081	1.084	1.087	1.089	1.092	1.093	1.095	1.096	1.097	1.098	1.099

Geothermal
Economic Feasibility - 70 year Horizon
DCF Analysis

Line No.	Col. 1 Description	Col. 68 Year 67	Col. 69 Year 68	Col. 70 Year 69	Col. 71 Year 70
	Discount factors to project outset	0.0297	0.0282	0.0267	0.0257
	INCREMENTAL CAPITAL INVESTMENT				
1.	Geothermal Loops	-	-	-	-
2.	Contribution In Aid Of Construction	-	-	-	-
3.	Net Investment Capital	-	-	-	-
4.	Working Capital	311,696	311,696	311,696	311,696
5.	Total Investment	311,696	311,696	311,696	311,696
6.	PV Of Total Investment At Project Outset	9,255	8,778	8,326	8,002
7.	**ACCUMULATED PV OF TOTAL INVESTMENT**	(541,356,583)	(541,347,805)	(541,339,480)	**(541,331,478)**
	CCA TAX SHIELD				
8.	CCA Tax Shield	0	0	0	0
9.	PV Of CCA Tax Shield At Project Outset	0	0	0	0
10.	**ACCUMULATED PV OF CCA TAX SHIELD**	131,123,877	131,123,877	131,123,877	**131,123,877**
	INCREMENTAL OPERATING CASHFLOWS (BEFORE TAXES)				
11.	Geothermal Revenues	13,091,232	9,350,880	5,610,528	1,870,176
12.	O&M Expenses	(1,103,839)	(901,596)	(699,352)	(311,465)
13.	Net Operating Cash (Before Taxes)	11,987,393	8,449,284	4,911,176	1,558,711
14.	PV of Net Operating Cash (Before Taxes) At Project Outset	355,922	237,948	131,184	40,016
15.	**ACCUMULATED PV OF NET OPERATING CASH (BEFORE TAXES)**	631,367,373	631,605,321	631,736,504	**631,776,520**
	TAXES				
16.	Income Tax (Before Interest Tax Shield)	(3,176,659)	(2,239,060)	(1,301,462)	(413,058)
17.	Municipal Tax	-	-	-	-
18.	Total Taxes	(3,176,659)	(2,239,060)	(1,301,462)	(413,058)
19.	PV of Total Taxes At Project Outset	(94,319)	(63,056)	(34,764)	(10,604)
20.	**ACCUMULATED PV OF TOTAL TAXES**	(167,312,354)	(167,375,410)	(167,410,174)	**(167,420,778)**
	ACCUMULATED NPV AND PI				
21.	Net Present Value	53,822,312	54,005,982	54,110,728	**54,148,141**
22.	Profitability Index	1.099	1.100	1.100	**1.100**

Geothermal
Revenue and Revenue Requirement

Line No.	Description	Col. 1	Col. 2 Year 1	Col. 3 Year 2	Col. 4 Year 3	Col. 5 Year 4	Col. 6 Year 5	Col. 7 Year 6	Col. 8 Year 7	Col. 9 Year 8	Col. 10 Year 9	Col. 11 Year 10	Col. 12 Year 11
1	Number of Customers		170	300	430	740	1,220	2,240	3,220	3,220	3,220	3,220	3,220
2	Number of Cumulative Customers [50% Effective]		85	320	685	1,270	2,250	3,980	6,710	9,930	13,150	16,370	19,590
3	Number of Tonnes per Customer		4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes		340	1,280	2,740	5,080	9,000	15,920	26,840	39,720	52,600	65,480	78,360
5	Capital		2,702,492	4,339,017	6,140,834	10,002,812	16,355,698	29,384,945	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
6	**Rate Base**												
7	Balance, beginning		0	2,665,678	6,865,043	12,704,145	22,157,460	37,562,589	65,307,220	104,628,716	142,595,787	179,161,002	214,324,361
8	+ Additions		2,702,492	4,339,017	6,140,834	10,002,812	16,355,698	29,384,945	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
9	+ Working Capital Additions		8,228	22,748	35,332	56,628	94,864	167,464	264,264	311,696	311,696	311,696	311,696
10	- Depreciation		(45,042)	(162,400)	(337,064)	(606,125)	(1,045,433)	(1,807,778)	(2,998,455)	(4,400,311)	(5,802,167)	(7,204,023)	(8,605,880)
11	Balance, ending		2,665,678	6,865,043	12,704,145	22,157,460	37,562,589	65,307,220	104,628,716	142,595,787	179,161,002	214,324,361	248,085,864
12	Average Rate Base		1,332,839	4,765,361	9,784,594	17,430,803	29,860,024	51,434,905	84,967,968	123,612,252	160,878,395	196,742,682	231,205,113
13	**Revenue Requirement**												
14	Return on Rate Base		82,705	295,698	607,148	1,081,606	1,852,858	3,191,610	5,272,385	7,670,318	9,982,736	12,208,167	14,346,610
15	O&M		1,537,863	1,270,622	1,370,697	1,821,824	2,169,226	2,886,184	3,639,550	3,830,591	4,016,733	4,202,875	4,389,017
16	Municipal Taxes		-	-	-	-	-	-	-	-	-	-	-
17	Deprecation		45,042	162,400	337,064	606,125	1,045,433	1,807,778	2,998,455	4,400,311	5,802,167	7,204,023	8,605,880
18	Taxes		(209,421)	(635,219)	(1,074,931)	(1,675,163)	(2,677,436)	(4,534,719)	(7,200,255)	(9,115,981)	(9,608,698)	(9,398,348)	(8,844,763)
19	Revenue Requirement		1,456,188	1,093,501	1,239,979	1,834,393	2,390,081	3,350,852	4,710,135	6,785,240	10,192,939	14,216,717	18,496,744
20	**Revenue**												
21	Revenue per Tonne per Month		$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20
22	Geothermal Revenue		98,736	371,712	795,696	1,475,232	2,613,600	4,623,168	7,794,336	11,534,688	15,275,040	19,015,392	22,755,744
23	**Sufficiency / (Deficiency)**		**(1,357,452)**	**(721,789)**	**(444,283)**	**(359,161)**	**223,519**	**1,272,316**	**3,084,201**	**4,749,448**	**5,082,101**	**4,798,675**	**4,259,000**

Geothermal
Revenue and Revenue Requirement

Line No.	Description	Col. 1	Col. 13 Year 12	Col. 14 Year 13	Col. 15 Year 14	Col. 16 Year 15	Col. 17 Year 16	Col. 18 Year 17	Col. 19 Year 18	Col. 20 Year 19	Col. 21 Year 20	Col. 22 Year 21	Col. 23 Year 22
1	Number of Customers		3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220
2	Number of Cumulative Customers [50% Effective]		22,810	26,030	29,250	32,470	35,690	38,910	42,130	45,350	48,570	51,790	55,010
3	Number of Tonnes per Customer		4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes		91,240	104,120	117,000	129,880	142,760	155,640	168,520	181,400	194,280	207,160	220,040
5	Capital		42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
6	**Rate Base**												
7	Balance, beginning		248,085,864	280,445,511	311,403,301	340,959,235	369,113,313	395,865,535	421,215,900	445,164,410	467,711,063	488,855,860	508,598,800
8	+ Additions		42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
9	+ Working Capital Additions		311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696
10	- Depreciation		(10,007,736)	(11,409,592)	(12,811,448)	(14,213,304)	(15,615,161)	(17,017,017)	(18,418,873)	(19,820,729)	(21,222,585)	(22,624,442)	(24,026,298)
11	Balance, ending		280,445,511	311,403,301	340,959,235	369,113,313	395,865,535	421,215,900	445,164,410	467,711,063	488,855,860	508,598,800	526,939,885
12	Average Rate Base		264,265,688	295,924,406	326,181,268	355,036,274	382,489,424	408,540,718	433,190,155	456,437,736	478,283,461	498,727,330	517,769,343
13	**Revenue Requirement**												
14	Return on Rate Base		16,398,066	18,362,536	20,240,017	22,030,512	23,734,020	25,350,540	26,880,073	28,322,619	29,678,178	30,946,749	32,128,333
15	O&M		4,575,159	4,761,300	4,947,442	5,133,584	5,527,013	5,731,857	5,936,700	6,141,544	6,346,387	6,551,231	6,756,074
16	Municipal Taxes		-	-	-	-	-	-	-	-	-	-	-
17	Deprecation		10,007,736	11,409,592	12,811,448	14,213,304	15,615,161	17,017,017	18,418,873	19,820,729	21,222,585	22,624,442	24,026,298
18	Taxes		(8,127,858)	(7,337,592)	(6,518,943)	(5,694,400)	(4,875,208)	(4,066,990)	(3,272,557)	(2,493,314)	(1,729,964)	(982,858)	(252,173)
19	Revenue Requirement		22,853,102	27,195,836	31,479,965	35,683,001	40,000,985	44,032,423	47,963,089	51,791,578	55,517,186	59,139,563	62,658,532
20	**Revenue**												
21	Revenue per Tonne per Month		$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20
22	Geothermal Revenue		26,496,096	30,236,448	33,976,800	37,717,152	41,457,504	45,197,856	48,938,208	52,678,560	56,418,912	60,159,264	63,899,616
23	**Sufficiency / (Deficiency)**		**3,642,994**	**3,040,612**	**2,496,835**	**2,034,151**	**1,456,519**	**1,165,433**	**975,119**	**886,982**	**901,726**	**1,019,701**	**1,241,084**

Geothermal
Revenue and Revenue Requirement

Line No.	Col. 1 Description	Col. 24 Year 23	Col. 25 Year 24	Col. 26 Year 25	Col. 27 Year 26	Col. 28 Year 27	Col. 29 Year 28	Col. 30 Year 29	Col. 31 Year 30	Col. 32 Year 31	Col. 33 Year 32	Col. 34 Year 33
1	Number of Customers	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220	3,220
2	Number of Cumulative Customers [50% Effective]	58,230	61,450	64,670	67,890	71,110	74,330	77,550	80,770	83,905	86,890	89,745
3	Number of Tonnes per Customer	4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes	232,920	245,800	258,680	271,560	284,440	297,320	310,200	323,080	335,620	347,560	358,980
5	Capital	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
6	**Rate Base**											
7	Balance, beginning	526,939,885	543,879,113	559,416,485	573,552,001	586,285,661	597,617,464	607,547,411	616,075,502	623,201,737	628,962,929	633,425,104
8	+ Additions	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686
9	+ Working Capital Additions	311,696	311,696	311,696	311,696	311,696	311,696	311,696	311,696	303,468	288,948	276,364
10	- Depreciation	(25,428,154)	(26,830,010)	(28,231,866)	(29,633,723)	(31,035,579)	(32,437,435)	(33,839,291)	(35,241,148)	(36,597,962)	(37,882,460)	(39,109,652)
11	Balance, ending	543,879,113	559,416,485	573,552,001	586,285,661	597,617,464	607,547,411	616,075,502	623,201,737	628,962,929	633,425,104	636,647,502
12	Average Rate Base	535,409,499	551,647,799	566,484,243	579,918,831	591,951,562	602,582,438	611,811,457	619,638,620	626,082,333	631,194,016	635,036,303
13	**Revenue Requirement**											
14	Return on Rate Base	33,222,930	34,230,540	35,151,163	35,984,799	36,731,447	37,391,108	37,963,782	38,449,469	38,849,310	39,166,498	39,404,917
15	O&M	6,960,918	7,170,961	7,375,805	7,575,448	7,780,292	7,985,135	8,189,979	8,394,822	8,594,259	8,784,152	8,965,776
16	Municipal Taxes	-	-	-	-	-	-	-	-	-	-	-
17	Deprecation	25,428,154	26,830,010	28,231,866	29,633,723	31,035,579	32,437,435	33,839,291	35,241,148	36,597,962	37,882,460	39,109,652
18	Taxes	462,004	1,159,629	1,840,680	2,505,146	3,153,022	3,784,304	4,398,992	4,997,085	5,562,560	6,086,193	6,574,137
19	Revenue Requirement	66,074,006	69,391,141	72,599,514	75,699,115	78,700,339	81,597,982	84,392,044	87,082,523	89,604,091	91,919,303	94,054,482
20	**Revenue**											
21	Revenue per Tonne per Month	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20
22	Geothermal Revenue	67,639,968	71,380,320	75,120,672	78,861,024	82,601,376	86,341,728	90,082,080	93,822,432	97,464,048	100,931,424	104,247,792
23	**Sufficiency / (Deficiency)**	**1,565,962**	**1,989,179**	**2,521,158**	**3,161,909**	**3,901,037**	**4,743,746**	**5,690,036**	**6,739,909**	**7,859,957**	**9,012,121**	**10,193,310**

Geothermal
Revenue and Revenue Requirement

Line No.	Col. 1 Description	Col. 35 Year 34	Col. 36 Year 35	Col. 37 Year 36	Col. 38 Year 37	Col. 39 Year 38	Col. 40 Year 39	Col. 41 Year 40	Col. 42 Year 41	Col. 43 Year 42	Col. 44 Year 43	Col. 45 Year 44
1	Number of Customers	3,220	3,220	3,220	3,220	3,220	3,220	3,220				
2	Number of Cumulative Customers [50% Effective]	92,380	94,620	96,110	96,600	96,600	96,600	96,600	94,990	91,770	88,550	85,330
3	Number of Tonnes per Customer	4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes	369,520	378,480	384,440	386,400	386,400	386,400	386,400	379,960	367,080	354,200	341,320
5	Capital	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686				
6	**Rate Base**											
7	Balance, beginning	636,647,502	638,715,809	639,783,332	640,138,743	640,186,175	640,186,175	640,186,175	640,186,175	598,675,569	558,410,971	519,548,229
8	+ Additions	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	42,055,686	-	-	-	-
9	+ Working Capital Additions	255,068	216,832	144,232	47,432	0	0	0	(155,848)	(311,696)	(311,696)	(311,696)
10	- Depreciation	(40,242,447)	(41,204,995)	(41,844,507)	(42,055,686)	(42,055,686)	(42,055,686)	(42,055,686)	(41,354,758)	(39,952,902)	(38,551,046)	(37,149,190)
11	Balance, ending	638,715,809	639,783,332	640,138,743	640,186,175	640,186,175	640,186,175	640,186,175	598,675,569	558,410,971	519,548,229	482,087,343
12	Average Rate Base	637,681,655	639,249,570	639,961,037	640,162,459	640,186,175	640,186,175	640,186,175	619,430,872	578,543,270	538,979,600	500,817,786
13	**Revenue Requirement**											
14	Return on Rate Base	39,569,065	39,666,356	39,710,504	39,723,002	39,724,474	39,724,474	39,724,474	38,436,578	35,899,443	33,444,460	31,076,465
15	O&M	9,133,404	9,275,904	9,370,692	9,401,864	9,401,864	9,401,864	9,401,864	6,430,271	6,209,327	6,004,484	5,799,640
16	Municipal Taxes	-	-	-	-	-	-	-	-	-	-	-
17	Deprecation	40,242,447	41,204,995	41,844,507	42,055,686	42,055,686	42,055,686	42,055,686	41,354,758	39,952,902	38,551,046	37,149,190
18	Taxes	7,013,877	7,379,480	7,618,475	7,696,999	7,697,280	7,697,280	7,697,280	10,959,983	15,612,199	17,459,240	17,912,453
19	Revenue Requirement	95,958,793	97,526,735	98,544,178	98,877,551	98,879,304	98,879,304	98,879,304	97,181,589	97,673,871	95,459,230	91,937,748
20	**Revenue**											
21	Revenue per Tonne per Month	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20
22	Geothermal Revenue	107,308,608	109,910,592	111,641,376	112,210,560	112,210,560	112,210,560	112,210,560	110,340,384	106,600,032	102,859,680	99,119,328
23	**Sufficiency / (Deficiency)**	**11,349,815**	**12,383,857**	**13,097,198**	**13,333,009**	**13,331,256**	**13,331,256**	**13,331,256**	**13,158,795**	**8,926,161**	**7,400,450**	**7,181,580**

Geothermal
Revenue and Revenue Requirement

Line No.		Col. 1 Description	Col. 46 Year 45	Col. 47 Year 46	Col. 48 Year 47	Col. 49 Year 48	Col. 50 Year 49	Col. 51 Year 50	Col. 52 Year 51	Col. 53 Year 52	Col. 54 Year 53	Col. 55 Year 54	Col. 56 Year 55	Col. 57 Year 56
1		Number of Customers												
2		Number of Cumulative Customers [50% Effective]	82,110	78,890	75,670	72,450	69,230	66,010	62,790	59,570	56,350	53,130	49,910	46,690
3		Number of Tonnes per Customer	4	4	4	4	4	4	4	4	4	4	4	4
4		Total Number of Tonnes	328,440	315,560	302,680	289,800	276,920	264,040	251,160	238,280	225,400	212,520	199,640	186,760
5		Capital												
6		**Rate Base**												
7		Balance, beginning	482,087,343	446,028,314	411,371,141	378,115,824	346,262,363	315,810,759	286,761,010	259,113,118	232,867,082	208,022,902	184,580,579	162,540,112
8	+	Additions	-	-	-	-	-	-	-	-	-	-	-	-
9	+	Working Capital Additions	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)
10	-	Depreciation	(35,747,333)	(34,345,477)	(32,943,621)	(31,541,765)	(30,139,909)	(28,738,052)	(27,336,196)	(25,934,340)	(24,532,484)	(23,130,627)	(21,728,771)	(20,326,915)
11		Balance, ending	446,028,314	411,371,141	378,115,824	346,262,363	315,810,759	286,761,010	259,113,118	232,867,082	208,022,902	184,580,579	162,540,112	141,901,501
12		Average Rate Base	464,057,829	428,699,727	394,743,482	362,189,093	331,036,561	301,285,884	272,937,064	245,990,100	220,444,992	196,301,741	173,560,345	152,220,806
13		**Revenue Requirement**												
14		Return on Rate Base	28,795,457	26,601,435	24,494,402	22,474,355	20,541,295	18,695,223	16,936,138	15,264,040	13,678,929	12,180,806	10,769,669	9,445,520
15		O&M	5,594,797	5,389,953	5,185,110	4,980,266	4,775,423	4,570,579	4,365,736	4,160,892	3,956,049	3,751,205	3,546,362	3,341,518
16		Municipal Taxes	-	-	-	-	-	-	-	-	-	-	-	-
17		Deprecation	35,747,333	34,345,477	32,943,621	31,541,765	30,139,909	28,738,052	27,336,196	25,934,340	24,532,484	23,130,627	21,728,771	20,326,915
18		Taxes	17,677,050	17,105,637	16,374,516	15,571,840	14,741,684	13,906,086	13,076,065	12,257,131	11,452,038	10,662,163	9,888,196	9,130,480
19		Revenue Requirement	87,814,637	83,442,502	78,997,648	74,568,226	70,198,311	65,909,941	61,714,135	57,616,403	53,619,499	49,724,801	45,932,998	42,244,433
20		**Revenue**												
21		Revenue per Tonne per Month	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20
22		Geothermal Revenue	95,378,976	91,638,624	87,898,272	84,157,920	80,417,568	76,677,216	72,936,864	69,196,512	65,456,160	61,715,808	57,975,456	54,235,104
23		**Sufficiency / (Deficiency)**	**7,564,339**	**8,196,122**	**8,900,624**	**9,589,694**	**10,219,257**	**10,767,275**	**11,222,729**	**11,580,109**	**11,836,661**	**11,991,007**	**12,042,458**	**11,990,671**

Geothermal
Revenue and Revenue Requirement

Line No.	Description	Col. 1	Col. 58 Year 57	Col. 59 Year 58	Col. 60 Year 59	Col. 61 Year 60	Col. 62 Year 61	Col. 63 Year 62	Col. 64 Year 63	Col. 65 Year 64	Col. 66 Year 65	Col. 67 Year 66	Col. 68 Year 67	Col. 69 Year 68	Col. 70 Year 69
1	Number of Customers														
2	Number of Cumulative Customers [50% Effective]		43,470	40,250	37,030	33,810	30,590	27,370	24,150	20,930	17,710	14,490	11,270	8,050	4,830
3	Number of Tonnes per Customer		4	4	4	4	4	4	4	4	4	4	4	4	4
4	Total Number of Tonnes		173,880	161,000	148,120	135,240	122,360	109,480	96,600	83,720	70,840	57,960	45,080	32,200	19,320
5	Capital														
6	**Rate Base**														
7	Balance, beginning		141,901,501	122,664,746	104,829,847	88,396,805	73,365,619	59,736,289	47,508,815	36,683,197	27,259,436	19,237,531	12,617,482	7,399,289	3,582,952
8	+ Additions		-	-	-	-	-	-	-	-	-	-	-	-	-
9	+ Working Capital Additions		(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)	(311,696)
10	- Depreciation		(18,925,059)	(17,523,203)	(16,121,346)	(14,719,490)	(13,317,634)	(11,915,778)	(10,513,922)	(9,112,065)	(7,710,209)	(6,308,353)	(4,906,497)	(3,504,641)	(2,102,784)
11	Balance, ending		122,664,746	104,829,847	88,396,805	73,365,619	59,736,289	47,508,815	36,683,197	27,259,436	19,237,531	12,617,482	7,399,289	3,582,952	1,168,472
12	Average Rate Base		132,283,123	113,747,297	96,613,326	80,881,212	66,550,954	53,622,552	42,096,006	31,971,316	23,248,483	15,927,506	10,008,385	5,491,121	2,375,712
13	**Revenue Requirement**														
14	Return on Rate Base		8,208,358	7,058,184	5,994,996	5,018,796	4,129,583	3,327,357	2,612,118	1,983,866	1,442,602	988,325	621,035	340,732	147,416
15	O&M		3,136,674	2,931,831	2,726,987	2,522,144	2,317,300	2,115,057	1,912,813	1,710,570	1,508,326	1,306,083	1,103,839	901,596	699,352
16	Municipal Taxes		-	-	-	-	-	-	-	-	-	-	-	-	-
17	Deprecation		18,925,059	17,523,203	16,121,346	14,719,490	13,317,634	11,915,778	10,513,922	9,112,065	7,710,209	6,308,353	4,906,497	3,504,641	2,102,784
18	Taxes		8,389,188	7,664,405	6,956,176	6,264,521	5,589,451	4,930,972	4,289,086	3,663,795	3,055,099	2,462,998	1,887,494	1,328,585	786,272
19	Revenue Requirement		38,659,279	35,177,623	31,799,506	28,524,951	25,353,968	22,289,163	19,327,939	16,470,296	13,716,236	11,065,759	8,518,864	6,075,553	3,735,825
20	**Revenue**														
21	Revenue per Tonne per Month		$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20	$ 24.20
22	Geothermal Revenue		50,494,752	46,754,400	43,014,048	39,273,696	35,533,344	31,792,992	28,052,640	24,312,288	20,571,936	16,831,584	13,091,232	9,350,880	5,610,528
23	**Sufficiency / (Deficiency)**		**11,835,473**	**11,576,777**	**11,214,542**	**10,748,745**	**10,179,376**	**9,503,829**	**8,724,701**	**7,841,992**	**6,855,700**	**5,765,825**	**4,572,368**	**3,275,327**	**1,874,703**

Geothermal
Revenue and Revenue Requirement

		Col. 1	Col. 71
Line No.		Description	Year 70
1		Number of Customers	
2		Number of Cumulative Customers [50% Effective]	1,610
3		Number of Tonnes per Customer	4
4		Total Number of Tonnes	6,440
5		Capital	
6		**Rate Base**	
7		Balance, beginning	1,168,472
8	+	Additions	-
9	+	Working Capital Additions	(311,696)
10	-	Depreciation	(700,928)
11		Balance, ending	155,848
12		Average Rate Base	662,160
13		**Revenue Requirement**	
14		Return on Rate Base	41,088
15		O&M	311,465
16		Municipal Taxes	-
17		Deprecation	700,928
18		Taxes	260,555
19		Revenue Requirement	1,314,036
20		**Revenue**	
21		Revenue per Tonne per Month	$ 24.20
22		Geothermal Revenue	1,870,176
23		**Sufficiency / (Deficiency)**	**556,140**

OGA INTERROGATORY #12

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Preamble:

Enbridge has calculated a service fee of $25.20 per tonne based on a 10 year customer forecast. However, geothermal loops have easily a 50+ lifetime.

Furthermore, the final report of the Board in EBO 188 states that: "A maximum 10 year forecast horizon will be utilized. For customer attachment periods of greater than 10 years an explanation of the extension of the period will be provided to the Board." See section 3.2.1.

Interrogatory:

Please:

(a) Explain why a longer term such as 40 years wasn't used (which would result in lower than otherwise available monthly rates); and
(b) Discuss the pros and cons of using a period longer than 10 years.

RESPONSE

a) The standard approach from EBO 188 is appropriate. Given the relatively new nature of this market and other competing technologies, the Company does not feel it is appropriate to use a customer additions forecast period longer than 10 years.

b) Pro: Would contribute to slightly lower rates and make the offering more attractive
Con: Higher risk of recovery of deficiencies from early years
Forecasting inaccuracy

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #13

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 28 & Appendix 11

Preamble:

Enbridge references:

(a) A service fee of $25.20 per tonne in 2018 in Ex B-1-1, p. 28; and
(b) A revenue per tonne per month of $25.30 in Ex B-1-1, Attachment 4, p. 1.

Interrogatory:

Please reconcile these figures.

RESPONSE

The correct number is $25.07. The $25.20 was an error. Please refer to Enbridge's cover letter in relation to the filing of interrogatory responses in this proceeding.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #14

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Appendix 11

Please provide an electronic excel copy of Appendix 11.

RESPONSE

Please see the response to SEC Interrogatory #24 filed at Exhibit I.2.EGDI.SEC.24.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #15

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27 & Appendix 11

Please provide documentation justifying and explaining Enbridge's estimated capital costs for the installation of the geothermal loops. Please produce an explanation and attach any pre-existing cost estimate documentation in Enbridge's possession.

RESPONSE

Please see response to Board Staff Interrogatory #14 filed at Exhibit I.2.EGDI.STAFF.14.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #16

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27 & Appendix 11

Please provide documentation justifying and explaining Enbridge's estimated costs for operating and maintaining the geothermal loops. Please produce an explanation and attach any pre-existing cost estimate documentation in Enbridge's possession.

RESPONSE

Please see the response to Board Staff Interrogatory #14 filed at Exhibit I.2.EGDI.STAFF.14.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #17

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27

Preamble:

In EB-2016-0004, the OGA submitted a report and interrogatory responses regarding the cost of installing geothermal loops.

Interrogatory:

Please compare Enbridge's estimated capital and O&M costs for the installation and maintenance of geothermal loops with the OGA's evidence and interrogatory responses in EB-2016-0004.

RESPONSE

The above referenced OGA evidence alluded to vertical loop tonne costs of $2,000 to $3,000 and on average $2,500. As discussed in the response to Board Staff Interrogatory #14 filed at Exhibit I.2.EGDI.STAFF.14, Enbridge's current information (which includes information from discussions with the OGA) is that the likely range of costs in 2018 will be between $2,500 to $4,500 per tonne, depending on geography. Enbridge has used $3,000 per tonne as a baseline to determine fees. The Company has assumed (based on geography and likely customer base in new residential developments) that the high majority of installations will be vertical and not horizontal loops. Hence horizontal loops have not been considered.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #18

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Preamble:

In EB-2016-0004, the OGA submitted a report and interrogatory responses regarding the cost of geothermal. This evidence discussed how the costs of geothermal energy would decline with economies of scale and technological improvements.

Interrogatory:

Please:

(a) Discuss whether the Enbridge has assumed that the estimated capital costs will decline over time based on economies of scale and technological improvements;
(b) If not, please put forward Enbridge's best estimates for the reduction in capital costs due to economies of scale and technological improvements.

RESPONSE

a) The approach set out in EBO 188 requires the use of current capital and O&M costs and current customer service fees. The service fee setting process the Company is proposing will allow for service fees to be adjusted in future years in the event the capital and O&M costs decline.

b) All things being equal, the Company expects that the cost of installations will decline over time, assuming growth in the market. Enbridge has not estimated the magnitude or amount of any future changes in capital costs at this time.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #19

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Preamble:

In EB-2016-0004, the OGA submitted a report and interrogatory responses regarding the cost of geothermal. This evidence discussed how the costs of geothermal energy would decline with economies of scale and technological improvements.

Interrogatory:

Please:

(a) Discuss whether the Enbridge has assumed that the estimated O&M costs will decline over time based on economies of scale and technological improvements;
(b) If not, please put forward Enbridge's best estimates for the reduction in O&M costs due to economies of scale and technological improvements.

RESPONSE

a) and b) Please see the response to OGA Interrogatory #18 filed at Exhibit I.1.EGDI.OGA.18. The responses in respect of capital costs also generally apply in relation to O&M costs, though it is less foreseeable that O&M costs could decline over time.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #20

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Preamble:

In EB-2016-0004, the OGA submitted a report and interrogatory responses regarding the cost of geothermal. This evidence discussed how the costs of geothermal energy would decline with economies of scale and technological improvements.

Interrogatory:

Please:

(a) Discuss whether the Enbridge has assumed an increase in customer uptake (i.e. customer attachments) as the cost of heat pumps and other geothermal system equipment declines with economies of scale and technological improvements;
(b) If not, please put forward Enbridge's best estimates for an increase in customer uptake (i.e. customer attachments) as the cost of heat pumps and other geothermal system equipment declines with economies of scale and technological improvements.

RESPONSE

a) Enbridge has presented its 10 year customer additions estimate which is filed in response to Board Staff Interrogatory #13 filed at Exhibit I.2.EGDI.STAFF.13. This assumes the GreenON rebate program to start the market and also assumes that heat pump prices will decline as adoption grows.

b) The Company has had discussions with OGA members, a lot of whom are heat pump suppliers and currently there are no quantitative estimates of the reduction of heat pump prices.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #21

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 23

Please list and explain the benefits of Enbridge undertaking its proposed geothermal project as a regulated vs. unregulated business.

RESPONSE

A regulated model accelerates adoption of innovation and new technologies. A regulated model has proven over time to achieve high adoption, e.g., natural gas has had near universal adoption since regulation was first introduced. With Federal and Provincial policy driving towards a lower carbon economy, it is imperative that the same sound, transparent framework be used for the market transformation and faster adoption for new lower carbon technologies like Geothermal. The response to Board Staff Interrogatory #2(a) filed at Exhibit I.1.EGDI.STAFF.2. also discusses the specific market barriers that the proposed model is designed to overcome.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #22

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

If Enbridge were to provide a similar geothermal offering to customers as part of its unregulated business (e.g. via an affiliate), would it need to charge higher rates to customers? If yes, please estimate those higher rates and explain the reasons why.

RESPONSE

An unregulated offering is a different business model that may require different service fees and terms.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #23

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

If Enbridge were to provide a similar geothermal offering to customers as part of its unregulated business (e.g. via an affiliate), would the financing costs for the high upfront capital costs be higher? If yes, please estimate the difference.

RESPONSE

The rate of return that the Company or affiliate would be seeking from an unregulated offering depends on the nature of the contracts, the terms, the type of customers (retrofit vs new) and various other factors.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #24

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

If Enbridge were to provide a similar geothermal offering to customers as part of its unregulated business (e.g. via an affiliate), would there be any mechanism to capture avoided carbon costs and incorporate them into lower charges for customers?

RESPONSE

No.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

OGA INTERROGATORY #25

INTERROGATORY

Issue 1.2 - Should the new business activity – Geothermal Energy Service Program – be considered as part of the utility's regulated business?[1]

Reference: Ex. B, Tab 1, Schedule 1, p. 27-30 & Appendix 11

Please recalculate the table in response to OGA interrogatory #4 based on the longer customer attachment forecast provided in OGA interrogatory #10. Please also recalculate the response to OGA interrogatory #5 based on these revised assumptions.

RESPONSE

Please see Attachment 1 to this response.

[1] Note that these interrogatories also relate to issue 2.3 - Are the services fees for the Geothermal Energy Service Program reasonable and appropriate?

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program - 40 Year Customer Additions

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14
Retrofit customers														
Conversions(#)	80	120	160	200	320	440	520	520	520	520	520	520	520	520
Cumulative number of customers (#)	80	200	360	560	880	1,320	1,840	2,360	2,880	3,400	3,920	4,440	4,960	5,480
Cumulative number of customers (#) [50% effective]	40	140	280	460	720	1,100	1,580	2,100	2,620	3,140	3,660	4,180	4,700	5,220
Forecast annual NG savings (m^3) [(1)]	96,000	336,000	672,000	1,104,000	1,728,000	2,640,000	3,792,000	5,040,000	6,288,000	7,536,000	8,784,000	10,032,000	11,280,000	12,528,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	180	630	1,260	2,070	3,239	4,949	7,109	9,448	11,788	14,127	16,467	18,806	21,146	23,485
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 17.00	$ 18.00	$ 18.00	$ 19.00	$ 20.00	$ 21.00	$ 31.00	$ 36.00	$ 43.00	$ 50.00	$ 57.00	$ 60.88	$ 65.02	$ 69.44
Value of GHG reduction ($, nominal)	$ 3,059	$ 11,338	$ 22,675	$ 39,322	$ 64,787	$ 103,929	$ 220,366	$ 340,132	$ 506,869	$ 706,359	$ 938,603	$ 1,144,850	$ 1,374,806	$ 1,630,742
Value of GHG reduction ($, NPV)	$ 31,647,135													
New Construction														
New Construction (#)	90	180	270	540	900	1,800	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Cumulative number of customers (#)	90	270	540	1,080	1,980	3,780	6,480	9,180	11,880	14,580	17,280	19,980	22,680	25,380
Cumulative number of customers (#) [50% effective]	45	180	405	810	1,530	2,880	5,130	7,830	10,530	13,230	15,930	18,630	21,330	24,030
Forecast annual NG savings (m^3) [(1)]	99,000	396,000	891,000	1,782,000	3,366,000	6,336,000	11,286,000	17,226,000	23,166,000	29,106,000	35,046,000	40,986,000	46,926,000	52,866,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	186	742	1,670	3,341	6,310	11,878	21,157	32,292	43,428	54,563	65,698	76,833	87,969	99,104
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 17.00	$ 18.00	$ 18.00	$ 19.00	$ 20.00	$ 21.00	$ 31.00	$ 36.00	$ 43.00	$ 50.00	$ 57.00	$ 60.88	$ 65.02	$ 69.44
Value of GHG reduction ($, nominal)	$ 3,155	$ 13,362	$ 30,065	$ 63,471	$ 126,200	$ 249,430	$ 655,868	$ 1,162,524	$ 1,867,387	$ 2,728,145	$ 3,744,796	$ 4,677,314	$ 5,719,338	$ 6,881,450
Value of GHG reduction ($, NPV)	$ 142,041,834													
Totals														
Forecast annual NG savings (m^3)	195,000	732,000	1,563,000	2,886,000	5,094,000	8,976,000	15,078,000	22,266,000	29,454,000	36,642,000	43,830,000	51,018,000	58,206,000	65,394,000
Forecast annual GHG reduction from NG (t CO_2e)	366	1,372	2,930	5,410	9,549	16,827	28,266	41,740	55,215	68,690	82,165	95,640	109,115	122,589
Value of GHG reduction ($, nominal)	$ 6,214	$ 24,700	$ 52,741	$ 102,793	$ 190,987	$ 353,360	$ 876,234	$ 1,502,656	$ 2,374,256	$ 3,434,504	$ 4,683,399	$ 5,822,164	$ 7,094,144	$ 8,512,191
Value of GHG reduction ($, NPV)	$ 173,688,969													

1. Avoided natural gas volume for conversion of existing customers is 2,400 m^3/yr and of new construction is 2,200 m^3/yr.
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic meter of gas.
3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbon Price (Real 2017 CAD) per the "Long Term Carbon Price Forecast Report" (ICF, 2017).
4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 2017 CAD) esclated using the Minimum LTCPF methodology per the "Long Term Carbon Price Forecast Report" (ICF, 2017) of 5% annual growth
5. For 2034 and beyond, asssumes the carbon price is constant.

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program - 40 Year Customer Additions

	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27
Retrofit customers													
Conversions(#)	520	520	520	520	520	520	520	520	520	520	520	520	520
Cumulative number of customers (#)	6,000	6,520	7,040	7,560	8,080	8,600	9,120	9,640	10,160	10,680	11,200	11,720	12,240
Cumulative number of customers (#) [50% effective]	5,740	6,260	6,780	7,300	7,820	8,340	8,860	9,380	9,900	10,420	10,940	11,460	11,980
Forecast annual NG savings (m^3) [(1)]	13,776,000	15,024,000	16,272,000	17,520,000	18,768,000	20,016,000	21,264,000	22,512,000	23,760,000	25,008,000	26,256,000	27,504,000	28,752,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	25,825	28,164	30,504	32,843	35,183	37,523	39,862	42,202	44,541	46,881	49,220	51,560	53,899
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 74.16	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 1,915,128	$ 2,230,651	$ 2,415,944	$ 2,601,238	$ 2,786,532	$ 2,971,825	$ 3,157,119	$ 3,342,413	$ 3,527,706	$ 3,713,000	$ 3,898,294	$ 4,083,587	$ 4,268,881
Value of GHG reduction ($, NPV)													
New Construction													
New Construction (#)	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Cumulative number of customers (#)	28,080	30,780	33,480	36,180	38,880	41,580	44,280	46,980	49,680	52,380	55,080	57,780	60,480
Cumulative number of customers (#) [50% effective]	26,730	29,430	32,130	34,830	37,530	40,230	42,930	45,630	48,330	51,030	53,730	56,430	59,130
Forecast annual NG savings (m^3) [(1)]	58,806,000	64,746,000	70,686,000	76,626,000	82,566,000	88,506,000	94,446,000	100,386,000	106,326,000	112,266,000	118,206,000	124,146,000	130,086,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	110,239	121,375	132,510	143,645	154,780	165,916	177,051	188,186	199,322	210,457	221,592	232,727	243,863
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 74.16	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 8,175,162	$ 9,613,000	$ 10,494,926	$ 11,376,853	$ 12,258,779	$ 13,140,706	$ 14,022,633	$ 14,904,559	$ 15,786,486	$ 16,668,412	$ 17,550,339	$ 18,432,266	$ 19,314,192
Value of GHG reduction ($, NPV)													
Totals													
Forecast annual NG savings (m^3)	72,582,000	79,770,000	86,958,000	94,146,000	101,334,000	108,522,000	115,710,000	122,898,000	130,086,000	137,274,000	144,462,000	151,650,000	158,838,000
Forecast annual GHG reduction from NG (t CO_2e)	136,064	149,539	163,014	176,489	189,963	203,438	216,913	230,388	243,863	257,338	270,812	284,287	297,762
Value of GHG reduction ($, nominal)	$ 10,090,290	$ 11,843,650	$ 12,910,871	$ 13,978,091	$ 15,045,311	$ 16,112,531	$ 17,179,752	$ 18,246,972	$ 19,314,192	$ 20,381,412	$ 21,448,633	$ 22,515,853	$ 23,583,073
Value of GHG reduction ($, NPV)													

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbo
4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 20
5. For 2034 and beyond, asssumes the carbon price is cons

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program - 40 Year Customer Additions

	Year 28	Year 29	Year 30	Year 31	Year 32	Year 33	Year 34	Year 35	Year 36	Year 37	Year 38	Year 39	Year 40
Retrofit customers													
Conversions(#)	520	520	520	520	520	520	520	520	520	520	520	520	520
Cumulative number of customers (#)	12,760	13,280	13,800	14,240	14,640	15,000	15,320	15,520	15,600	15,600	15,600	15,600	15,600
Cumulative number of customers (#) [50% effective]	12,500	13,020	13,540	14,020	14,440	14,820	15,160	15,420	15,560	15,600	15,600	15,600	15,600
Forecast annual NG savings (m^3) [(1)]	30,000,000	31,248,000	32,496,000	33,648,000	34,656,000	35,568,000	36,384,000	37,008,000	37,344,000	37,440,000	37,440,000	37,440,000	37,440,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	56,239	58,578	60,918	63,077	64,967	66,677	68,206	69,376	70,006	70,186	70,186	70,186	70,186
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 4,454,175	$ 4,639,468	$ 4,824,762	$ 4,995,802	$ 5,145,463	$ 5,280,869	$ 5,402,023	$ 5,494,670	$ 5,544,557	$ 5,558,810	$ 5,558,810	$ 5,558,810	$ 5,558,810
Value of GHG reduction ($, NPV)													
New Construction													
New Construction (#)	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700	2,700
Cumulative number of customers (#)	63,180	65,880	68,580	71,190	73,710	76,140	78,300	80,100	81,000	81,000	81,000	81,000	81,000
Cumulative number of customers (#) [50% effective]	61,830	64,530	67,230	69,885	72,450	74,925	77,220	79,200	80,550	81,000	81,000	81,000	81,000
Forecast annual NG savings (m^3) [(1)]	136,026,000	141,966,000	147,906,000	153,747,000	159,390,000	164,835,000	169,884,000	174,240,000	177,210,000	178,200,000	178,200,000	178,200,000	178,200,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	254,998	266,133	277,269	288,218	298,797	309,004	318,469	326,635	332,203	334,059	334,059	334,059	334,059
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 20,196,119	$ 21,078,045	$ 21,959,972	$ 22,827,200	$ 23,665,030	$ 24,473,463	$ 25,223,100	$ 25,869,846	$ 26,310,810	$ 26,457,797	$ 26,457,797	$ 26,457,797	$ 26,457,797
Value of GHG reduction ($, NPV)													
Totals													
Forecast annual NG savings (m^3)	166,026,000	173,214,000	180,402,000	187,395,000	194,046,000	200,403,000	206,268,000	211,248,000	214,554,000	215,640,000	215,640,000	215,640,000	215,640,000
Forecast annual GHG reduction from NG (t CO_2e)	311,237	324,712	338,186	351,296	363,764	375,681	386,676	396,011	402,209	404,245	404,245	404,245	404,245
Value of GHG reduction ($, nominal)	$ 24,650,293	$ 25,717,514	$ 26,784,734	$ 27,823,002	$ 28,810,492	$ 29,754,332	$ 30,625,123	$ 31,364,516	$ 31,855,366	$ 32,016,607	$ 32,016,607	$ 32,016,607	$ 32,016,607
Value of GHG reduction ($, NPV)													

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbo
4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 20
5. For 2034 and beyond, asssumes the carbon price is cons

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program - 40 Year Customer Additions

	Year 41	Year 42	Year 43	Year 44	Year 45	Year 46	Year 47	Year 48	Year 49	Year 50	Year 51	Year 52	Year 53
Retrofit customers													
Conversions(#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	15,080	14,560	14,040	13,520	13,000	12,480	11,960	11,440	10,920	10,400	9,880	9,360	8,840
Cumulative number of customers (#) [50% effective]	15,340	14,820	14,300	13,780	13,260	12,740	12,220	11,700	11,180	10,660	10,140	9,620	9,100
Forecast annual NG savings (m^3) [(1)]	36,816,000	35,568,000	34,320,000	33,072,000	31,824,000	30,576,000	29,328,000	28,080,000	26,832,000	25,584,000	24,336,000	23,088,000	21,840,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	69,016	66,677	64,337	61,998	59,658	57,319	54,979	52,640	50,300	47,960	45,621	43,281	40,942
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 5,466,163	$ 5,280,869	$ 5,095,576	$ 4,910,282	$ 4,724,988	$ 4,539,695	$ 4,354,401	$ 4,169,107	$ 3,983,814	$ 3,798,520	$ 3,613,226	$ 3,427,933	$ 3,242,639
Value of GHG reduction ($, NPV)													
New Construction													
New Construction (#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	78,300	75,600	72,900	70,200	67,500	64,800	62,100	59,400	56,700	54,000	51,300	48,600	45,900
Cumulative number of customers (#) [50% effective]	79,650	76,950	74,250	71,550	68,850	66,150	63,450	60,750	58,050	55,350	52,650	49,950	47,250
Forecast annual NG savings (m^3) [(1)]	175,230,000	169,290,000	163,350,000	157,410,000	151,470,000	145,530,000	139,590,000	133,650,000	127,710,000	121,770,000	115,830,000	109,890,000	103,950,000
Forecast annual GHG reduction from NG (t CO_2e)[(2)]	328,491	317,356	306,220	295,085	283,950	272,814	261,679	250,544	239,409	228,273	217,138	206,003	194,867
Forecast carbon price ($/tonne)[(3)(4)(5)]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 26,016,834	$ 25,134,908	$ 24,252,981	$ 23,371,054	$ 22,489,128	$ 21,607,201	$ 20,725,275	$ 19,843,348	$ 18,961,421	$ 18,079,495	$ 17,197,568	$ 16,315,642	$ 15,433,715
Value of GHG reduction ($, NPV)													
Totals													
Forecast annual NG savings (m^3)	212,046,000	204,858,000	197,670,000	190,482,000	183,294,000	176,106,000	168,918,000	161,730,000	154,542,000	147,354,000	140,166,000	132,978,000	125,790,000
Forecast annual GHG reduction from NG (t CO_2e)	397,507	384,032	370,558	357,083	343,608	330,133	316,658	303,183	289,709	276,234	262,759	249,284	235,809
Value of GHG reduction ($, nominal)	$ 31,482,997	$ 30,415,777	$ 29,348,557	$ 28,281,337	$ 27,214,116	$ 26,146,896	$ 25,079,676	$ 24,012,456	$ 22,945,235	$ 21,878,015	$ 20,810,795	$ 19,743,575	$ 18,676,354
Value of GHG reduction ($, NPV)													

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbo
4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 20
5. For 2034 and beyond, asssumes the carbon price is cons

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program - 40 Year Customer Additions

	Year 54	Year 55	Year 56	Year 57	Year 58	Year 59	Year 60	Year 61	Year 62	Year 63	Year 64	Year 65	Year 66
Retrofit customers													
Conversions(#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	8,320	7,800	7,280	6,760	6,240	5,720	5,200	4,680	4,160	3,640	3,120	2,600	2,080
Cumulative number of customers (#) [50% effective]	8,580	8,060	7,540	7,020	6,500	5,980	5,460	4,940	4,420	3,900	3,380	2,860	2,340
Forecast annual NG savings (m^3) [1]	20,592,000	19,344,000	18,096,000	16,848,000	15,600,000	14,352,000	13,104,000	11,856,000	10,608,000	9,360,000	8,112,000	6,864,000	5,616,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	38,602	36,263	33,923	31,584	29,244	26,905	24,565	22,226	19,886	17,547	15,207	12,867	10,528
Forecast carbon price ($/tonne)[3][4][5]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 3,057,345	$ 2,872,052	$ 2,686,758	$ 2,501,464	$ 2,316,171	$ 2,130,877	$ 1,945,583	$ 1,760,290	$ 1,574,996	$ 1,389,702	$ 1,204,409	$ 1,019,115	$ 833,821
Value of GHG reduction ($, NPV)													
New Construction													
New Construction (#)	-	-	-	-	-	-	-	-	-	-	-	-	-
Cumulative number of customers (#)	43,200	40,500	37,800	35,100	32,400	29,700	27,000	24,300	21,600	18,900	16,200	13,500	10,800
Cumulative number of customers (#) [50% effective]	44,550	41,850	39,150	36,450	33,750	31,050	28,350	25,650	22,950	20,250	17,550	14,850	12,150
Forecast annual NG savings (m^3) [1]	98,010,000	92,070,000	86,130,000	80,190,000	74,250,000	68,310,000	62,370,000	56,430,000	50,490,000	44,550,000	38,610,000	32,670,000	26,730,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	183,732	172,597	161,462	150,326	139,191	128,056	116,920	105,785	94,650	83,515	72,379	61,244	50,109
Forecast carbon price ($/tonne)[3][4][5]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20	$ 79.20
Value of GHG reduction ($, nominal)	$ 14,551,789	$ 13,669,862	$ 12,787,935	$ 11,906,009	$ 11,024,082	$ 10,142,156	$ 9,260,229	$ 8,378,303	$ 7,496,376	$ 6,614,449	$ 5,732,523	$ 4,850,596	$ 3,968,670
Value of GHG reduction ($, NPV)													
Totals													
Forecast annual NG savings (m^3)	118,602,000	111,414,000	104,226,000	97,038,000	89,850,000	82,662,000	75,474,000	68,286,000	61,098,000	53,910,000	46,722,000	39,534,000	32,346,000
Forecast annual GHG reduction from NG (t CO_2e)	222,335	208,860	195,385	181,910	168,435	154,960	141,486	128,011	114,536	101,061	87,586	74,112	60,637
Value of GHG reduction ($, nominal)	$ 17,609,134	$ 16,541,914	$ 15,474,694	$ 14,407,473	$ 13,340,253	$ 12,273,033	$ 11,205,813	$ 10,138,592	$ 9,071,372	$ 8,004,152	$ 6,936,932	$ 5,869,711	$ 4,802,491
Value of GHG reduction ($, NPV)													

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbo
4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 20
5. For 2034 and beyond, asssumes the carbon price is cons

Value of Lifetime GHG Emissions Reductions from the Proposed Geothermal Program - 40 Year Customer Additions

	Year 67	Year 68	Year 69	Year 70	TOTAL
Retrofit customers					
Conversions(#)	-	-	-	-	-
Cumulative number of customers (#)	1,560	1,040	520	-	-
Cumulative number of customers (#) [50% effective]	1,820	1,300	780	260	
Forecast annual NG savings (m^3) [1]	4,368,000	3,120,000	1,872,000	624,000	1,368,000,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	8,188	5,849	3,509	1,170	2,564,490
Forecast carbon price ($/tonne)[3][4][5]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	-
Value of GHG reduction ($, nominal)	$ 648,528	$ 463,234	$ 277,940	$ 92,647	$ 199,419,335
Value of GHG reduction ($, NPV)					
New Construction					
New Construction (#)	-	-	-	-	-
Cumulative number of customers (#)	8,100	5,400	2,700	-	-
Cumulative number of customers (#) [50% effective]	9,450	6,750	4,050	1,350	
Forecast annual NG savings (m^3) [1]	20,790,000	14,850,000	8,910,000	2,970,000	6,308,280,000
Forecast annual GHG reduction from NG (t CO_2e)[2]	38,973	27,838	16,703	5,568	11,825,672
Forecast carbon price ($/tonne)[3][4][5]	$ 79.20	$ 79.20	$ 79.20	$ 79.20	-
Value of GHG reduction ($, nominal)	$ 3,086,743	$ 2,204,816	$ 1,322,890	$ 440,963	$ 923,962,553
Value of GHG reduction ($, NPV)					
Totals					
Forecast annual NG savings (m^3)	25,158,000	17,970,000	10,782,000	3,594,000	7,676,280,000
Forecast annual GHG reduction from NG (t CO_2e)	47,162	33,687	20,212	6,737	14,390,162
Value of GHG reduction ($, nominal)	$ 3,735,271	$ 2,668,051	$ 1,600,830	$ 533,610	$ 611,116,171
Value of GHG reduction ($, NPV)					

1. Avoided natural gas volume for conversion of existing cus
2. Assumes a conversion rate of 1.875 kg of CO_2e per cubic
3. For 2018 - 2028, assumes the Mid-Range LTCPF Carbo
4. For 2029 - 2033, assumes LTCPF Carbon Price (Real 20
5. For 2034 and beyond, asssumes the carbon price is cons

OGVG INTERROGATORY #1

INTERROGATORY

REF: Exhibit B/Tab 1 Schedule 1 page 26

PREAMBLE:

Under Enbridge's Geothermal Energy Service program, the Company will install, own and maintain the geothermal loop component of new geothermal systems. Enbridge will charge the home or building owner a monthly service fee specific to the heating capacity of the ground source loop. The Program is initially targeted to single family homes (both new and retrofit). In the future, the Program may be expanded to multi-residential and commercial markets.

a) Please provide details as to why the program is currently only targeted to single family homes.

b) Assuming the program is approved in some form, please discuss the viability and cost effectiveness of expanding the program to include large, commercial, heat sensitive customers such as commercial greenhouse operators.

RESPONSE

a) The program is currently targeted at low density residential level to align with GreenON geothermal heat pump rebate programs. The Company believes the adoption of geothermal systems in the residential market will develop supply capability and drilling capacity.

b) In the event that Enbridge seeks to extend its Geothermal Energy Services offering to other market sectors it will seek approval from the Board to the extent required to establish new or different service fees to these types of customers. At this time the Company has not conducted a cost effectiveness analysis for commercial greenhouse operators.

SEC INTERROGATORY #1

INTERROGATORY

Issue 1.1

[B1-1-1, p.15]

Please provide a copy of the full business case for each of the RNG Enabling programs.

RESPONSE

The business case for the for each of the Company's proposed RNG Enabling programs is articulated in Exhibit B, Tab 1, Schedule 1, pages 16 through 20 with a numeric example showing the revenues, costs and returns for these programs in Appendices 5, 6, 7 and 8 at Exhibit B, Tab 1, Schedule 1, Appendices 5, 6, 7 and 8.

SEC INTERROGATORY #2

INTERROGATORY

Issue 1.1

[B-1-1, p.15]

With respect to the RNG Enabling Program:

a. Please confirm that part of Enbridge's gas supply mix is locally produced (Ontario) supply.
b. If confirmed, please explain how Enbridge injects the supply into its system, and how that differs from the proposed RNG Enabling Program – Injection service.
c. Please provide details regarding how Enbridge is compensated for this service.

RESPONSE

a. Not confirmed. Enbridge currently does not source any of its gas supply from local Ontario production.

b. Please see response to a) above.

c. Please see response to a) above.

SEC INTERROGATORY #3

INTERROGATORY

Issue 1.1

[B-1-1, p.15]

Please explain why Enbridge believes that the RNG Enabling Program should be a regulated activity.

Please explain what benefits and risks are borne by each of the following parties: i) existing natural gas customers, ii) RNG producers, and iii) Enbridge shareholders.

RESPONSE

Please see the Company's responses to Board Staff Interrogatory #1 filed at Exhibit I.1.EGDI.STAFF.1 and Energy Probe Interrogatory #2 filed at Exhibit I.1.EGDI.EP.2.

With respect to benefits and risks to be borne by existing natural gas customers, please see the Company's response to Board Staff Interrogatory #16 filed at Exhibit I.2.EGDI.STAFF.16. With respect to the risks to be borne by RNG producers please see the Company's response to Board Staff Interrogatory #9 filed at Exhibit I.2.EGDI.STAFF.9. Enbridge does not believe that its shareholders should bear any incremental risk from these abatement activities, given that the Board has determined that GHG abatement costs are incurred as part of the Utilities' role of providing distribution service similar to other delivery costs.

SEC INTERROGATORY #4

INTERROGATORY

Issue 1.1

[B-1-1, p.15]

Please provide copies of all memorandum, correspondence, presentations, meeting notes, and similar documents exchanged between Enbridge, MOE, MOECC, and GreenON, regarding the proposed RNG Enabling Program.

RESPONSE

Enbridge has not had any formal discussions or correspondence with the MOECC, MOE and GreenON specifically regarding the RNG enabling program, other than providing notification to the MOECC and MOE that this application had been filed.

SEC INTERROGATORY #5

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

Please provide a copy of the full business case for each of the Geothermal Energy Services Programs.

RESPONSE

The business case for the Company's proposed GES program is articulated in Exhibit B, Tab 1, Schedule 1, pages 22 through 30 with a numeric example showing the revenues, costs and returns for these programs in Appendices 11 and 12 at Exhibit B, Tab 1, Schedule 1.

SEC INTERROGATORY #6

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

Please provide all information or analysis that Enbridge has regarding the current and future market for geothermal energy systems in Ontario.

RESPONSE

Please see response to Board Staff Interrogatory #13 (b) filed at Exhibit I.2.EGDI.STAFF.13.

SEC INTERROGATORY #7

INTERROGATORY

Issue 1.2

[B-1-1, p.21]

Does the Enbridge believe geothermal systems are a mature technology? Please explain.

RESPONSE

Enbridge believes geothermal systems are a mature technology and if designed, sized and installed properly, they work very well. Enbridge also believes that Geothermal heating and cooling is one of the best, reliable, low carbon alternatives to natural gas heating in relation to other competing technologies.

SEC INTERROGATORY #8

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

Please provide copies of all memorandum, correspondence, presentations, meeting notes, and similar documents exchanged between Enbridge, MOE, MOECC, and GreenON, regarding the proposed Geothermal Energy Service Program.

RESPONSE

Enbridge has had discussions and meetings with MOE, MOECC and GreenON regarding the proposed GES program along with various other topics. The discussions pertaining to this proceeding were around the proposed model set out in the evidence to this proceeding. Attachment 1 to this response is a presentation that is indicative of the discussion with Government agencies about Enbridge's proposed Geothermal Energy Services program.

Enbridge Geothermal

MoECC - December 19th, 2016

ENBRIDGE®

Purpose

Help Province of Ontario with its GHG reduction goals

Climate Change Action Plan (CCAP)

- 15% reduction target by 2020
- 37% by 2030

Enbridge exist to help fuel people's quality of life

- We will deliver the energy our customers want and need
- The CCAP gives us business imperative to increase our focus on low carbon technologies like Geothermal

Utility Based Geothermal

A Strategic Partnership with the Geothermal Industry

- Our Model:
  - Reduces GGRA incentive requirement
  - Increases number of geothermal homes, with faster deployment
  - Built in electricity price hedge
  - Keeps customers “whole” relative to what it would cost to heat and cool their homes with natural gas
  - High GHG abatement at lower $/Tonne
  - Increased quality/standardization of a currently fragmented geothermal market
- Our Ask:
  - Government support to include geothermal activities in our OEB-regulated undertakings
  - Commitment that GGRA dollars will be made available for geothermal delivered through our proposed model

Market Strategy

Build scale through smart adoption

- Primary Market: Residential New Construction
  - Coordinate geothermal service delivery process with residential subdivision builders and developers and geothermal service providers operating in high growth areas
  - Target new residential market: 10% Year 1, increasing by 10% after
  - Help to enable Net Zero Ready homes

- Secondary Market
  - Small to mid-scale commercial new construction
  - Communities currently without natural gas service, where the provision of natural gas service is determined not to be economically feasible

- Market evolution
  - As market adoption and penetration increases, the cost of Geothermal systems will decrease which will reduce the need for subsidies over time

Business Models

Two different models are considered

- Two scenarios compared to the status quo (Natural Gas Heating, Water Heating & Electrical Central Air Conditioning)
  - **Fully Unregulated** – all system components installed and serviced by others
  - **Hybrid** - Loop in Utility Rate Base; Heat Pump, water Heater & Distribution system to be owned or rented by customer

- The Hybrid model;
  - is consistent with Provincial Government policy direction,
  - **will achieve greater GHG reduction for GGRA dollar spent**,
  - **maintain affordability for consumers**, and
  - will result in a larger number of geothermal system installations
  - **Geothermal Industry supports the hybrid model**

Stakeholder Views

Government and Geothermal Association support will be the key to success

- Customer:
  - Subsidy keeps the customer financially whole through the system lifecycle
  - Eliminates carbon emissions while keeping energy costs affordable

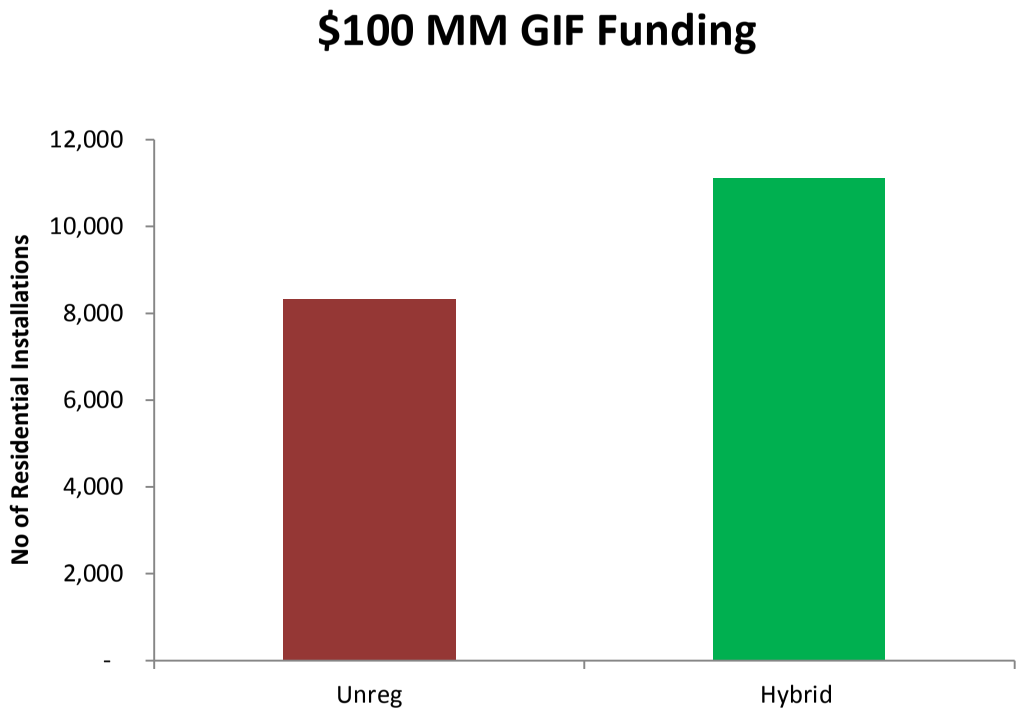
- Builder / Developer:
  - More economical path to low / no carbon development
  - Presents opportunity to position their developments as the green alternative

– Geothermal and HVAC Contractors:
  - Faster market acceptance and adoption
  - Opportunity to expand business beyond what the Unregulated Model can provide (more geothermal installations for any given amount of GGRA funding
  - Greater Ontario economic value compared to alternatives (more geothermal installations means more more local content)

Government View

Significant multi-year GHG reductions through one time funding to new home owners

- Reduces incentive per customer
- Increases number of geothermal homes
- Built in electricity price hedge
- High GHG abatement at lower $/Tonne
- Increased quality/standardization of a currently fragmented market
- Enbridge's brand and credibility will significantly reduce risk to builders and customers
- Enbridge outsourcing model for installation and maintenance of geothermal systems enables competition in the market for these services



Model Comparison & Factors for Success

	Fully Unregulated Model	Hybrid Model
Government subsidy to offset rate impact ($/Customer)	12,000	**9,000**
Rented/Customer Owned Equipment ($/Customer)	9,000	**4,500**
$/Tonne of Carbon abated	94	**70**
No of Customer with $100 MM subsidy	8,300	**11,100**

EGD Strengths	EGD Needs
Effective and efficient new construction delivery model	Government support to include geothermal activities in our OEB-regulated undertakings
Patient low cost capital structure	Commitment that GGRA dollars will be made available for geothermal delivered through our proposed model
Strong Brand and market reputation	Experience & partners in Geothermal industry (OGA support)
Existing relationships with developers and builders	Support in convincing developers that Geothermal is an attractive option

Next Steps

- Continue to define and develop partnership with Geothermal Industry
- Confirm assumptions and conduct market research
- Pilot project
- Seek Ministry Directive to Ontario Energy Board to allow us to include geothermal within regulated utility operations
  - Regulated cost base provides for oversight and regulated rates replace high upfront costs with regulated monthly payments over a long period of time
  - Leverages Enbridge's financial strength, customer base, marketing reach, supplier and industry relationships within a competitive procurement framework
  - Ability to offer lower and zero carbon solutions within regulation increases effectiveness of cap and trade funding and lowers carbon abatement costs

Appendix

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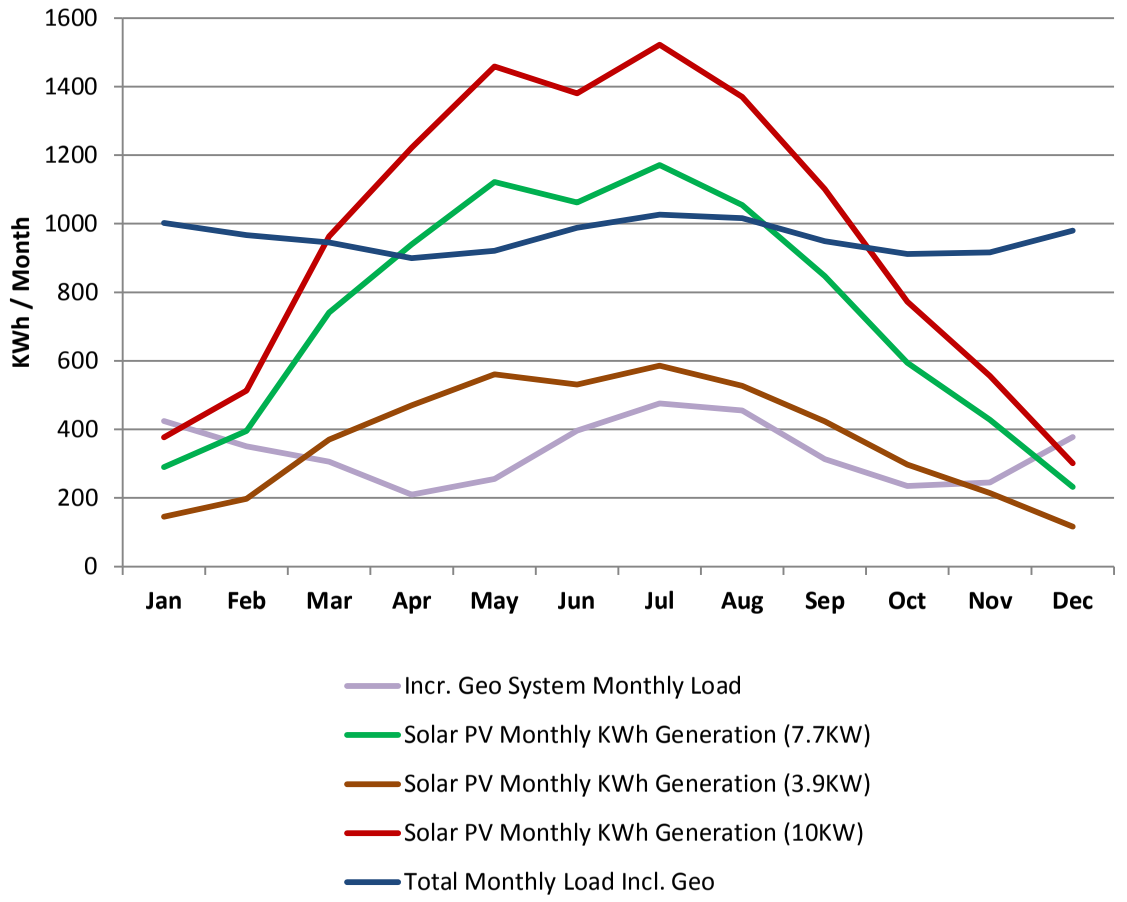
Analysis Summary

	Unreg Model	Hybrid Model	NG Heating and AC
Annual Heating/Cooling Cost	4,089	**3,748**	2,698
Capital Servicing	3,089	**2,748**	1,641
Electricity	1,000	**1,000**	318
Gas	-	**-**	739
Break even capital cost servicing with Gas	1,698	**1,698**	
CAPEX per customer (Year 1 - 20)	21,000	**21,000**	11,750
CAPEX per customer (Year 21 - 40)	13,500	**13,500**	10,000
Annual CO2 Emissions (Tonnes per year)	-	**-**	3.21
GGRA Funding per year	1,391	**1,050**	-
GGRA Capital Contribution	**12,000**	**9,000**	
$/Tonne GHG (For 40 Years)	94	**70**	-
No of customers ($100 MM GIF Funding)	8,333	**11,111**	-
Tonnes of CO2 abated per year	26,727	**35,636**	-

Combination with Solar

Offsetting incremental geo load

- Solar generation and geo system loads are not fully matched in winter
- Sizing Considerations
  - A solution is to oversize the solar system to meet peak
  - Or continue to use the grid as a battery
  - Three capacities considered: 3.9KW, 7.7 KW & 10KW
- 7.7kW solar system with battery:
  - Useful Life of System: 20 years
  - Cost: ~$35,000
  - Annual Electricity Bill Savings: ~$1,300
- Subsidy required for customer to break even in utility models:
  - Regulated = $22,000-23,000
  - Unregulated = $25,000-26,000
- This does not account for benefit of displaced electricity generation, transmission & distribution



Assumptions

Inputs and calculations:	Unreg Model	Hybrid Model	Full Reg Model	NG Heating and AC	Notes
Financial					
Regulated Equity Thickness		**36%**	36%	36%	
Unregulated Equity Thickness	40%	**40%**		40%	
Regulated ROE		**9.19%**	9.19%	9.19%	
Unregulated ROE	15.00%	**15.00%**	15.00%	15.00%	
Capital Costs ($)					
Loop	7,500	**7,500**	7,500		3 Tonne vertical u-loop under each residence, average cost 2,500 per tonne
Heat Pump	13,500	**13,500**	13,500		Circulation pump $1,000; 40 gallon tank $1,500, Heat pump $11,000
Furnace				5,500	Retail prices
Water Heater				1,500	Retail prices
AC				3,000	Retail prices
New service line				1,750	New residential
Fuel Cost per unit (Cents)					
Cost of Natural gas per m3	-	**-**	-	43.34	(includes 3.28 cents for Carbon Tax)
Cost of Electricity per KWH	16.88	**16.88**	16.88	16.88	2017 forecast
Fuel Usage					
Natural Gas (m3)	-	**-**	-	1,706	New construction furnace and hot water based on new building code
Electricity (KWH)	5,925	**5,925**	5,925	1,882	From EGD Technical Group
Fuel Cost ($)	1,000	**1,000**	1,000	1,057	

SEC INTERROGATORY #9

INTERROGATORY

Issue 1.2

[B1-1-1, p.26]

Enbridge states that it initially targeting single family homes with the Geothermal Energy Services program and in the future it may expand to multi-residential and commercial market.

a. Please clarify if Enbridge is only offering the program to single-family homes or that it is only targeting single-family homes. For example, will a school or other non-single family home property be eligible to participate in the program even if they are not targeted by Enbridge
b. If other classes of properties besides single family homes will be able to participate, will the proposed service fee and terms be any different. If so, please provide details.

RESPONSE

a) Please see response to Board Staff Interrogatory #12 (a) filed at Exhibit I.2.STAFF.EGDI.12. The primary market for the Geothermal Energy Services program is the low density residential market. The Company will consider geothermal energy services to commercial buildings, including schools.

b) Depending on the nature of the property, fees and terms may be different.

SEC INTERROGATORY #10

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

For each of the listed segments of the potential geothermal market, Please explain if Enbridge, i) will make its Geothermal Energy Services Program available ii) will target with its Geothermal Energy Services Program, and iii) expects uptake of its Geothermal Energy Services Program.

a. Homes, business or others who are Enbridge natural gas customers;
b. Homes, business or others who are currently eligible to be Enbridge natural gas customers;
c. Homes, business or others where Enbridge does not currently offer service but could be based on EBO 188;
d. H Homes, business or others where Enbridge does not currently offer service but reasonably could be based on the Board's Community Expansion Decision (EB-2016-0004);
e. Homes, business or others where Enbridge does not currently offer service and could not be based on EBO 188 or the Community Expansion Decision (EB-2016-0004);
f. Homes, business or others that are not within Enbridge's existing franchise territory;
g. Other

RESPONSE

a) to g) Please see table below.

	(i) GES Available?	(ii)Targeted GES?	(iii)Expected Uptake of GES?
Homes, business or others who are Enbridge natural gas customers	Yes	No	Low uptake
Homes, business or others who are currently eligible to be Enbridge natural gas customers	Yes	Yes	High uptake
Homes, business or others where Enbridge does not currently offer service but could be based on EBO 188	Yes	Yes	High uptake
Homes, business or others where Enbridge does not currently offer service but reasonably could be based on the Board's Community Expansion Decision (EB-2016-0004)	Yes	No	Low uptake
Homes, business or others where Enbridge does not currently offer service and could not be based on EBO 188 or the Community Expansion Decision (EB-2016-0004)	No	No	N/A
Homes, business or others that are not within Enbridge's existing franchise territory	No	No	N/A
Other	N/A	N/A	N/A

SEC INTERROGATORY #11

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

Does Enbridge currently believe that there is sufficient competition to protect the public interest in Ontario for the provision of geothermal energy systems? Please explain your response.

RESPONSE

Enbridge believes that the current level of adoption of geothermal systems in Ontario is much lower than it could be because of barriers facing the technology including poor historical experience and high costs. Enbridge's Geothermal Energy Service program aims to improve this situation, while achieving carbon abatement for its customers. Importantly, homeowners looking to install a geothermal system can choose whether to procure the entire system on their own, or to purchase their own heat pump system and obtain and pay for the geothermal loop through Enbridge's Geothermal Energy Service program.

SEC INTERROGATORY #12

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

Please provide the corresponding $/tonne CO2e avoided using the same methodology as that in the OEB's *Marginal Abatement Cost Curve for Assessment of Natural Gas Utilities' Cap and Trade Activities.* Please provide a breakdown of the calculation and any assumptions made.

RESPONSE

The Board's MACC study was based on a comprehensive Conservation Potential Study ("CPS") and ICF's proprietary models. Enbridge does not have access to the information or models used to develop the aforementioned study and therefore cannot provide a corresponding $/tonne CO2e not possible.

SEC INTERROGATORY #13

INTERROGATORY

Issue 1.2

[B1-1-1, p.21]

Please explain why Enbridge believes that the Geothermal Energy Service Program should be a regulated business and not undertaken on an unregulated basis.

RESPONSE

Please see response to Energy Probe Interrogatory #2 filed at Exhibit I.1.EGDI.EP.2.

SEC INTERROGATORY #14

INTERROGATORY

Issue 1.2

[B-1-1, p.21]

Does Enbridge have any plans for an unregulated part of its business, or that of any of its affiliates, to engage in the renewable natural gas or geothermal energy system business? If so, please provide details.

RESPONSE

The Company has explained the scope of its regulated Geothermal Energy Service program offering in the response to Board Staff Interrogatory #10 (a) filed at Exhibit I.2.EGDI.STAFF.10. Enbridge does plan to offer an unregulated Geothermal Energy Service program service to customers who are not potential gas distribution customers.

Enbridge entities may partner with other entities in Ontario to develop RNG producing facilities. This would be subject to compliance with any applicable rules, which may include the Affiliate Relationships Code.

SEC INTERROGATORY #15

INTERROGATORY

Issue 1.2

[B-1-1, p.15]

With respect to the Geothermal Energy Service Program:

a. Does the Enbridge consider the service fee a rate under the *OEB Act?*
b. What section of the *OEB Act* gives the Board the authority to set the service fee? Please explain your response in detail.
c. If the response to part (b) is pursuant to section 36, please explain how the service fee is for the "transmission, distribution and storage of gas."

RESPONSE

a) to c) Enbridge believes that the charge for the Geothermal Energy Service Program could be considered as a service fee similar to the service fees charged by Enbridge for other activities, such as the items subject to Riders G and H and amounts charged for open bill services. However, as set out in response to Energy Probe Interrogatory #2 filed at Exhibit I.1.EGDI.EP.2, Enbridge also believes that the Board has the ability to set rates for this service.