

# 2018 LCIF

# Customer Abatement Initiatives

[April 2018]

## 2018 CUSTOMER ABATEMENT INITIATIVES

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## Customer Abatement Initiative: Smart Metering Controls

### STAGE: 1 – CONCEPTUALIZE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Pilots to demonstrate the integration of hybrid heating (dual-fuel) appliance control that leverages new meter functionality to minimize carbon emissions.

#### BACKGROUND/EVOLUTION OF INITIATIVE:

Enbridge’s involvement with government testing labs, electrical utilities, government planning agencies and the Company’s participation in Ontario’s cap and trade regulatory environment have provided the insight that electrification of building space heating can have unintended consequences. Electrification of space heating makes energy affordability a challenge for homeowners, and it can have higher GHG emissions than direct use of natural gas at certain times (when taking into account source emissions). This has resulted in NRCan and other agencies such as the Advanced Energy Centre, identifying the need for hybrid heating (dual fuel appliances that integrate both electric heat pumps and direct natural gas). To further maximize the GHG savings, and homeowner affordability, next-generation controls technology is needed for hybrid heating.

#### RATIONALE/OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGES 23-24):

Hybrid heating systems hold the potential to reduce GHG emissions from home heating while preserving affordability and energy resiliency. To further increase the benefits, Enbridge has identified an opportunity to integrate smart metering platforms with the dispatch control of hybrid heating systems. The control would switch between electricity and gas input energy supplies in such a manner as to maximize GHG reductions while minimizing the utility bill impact.

The challenge is the HVAC industry today has limited ability to enable cloud-based / remote control of the homes appliances, and the industry has instead relied on smart thermostats that can be cloud-based. The smart thermostat industry however is not prioritized on developing the ability to optimize different appliances to manage competing priorities of GHG reductions and energy affordability. Today’s smart meter options include the ability to remotely gather and aggregate consumption data for improved customer management of their energy needs, but the smart gas meter also has a push-type communication/control capability (e.g. appliance switching and control). The expectation is that this same functionality (push-type communication/controls) could be leveraged to dispatch heating systems between electricity and natural gas input energy supplies. This initiative focuses on the development and testing of these control platforms.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	Early in TRL (Technology Readiness Level) – Requires investigation/development.
Support /Align with government targets/objectives – Potential to lower carbon emissions	Successful implementation is well-aligned with Outlook C and Outlook D in the Ontario Planning Outlook (IESO) and also the Fuels Technical Report (MOE). Potential to reduce carbon emissions.
Cost Effectiveness/ Cost to Customer and other initiatives	Current smart thermostat capabilities do not have intelligent dispatch which is needed to ensure homeowners have control capability to reduce their carbon footprint while preserving energy affordability.

Safety	No known issues at current time.
Market Size	Residential and Small Commercial space heating markets. In Ontario, the residential gas utility customer base is in excess of 3 million meters, and the potential exists to see hybrid-heating market penetration over the next 10-15 years.
Local Content	Conduct pilot in Ontario homes.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:** Residential/Small Commercial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$100,000
  - Technical consulting, research and due diligence \$50,000
  - Equipment, communication platforms, installation \$50,000
  - Number of pilot homes will vary depending on development costs

**ADDITIONAL WORKPLAN INPUTS:**

- Conduct pilot deployment to advance the due diligence, technical learning and identification of full operation needs before larger-scale deployments.
- Where possible, pilot will be deployed with other complementary activities (e.g. net-zero pilots) to help improve the data collection and the understanding of how different systems are integrated both physically and from a controls perspective.

**POSSIBLE GOVERNMENT FUNDING:**

- Could expand number/scale of pilots.
  - GreenON Challenge Fund: Potential to submit expression of interest (“EOI”)

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- N/A

## Customer Abatement Initiative: RNG Gasification

### STAGE: 1 – CONCEPTUALIZE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Research Projects to investigate biomass conversion to RNG through gasification.

#### BACKGROUND/EVOLUTION OF INITIATIVE:

Both the province’s Climate Change Action Plan and 2017 Long Term Energy Plan (“LTEP”) reference RNG as an important part of the province’s energy future. The LTEP expresses the provincial government’s desire to leverage existing infrastructure, including gas appliances currently used by consumers, while at the same time reducing GHG emissions. The RNG market in Ontario is nascent, and could be enhanced through the active participation of the province’s natural gas distribution utilities. This is particularly important given the expectation that a “clean fuel standard” will be imposed / required by either of both the Provincial and Federal Governments. A “clean fuel standard” will impose a renewable content requirement on all fossil fuels, including natural gas. Enbridge’s planned RFP and contracting for RNG will provide important information that will inform future expectations, policy and regulation as the “clean fuel standard” is developed and implemented. It will also encourage the development of RNG supply needed to satisfy any “clean fuel standard”. EGD has gained greater awareness of potential RNG technologies through sources such as the Canadian Gas Association and is aligned with other CGA members on the importance of helping to move technical advancement in this area along.

#### RATIONALE / OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGE 24):

As noted with respect to the Company’s RNG Procurement Plan it is expected that the early adoption of renewable content in Ontario’s natural gas system can be met with biogas originating from organic waste (e.g. forestry industry residue). Over the medium-term, increasing the supplies of renewable content will require the commercialization of promising technologies. Solutions can include biomass conversion to RNG through gasification. It can also include harvesting carbon dioxide, from industrial processes, to upgrade into RNG by incorporating green hydrogen with a catalyst. In effect, this becomes a means of recycling carbon dioxide back into a renewable fuel to displace volumes of conventional natural gas. This becomes a way of achieving deep de-carbonization within natural gas pipeline systems.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	Early in TRL (Technology Readiness Level) – Requires acceleration/support. Biomass gasification to RNG is not yet fully commercialized.
Support /Align with government targets/objectives – Potential to lower carbon emissions	RNG is non-emitting, and would allow the province to reduce building emissions significantly, without having to build new transmission or distribution, at a fraction of the cost of electrification. Consistent with the Province’s 2017 Long Term Energy Plan, page 114.
Cost Effectiveness/ Cost to Customer and other initiatives	With respect to customer owned assets, RNG enables the reduction of customer GHG emissions without the customer having to replace or upgrade their heating or water heating equipment thereby conferring an economic benefit upon them as a result of the avoidance or deferral of the cost of replacing or upgrading gas consuming appliances.

Safety	No known issues at current time.
Market Size	Residential, Commercial and Industrial customers.
Local Content	Projects may take place in Ontario.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:**

Residential/Commercial/Industrial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$200,000
- Approximately 2-4 projects (depending on number of participants).

**ADDITIONAL WORKPLAN INPUTS:**

- Leverage Canadian Gas Association to proactively look for RNG gasification opportunities and bring them forward through the Natural Gas Innovation Fund where multiple utility funding can be accessed and EGD can work directly with applicants to ensure relevancy/applicability of the technology in order to become a carbon abatement opportunity.
- Investigate opportunities for technology advancement through other associations such as the Gas Technology Institute and Energy Solutions Centre.

**POSSIBLE GOVERNMENT FUNDING:**

- TBD

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- Biomass Conversion (Thermochemical) to RNG: Understand technologies and feedstocks converting biomass to RNG, through the completion of a Technology Scan. Planned work: Technology scan and feedstock studies (\$110,000)
- Assessment: Complimentary Initiative, engage as appropriate.

## Customer Abatement Initiative: Carbon Capture

### STAGE: 1 – CONCEPTUALIZE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Pilots in Ontario demonstrating potential for 2 carbon capture technologies. Market scan of existing technologies/limitations, development/leveraging of strategic partnerships as well as financial support for vendors to develop new technologies that can achieve up to 100% carbon capture.

#### BACKGROUND/EVOLUTION OF INITIATIVE:

Enbridge recognizes the potential for Carbon Capture solutions to be an important part of a low carbon future and raised this as a priority for technological advancement through the Canadian Gas Association. Through discussions with other member utilities, participation in NRCAN Space Heating R&D Roadmap Workshop as well as other associations such as the Gas Technology Institute and Energy Solutions Centre, Enbridge found that carbon capture solutions at the building level are at prototype or early commercialization stage, with few solutions currently available. Enbridge became aware of potential technologies that focus on Carbon Capture and Utilization through the Canadian Gas Association and sees benefit in focusing on those technologies where by-products can help to increase the feasibility of developing cost effective carbon capture solutions.

#### RATIONALE / OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGE 24):

In support of achieving lower carbon emissions, Enbridge will actively pursue/support technology development around carbon capture in all sectors of the economy. The initiative would include a market scan of existing technologies/limitations, development/leveraging of strategic partnerships as well as financial support for vendors to develop new technologies that can achieve up to 100% carbon capture.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	Commercial building / Residential options early in TRL (Technology Readiness Level) – Requires investigation/development.
Support /Align with government targets/objectives – Potential to lower carbon emissions	Potential to result in carbon emission reductions while leveraging existing system.
Cost Effectiveness/ Cost to Customer and other initiatives	Technology development could help reduce costs and the aspect of utilizing the by-products could help make carbon capture technologies cost effective.
Safety	No known issues at current time.
Market Size	Potential for Residential, Commercial and Industrial markets.
Local Content	Pilot in Ontario homes/small commercial facility.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:**

Residential/Commercial/Industrial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$250,000
- Target 2 Carbon Capture research / pilot projects (dependent on number of participating parties).
  - Technology 1 – Algae by product which can be utilized in the Nutraceutical market – estimated allocation \$100,000.
  - Technology 2 – Pearl Ash by product which can be utilized in glass, detergent and cosmetics manufacturing – estimated allocation \$150,000.

**ADDITIONAL WORKPLAN INPUTS:**

- Leverage associations such as Canadian Gas Association and Gas Technology Institute to further investigate potential carbon capture technologies
- Work with NRCAN and Canadian Laboratories to identify potential opportunities/synergies (e.g. carbon capture solution to a residential sized micro generation unit).
- Work with manufacturers to understand barriers and help to overcome obstacles in order to advance technologies.

**POSSIBLE GOVERNMENT FUNDING:**

- Could expand number of pilots/additional carbon capture solutions
  - GreenON Challenge Fund: Potential to submit EOI

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- Residential Scale Carbon Capture: Pilot project demonstrating GHG reduction, energy recovery and savings and overall performance of system. Planned work: Commercial pilot project initiation and execution (\$51,000)
- Assessment: Complimentary Initiative, engage as appropriate.

## Customer Abatement Initiative: Hydrogen Blending (P2G)

### STAGE: 2 – FORMULATE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Technical due diligence and planning, specific to Enbridge’s gas distribution system, to establish the initial guidance and capabilities for blending hydrogen into the natural gas pipeline network as a means of diversifying how Ontario can meet provincial and federal renewable content requirements. This work is required as a prerequisite before proceeding with an actual field trial of hydrogen blending in a segment of Enbridge’s pipeline network.

#### BACKGROUND/EVOLUTION OF INITIATIVE:

The implementation of cap and trade in Ontario and the pending federal Clean Fuel Standards (CFS) will require increasing quantities of renewable fuel to comply with these GHG reduction programs. The early market supplies of renewable fuel will be sourced from biomass; but, these supplies are limited. To meet the GHG reductions, additional supplies of renewable content will be required. These additional supplies will be derived from next-generation RNG technologies which will also have hydrogen as part of their output gas. Also, opportunities like Power to Gas energy storage can be used as a supply of renewable content if the natural gas system can accommodate increased flexibility for different gas compositions. MOECC has identified hydrogen as a source of renewable content for natural gas systems. Power to Gas supplies of hydrogen are expected to be the first market opportunity that will require increased flexibility for different gas compositions in the natural gas system; and the development of hydrogen blending capabilities from power to gas plants will be used to establish the operational, safety and integrity priorities that will also be needed for larger market adoption of the next-generation RNG technologies.

#### RATIONALE/OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGE 18-19):

It is expected that by 2019 or 2020 hydrogen blending could contribute to the Company’s renewable content requirements as part of future Cap and Trade Compliance Plans. In 2018, Enbridge will further evaluate the opportunity to blend hydrogen into its existing gas infrastructure. This will include research into what has been accomplished in other jurisdictions (primarily Europe) and working with North American companies (through the Canadian Gas Association and American Gas Association) to develop test protocols that will lead to the development of industry standards. Enbridge will also research and develop hydrogen pipeline standards for transportation of pure hydrogen to blending sites within the Company’s existing gas network. The additional staffing resources requested will co-ordinate this work and continue the research into hydrogen gas blending and other opportunities for hydrogen within the low carbon economy. LCIF money will be expended on working with consultant research around the remaining steps required for advancing the introduction of hydrogen into the energy market.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	Early in TRL (Technology Readiness Level) – Hydrogen blending with natural gas is not a common operating practice for North American natural gas utilities.
Support /Align with government targets/objectives – Potential to lower carbon emissions	Consistent with the Province’s 2017 Long Term Energy Plan, page 114. Hydrogen has been identified as an eligible supply for renewable content, it is non-emitting - allows the province to reduce building emissions.
Cost Effectiveness/ Cost to Customer and other initiatives	Enables higher renewable pipeline fuel penetration and offers customers cost-competitive options and diversity when evaluated against other renewable energy options for future consumer energy needs. With respect to customer owned assets, hydrogen blending will also

	enable the reduction of customer GHG emissions without the customer having to replace/upgrade their heating or water heating equipment.
Safety	This work is intended to better define/initiate technical due diligence that supports ongoing safety/integrity for the natural gas system and customer owned equipment.
Market Size	Residential/Commercial/Industrial - research will determine optimal blending levels given the current characteristics of the gas infrastructure and identify potential improvements.
Local Content	TBD.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:**

- Residential/Commercial/Industrial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$500,000
- Developing the initial safety, integrity and operability work plans for establishing the capability for EGD to accommodate an as yet-to-be-determined level of hydrogen in gas composition that is delivered to customers/subset of customers. Since this work is network specific, it cannot leverage cost-sharing from other utilities.
  - 20% Acquire prior research from other Jurisdictions (e.g. Europe, etc.)
  - 50% Consulting (Initial Risk Assessment Work)
  - 30% Consulting - Preliminary network-specific technical evaluations (focus on pipeline material safety, integrity and end-use equipment)

**ADDITIONAL WORKPLAN INPUTS:**

- Leverage Canadian Gas Association task force on hydrogen blending
- Review other jurisdictions/projects, from Europe and Gas Technology Institute in the USA
- Enbridge participation in Europe HyReady consortium

**POSSIBLE GOVERNMENT FUNDING:**

- Funding could be used to expand the work scope to accomplish a higher degree of engineering and technical capability.
  - NRCan Clean Growth Fund: application submitted, under evaluation.

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- Completion of P2G technology roadmap Planned work: Monitoring of Enbridge's Power to Gas pilot project and a pre-feasibility assessment and studies of potential demonstration concepts (\$100,000)
- Assessment: Complimentary Initiative, engage as appropriate.

## Customer Abatement Initiative: Net-Zero Homes/Micro-Generation

### STAGE: 2 - FORMULATE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Implementation of Net Zero Energy Emissions pilot project for residential homes to build on earlier 2017 technology integration assessments and planning. The pilot will be implemented in partnership with electric LDC(s) and Municipalities. The objective is testing, optimization and monitoring of variations in the hybrid heating solutions, as well as distributed power generation platforms like solar PV and micro Combined Heat and Power (“mCHP”).

#### BACKGROUND/EVOLUTION OF INITIATIVE:

Net Zero, and Net-Zero Ready (NZR) home construction is experiencing increased interest from the builder community, and an industry stakeholder process for building code changes is contemplating what role net-zero should have in future building codes. Furthermore, municipalities are developing municipal energy plans and these plans are trying to assess how different net-zero strategies help solve or hinder community energy plans that are seeking to strike the appropriate balance between housing growth, energy infrastructure demands and emission reductions. Municipalities are recognizing that different elements of net-zero will deliver different benefits, so a need exists to understand and identify what specific net-zero priorities can deliver the best solutions (\$/Tonne of GHG reduction, reduced energy infrastructure demands, increased energy resiliency, etc.) for a given development and ultimately the province at large.

#### RATIONALE/OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGE 19-20):

Net Zero homes are designed and constructed to reduce household energy to a minimum; in the extreme producing more energy than they consume, reducing overall GHG emissions and relieving pressure on the electricity and gas systems. An important factor to considering determining components within NZR homes is the ability to reach the desired decrease in long-term energy consumption that aligns with government targets without negatively impacting cost, comfort or customer choice. Enbridge would leverage funds from the LCIF to greatly expand on NZR home pilot that was launched in 2017 with an LDC and Municipality. The pilot involves testing variations of hybrid heating concepts and other embedded power generation platforms in an effort to validate achievable GHG reductions. The 2018 expansion pilot project would entail piloting 10 homes to test additional variations of components to help achieve Net Zero readiness. This expanded pilot would help reduce timelines towards commercialization of NZR homes as testing and validation of savings would be greatly accelerated.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	NZR construction practices and net-zero technologies are commercially available today; but their integration in the home and integration with each other (gas and electricity) can be cost-challenging, and not necessary well understood. This work will specifically seek to better define the opportunities to reduce cost and increase performance when improving system integration.
Support /Align with government targets/objectives – Potential to lower carbon emissions	Municipalities are developing community energy planning documents (funded in some cases by MOECC), and building code changes are trying to assess the future role of net-zero.
Cost Effectiveness/ Cost to Customer and other initiatives	The output from this work will inform future government direction and funding programs to help ensure cost effectiveness. This work has significant budget aligned with monitoring and verification on the pilot homes to define the best targeted areas. This will ensure future incentive programs have maximum cost effectiveness and impact.

Safety	No known issues at current time.
Market Size	Over 40,000 new customer additions occur each year, and the lessons from this work can help influence the building and HVAC solutions that are deployed. While this pilot focuses on net-zero, individual elements within net-zero pilot could be adopted for the larger new-construction market. Lessons learned could also be applied to the retrofit market involving 3.6 million existing natural gas customers in Ontario.
Local Content	Pilots in homes within Ontario.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:**

Residential/Small Commercial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$449,000
  - Anticipated number of homes in pilot: 7-10
  - Estimated budget breakdown is 35% equipment, 10% building efficiency improvements, 15% installation, 10% first-of-kind system integration engineering and 30% in monitoring verification and reporting.

**ADDITIONAL WORKPLAN INPUTS:**

- Work with MaRS (Advanced Energy Centre) on development of Future of Home Heating Report
- Collaborate with peer electric utilities on net-zero energy emissions pilot proposals
- Engage with municipalities for the development of community energy plans and development-specific energy strategies.

**POSSIBLE GOVERNMENT FUNDING:**

- Could expand number of pilots, and/or scope
  - NRCAN Smart Grid Fund: submitted, under evaluation
  - GreenON Challenge Fund: Potential to submit EOI

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- Micro Generation (Stage 2): Pilot projects demonstrating hybrid heating efficiencies, GHG savings, system resilience, integration with net zero homes and customer cost savings. Planned work: Pilot Project Initiation and phased execution (9 sites) M&V (\$535,000)
- Assessment: Complimentary Initiative, engage as appropriate.
- Micro Generation: (Stage 1): Pilot projects demonstrating hybrid heating efficiencies, GHG savings, system resilience, and customer cost savings. Planned work: Pre-screening and Assessment of new technologies (\$192,000)
- Assessment: Complimentary Initiative, engage as appropriate.

## Customer Abatement Initiative: Expanded NGV Program

### STAGE: 2 - FORMULATE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Demonstration projects with small fleets. Focus on developing the large transport truck market within Ontario.

#### BACKGROUND/EVOLUTION OF INITIATIVE:

The NGV marketplace in Ontario has been changing over the past ten to 15 years. Once focused on a public fueling infrastructure for the fueling of light duty vehicles, it is now directed at the medium and heavy duty marketplace. This change has in part been brought about by the availability of high horsepower natural gas engines from suppliers such as Cummins-Westport. This has pushed the use of natural gas into niche markets such as garbage trucks where it is attractive to use natural gas due to lower emissions and lower fuel costs. However, there remains a reluctance of some operators to fully commit their fleet to natural gas. Rather, they prefer to start with a small fleet percentage (e.g. 10 vehicles or less), before making the commitment to expand into their fleet. This puts great pressure on supplying an economically viable fueling station. A way to address this barrier is to work with a supplier to design and implement a small scale lower cost fueling station for use on small sized heavy duty vehicle fleets.

#### RATIONALE/OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGES 22-23):

In partnership with the Government, the Company plans to increase the use of natural gas for vehicles used in activities such as waste collection, trucking and transit. It should be noted that while this initiative will see total natural gas throughput volumes, and therefore the Company's Cap and Trade obligation, increase, GHG emissions in the province will decrease significantly as natural gas displaces diesel, which is a more carbon intensive fuel and provides future CO<sub>2</sub> offset potential. The province has committed up to \$270 million in their CCAP to "increase the use of low-carbon trucks and buses", which includes but is not limited to those powered by natural gas. Enbridge plans to focus on developing the large transport truck market within Ontario. Projects could include specialized research and development to further develop market receptiveness to natural gas vehicles and specialized small demonstration projects with small fleets.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	The technology to be utilized is mature. The way in which the technology is physically configured and utilized is where the technology advancement will take place.
Support /Align with government targets/objectives – Potential to lower carbon emissions	Natural gas has roughly 20% fewer GHG emissions compared to diesel fuel and if renewable natural gas is utilized the vehicles become carbon neutral. Natural gas is also a lower cost vehicle fuel. Heavy duty trucking consumes a significant portion of Ontario transportation fuel use. There are significant emission and fuel cost savings benefits by expanding this marketplace.
Cost Effectiveness/ Cost to Customer and other initiatives	Natural gas is up to 40% less expensive than diesel or gasoline - would reduce operator fuel costs improving competitiveness.
Safety	No known issues at current time (all systems would be required to meet the TSSA and Electrical Safety Authority requirements).
Market Size	Potential for Heavy Duty Trucking Market.

Local Content	The equipment is generally supplied by U.S. manufacturers. The system design and packaging of the equipment will be undertaken in Ontario.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:**

- Commercial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$300,000
  - Feasibility Study and Business Case: \$60,000
  - Evaluation of technology providers and equipment selection: \$40,000
  - Field evaluation of prototype unit: \$200,000

**ADDITIONAL WORKPLAN INPUTS:**

- Work with a supplier on the design and feasibility of fueling systems.
- Install a first generation system at a customer's facility for fueling of their vehicles.

**POSSIBLE GOVERNMENT FUNDING:**

- TBD

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- N/A

## Customer Abatement Initiative: Natural Gas Air-Source Heat Pumps

### STAGE: 2 - FORMULATE

#### DESCRIPTION OF WORK UNDER CONSIDERATION (STAFF.23):

Conduct field tests to quantify actual savings and provide performance data vs. energy efficient furnaces as well as electric heat pumps. Aim to develop competitively priced natural gas heat pumps specifically for the residential market.

#### BACKGROUND/EVOLUTION OF INITIATIVE:

This Initiative is an evolution from Enbridge's experience with two pilot projects in 2017 and discussions with associations such as the Gas Technology Institute. Heat pumps have existed in the North American and European markets for some time, however, low natural gas prices, high unit prices, unknown performance in northern regions, lack of competition, distribution channels and insufficient ROI models based on local conditions are barriers to this market in Ontario. Technology advancement and acceleration in this area is important to help reduce GHG emissions while keeping customer choice, affordability and comfort in mind.

#### RATIONALE/OBJECTIVE (EXHIBIT C, TAB 5, SCHEDULE 2, PAGES 21-22):

Enbridge will expand its work with vendors and/or other interested parties in the pursuit of developing natural gas heat pumps which will result in lower emissions while providing a cost effective alternative to electric heat pumps for customers. Enbridge will also support the integrated approach which includes electric heat pumps in the Net Zero program. The focus for 2018 will be to conduct field tests to quantify actual savings and provide performance data vs. energy efficient furnaces as well as electric heat pumps. The initiative will also encourage and support other manufacturers to invest in new product development. The aim of that research is to develop competitively priced natural gas heat pumps specifically for the residential market. Field tests of prototypes will be required to ensure real life performance and address any barriers at the pre-commercialization stage.

#### SCREENING CONSIDERATIONS/COMMENTS:

Technological Maturity/Timely Advancement of Technology	Residential sized Natural Gas Heat Pumps are Early in TRL (Technology Readiness Level) – Requires acceleration/support.
Support /Align with government targets/objectives – Potential to lower carbon emissions	Lowers carbon footprint of natural gas space and water heating.
Cost Effectiveness/ Cost to Customer and other initiatives	Commercially available natural gas and cold climate electric products have a payback over traditional equipment that exceeds market acceptance. However, the operating costs for a natural gas heat pump are lower than electric and do not create a burden on the electric grid.
Safety	No known issues at current time.
Market Size	Potential for residential, small commercial and small multi-family.
Local Content	Pilots in Ontario homes and buildings.
Resource Availability	Supported by 2 FTEs requested to administer LCIF Initiatives (Exhibit C, Tab 5, Schedule 1).

**TARGETED / APPLICABLE SECTORS:**

Residential/Commercial

**2018 BUDGET ESTIMATE:**

- LCIF allocated amount \$150,000
  - Manufacturer Research \$25,000
    - Approximately 2-3 Field Tests \$125,000 (residential and small commercial pilots (including equipment, installation and monitoring))

**ADDITIONAL WORKPLAN INPUTS:**

- Work with manufacturers with products in Ontario to develop sufficient ROI models, target early adopters. Local field tests and costs will help inform manufacturer models.
- Support development of potentially lower unit costs currently in prototype stage.
- Lead research initiative with other North American utilities targeted at manufacturers to better understand what utilities can do to address market barriers identified by manufacturers.
- Engage with other interested parties to leverage funding and increase feasibility of additional pilots.
- Advancement of 3 tonne unit for North America (currently exists in Europe).

**POSSIBLE GOVERNMENT FUNDING:**

- Could expand number/scale of pilots.
  - GreenON Challenge Fund: Potential to submit EOI

**UNION GAS 2018 LCIF INITIATIVE (EXHIBIT B.STAFF.21):**

- N/A