CANADIAN GAS ASSOCIATION
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# Potential Gas Pathways to Support Net-Zero Buildings in Canada

A Canadian Gas Association study prepared by ICF

October 2021

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This is a Canadian Gas Association (CGA) commissioned study prepared for the CGA by ICF. The CGA defined the cases to be evaluated and vetted the overall methodology and major assumptions. The Canadian Energy Regulator (CER) Energy Futures 2020 Reference Case, including energy consumption trends, was used as the starting point for this analysis.

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## Executive Summary

This report examines the opportunity to reduce emissions from Canada's building stock by leveraging the existing natural gas infrastructure system. This report is an initial national-level look at the possibilities for gas utilities and their infrastructure to support net-zero emission reduction targets, showcasing opportunities that need to be studied in more detail as part of national and regional climate planning efforts.

To assess the gas industry's potential contribution to net-zero targets set by the Government of Canada, one must first understand the scale of Canada's current reliance upon natural gas. Natural gas, and its infrastructure system, is an important part of daily life for many Canadians. Through a network of more than 573,000 kilometers of buried infrastructure, the gas system provides energy for more than two-thirds of Canadians.[1] In 2020, natural gas met 38% of the country's energy needs and was the largest source of energy for the industrial and buildings sectors.[2] Particularly given the current scale of gas consumption, the analysis documented in this report is based on a presumption that planning for a net-zero future does not necessitate a choice between one energy system or another energy system (gas or electric). Integrated 'both/and' systems thinking rather than 'either/or' binary thinking about the role of various energy sources is crucial. A net-zero future will likely require the coordinated efforts of gas and electric utilities, particularly in order to maintain energy system resiliency and reliability, reduce negative customer impacts, accelerate emission reductions, and create opportunities for emerging technologies (such as power-to-gas and hydrogen). Leveraging both systems for their relative strengths should allow for a lower-risk pathway to reducing emissions, while also maintaining the flexibility to adapt to new technologies and policies in the future.

Gas utilities in Canada are already piloting and implementing a range of initiatives to reduce greenhouse gas (GHG) emissions in Canada's building stock. These efforts include energy efficiency programs and pilot programs to evaluate the potential of hydrogen, renewable natural gas (RNG), and other low-carbon alternatives to conventional natural gas. Many of these utilities are also exploring and planning for a new suite of energy offerings that leverage existing infrastructure to reduce emissions. Key examples include expanded energy efficiency programs, RNG, liquefied and compressed natural gas, hydrogen, and hybrid gas-electric heating.

This report develops and illustrates three representative national-level pathways for the natural gas delivery industry to support net-zero emission targets in Canada's residential and commercial buildings that are currently using natural gas. All three scenarios include contributions towards net-zero targets from energy efficiency programs, new conservation-oriented building

[1] Canadian Gas Association (CGA), "The CGA Playbook (2020)", https://www.cga.ca/resources/publications/playbook/
[2] Canada Energy Regulator (CER), "Canada's Energy Future 2020: Energy Supply and Demand Projections to 2040", https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA

codes, large volumes of renewable natural gas (both biogenic and synthetic) and hydrogen blending into natural gas infrastructure. They are distinct from each other based on different combinations and assumed adoption levels of the highlighted customer emissions reduction measures. The distinguishing features of each of these three illustrative pathways can be summarized as follows:

- **Pathway 1 (Gas Energy Efficiency):** This pathway includes potential emissions reductions from significant adoption of gas heat pumps for space and water heating.
- **Pathway 2 (Hybrid Gas-Electric Heating):** This pathway also includes potential emissions reductions from significant adoption of hybrid heating arrangements that pair electric air-source heat pumps with natural gas furnaces.
- **Pathway 3 (Carbon Neutral Fuels):** This pathway includes a small portion of residential and commercial customers converting to use 100% hydrogen by 2050, as well as higher RNG consumption levels.

The optimal emissions reduction approach is likely to differ—potentially significantly—for different gas distribution companies. For instance, the suitability of different measures may vary depending on the company, jurisdiction, region, customer demographics, and unique customer needs. Emission reduction strategies should also be informed not just by technical emissions-reduction potential but also by integrated 'both/and' approaches that simultaneously address multiple imperatives, such as energy security, affordability, reliability, and safety.

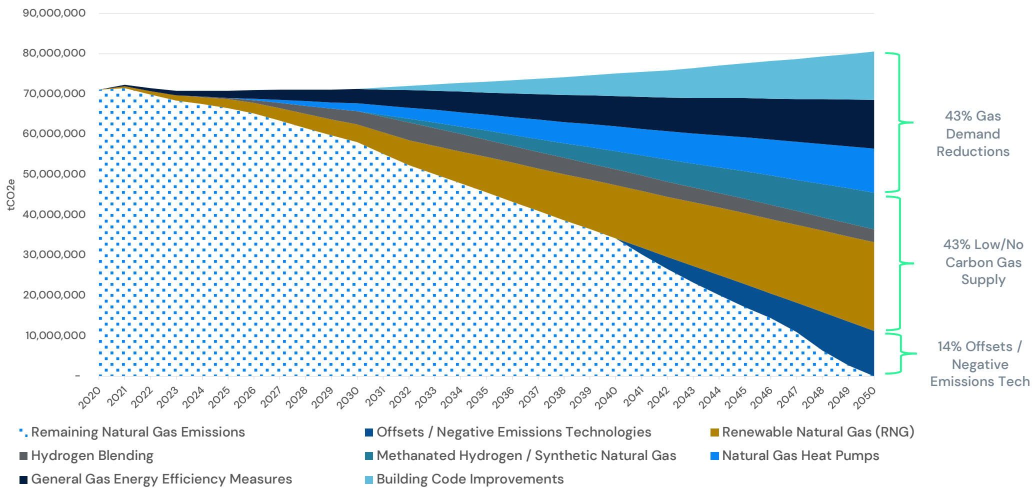
As a result, while this study showcases three pathways to achieve net-zero targets, these are not meant to be prescriptive. Instead, the pathways are illustrative frameworks for natural gas utilities, meant to outline how different customer/demand-side and supply-side initiatives can work in tandem, under a supportive regulatory environment, to decrease greenhouse gas emissions from gas utility customers. **ES Table 1** highlights the total contributions of gas demand reductions, renewable gases, and offsets or negative-emissions technologies to reaching net-zero emissions targets under each pathway, while **ES Exhibit 1** provides a more detailed look at how different measures could each contribute over the 2020-2050 timeframe.

*ES Table 1: Net-Zero Gas Buildings Pathway Highlights*

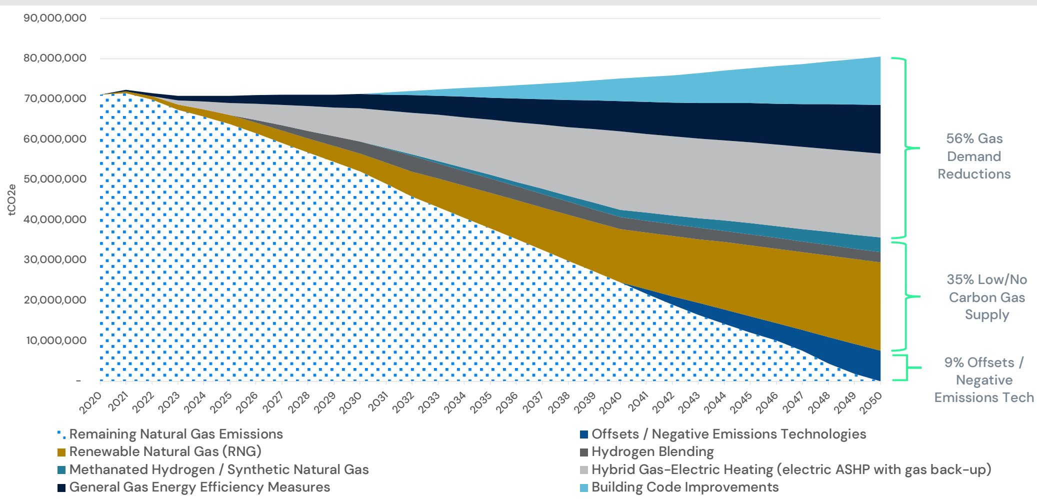
| | Gas Demand Reductions | Renewable Gases | Offsets / Negative Emissions | Scenario Reaches Net Zero Target |
|---|---|---|---|---|
| **Pathway 1 – Efficiency** | 35 million tonnes (43%) | 34 million tonnes (43%) | 11 million tonnes (14%) | ✓ |
| **Pathway 2 – Hybrid Heating** | 45 million tonnes (56%) | 28 million tonnes (35%) | 8 million tonnes (9%) | ✓ |
| **Pathway 3 – Renewable Gases** | 24 million tonnes (30%) | 44 million tonnes (55%) | 12 million tonnes (15%) | ✓ |

*ES Exhibit 1 – Illustrative Natural Gas Utility Emission Reduction Pathways*

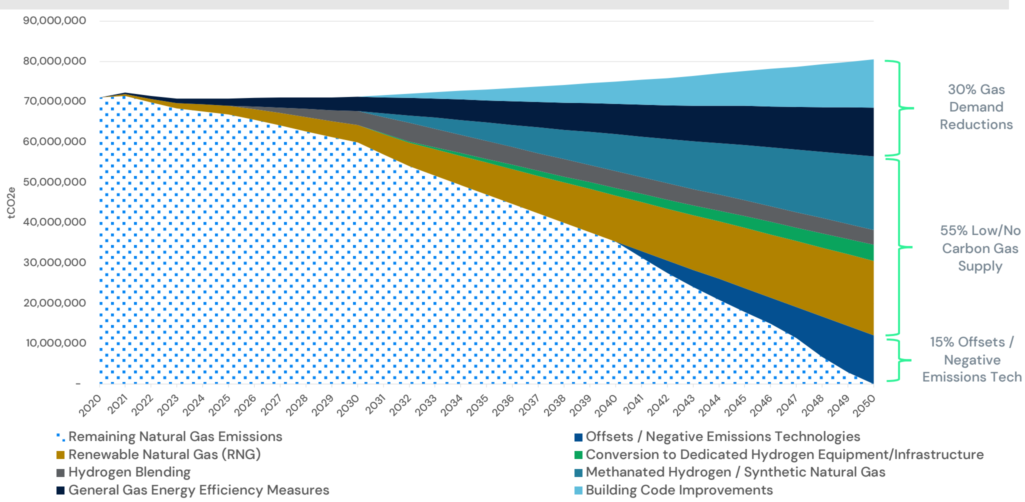
**Pathway 1: Gas Energy Efficiency Focus**




**Pathway 2: Hybrid Gas-Electric Heating Focus**




**Pathway 3: Carbon Neutral Fuels Focus**



The approaches identified in this report will require the industry to show leadership on innovation, new technology deployment, and the introduction of renewable gases to the infrastructure system. The natural gas delivery industry has many strengths that would help the industry support deep emission reductions in Canada, including private sector capital, a strong workforce, existing relationships with a large customer base, and transparent and rigorous regulatory systems.

Despite the substantial potential for gas utilities to contribute to emission reduction goals, meeting net-zero targets will not come without significant changes to traditional natural gas delivery regulatory and legislative models. For the gas sector to reach net-zero emissions, these changes must be supported by policymakers, regulators, and customers, as well as the utilities themselves. Regulatory frameworks and legislation will need to be reformed to enable, incentivize, and reward innovation for emissions reductions. In addition, many of the changes will require consumer acceptance to be implemented and will raise important consumer equity issues that will need to be addressed. Research and development of emerging technologies will also need the support of regulators and investors. Regulations encourage safe, effective, and coordinated planning, and can best support decarbonization when framed to facilitate the adoption of a variety of conventional and new technologies that meet emissions guidelines. In turn, policy can spur innovation and save consumers money.

A key uncertainty in Canada remains the reaction of consumers to the escalating costs of GHG emission pricing programs. Emissions reduction policy in Canada today places significant emphasis on $CO_2$ pricing. It is challenging to predict how much fuel switching or energy efficiency the pricing will drive on its own, without additional programs to support customers. Ultimately, $CO_2$ pricing has the potential to significantly increase energy bills for natural gas customers without guaranteed levels of GHG reductions, especially absent the availability of targeted financial support of emission reduction efforts for these customers. This study offers three pathways that illustrate how natural gas utilities can help mitigate these impacts on their customers by advancing energy efficient gas technologies, low- and zero-carbon fuels, gas heat pumps, hybrid heating systems, and more.

Although the full impact and costs of emission reduction measures on natural gas utility customers is outside the scope of this study, the study does assess potential energy cost impacts for different types of gas customers in 2030.[3] This is done for three customer configurations:

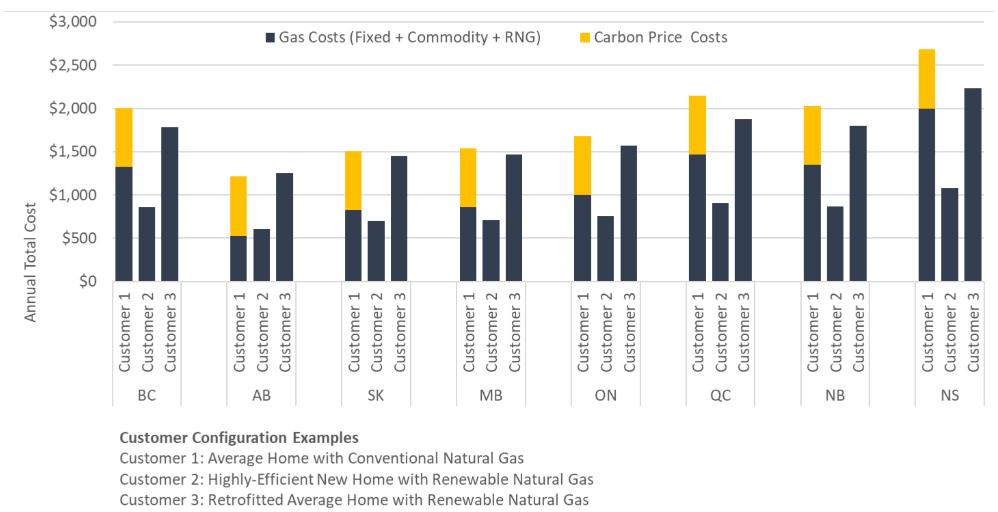
1. A customer who does not reduce emissions or use RNG, and instead pays the full carbon price

[3] Federal carbon pricing policy is designed to offset the increase in customer energy bills from carbon prices by returning money directly to Canadians, but customers would receive the same income tax rebates regardless of what emission reduction actions they take or do not take (rebate dependent only on income levels).

2. A customer in an energy-efficient new home who is also using RNG
3. A customer that implements energy efficiency measures in their existing home to reduce their gas consumption and decarbonizes their remaining gas through RNG.

This comparison, highlighted in **ES Exhibit 2**, demonstrates that customer energy costs are likely to be lowest for the 'highly efficient new construction' home and highest for the customer who makes no changes and just pays the carbon tax.

*ES Exhibit 2 – Comparison of Energy Cost Impact Examples for Residential Gas Customers in 2030*




Overall, the results of this study indicate that Canada's natural gas industry has the potential to make important contributions to the nation's energy and climate future. Gas utilities are already making strides on this front with energy efficiency programs, low- and zero-carbon fuel procurement, gas heat pumps and hybrid heating systems, and other investments in innovation. By expanding these initiatives and prioritizing a range of other emerging opportunities, natural gas utilities can help maintain a high quality of energy service while deeply contributing to net-zero emissions and providing Canadians with safe, reliable, and clean energy. Natural gas utilities have a big stake in today's energy sector and can be key players in supporting net-zero commitments.

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# 1. Introduction

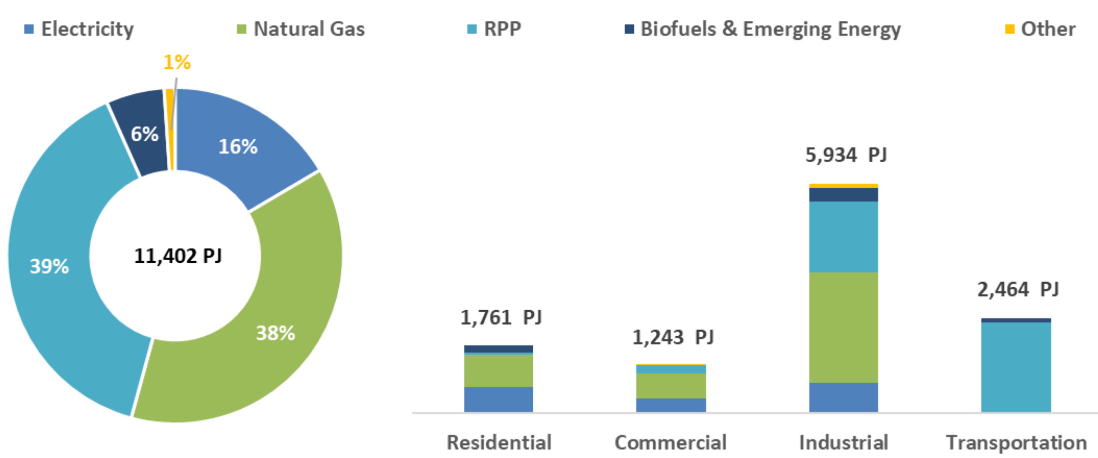
This report examines the opportunity to reduce emissions from Canada's building stock by leveraging the existing natural gas infrastructure system. This report is an initial national-level look at the possibilities for gas utilities and their infrastructure to support net-zero emission reduction targets, showcasing opportunities that need to be studied in more detail as part of national and regional climate planning efforts.

## 1.1 The Role of Natural Gas in Canada

To assess the gas industry's potential contribution to net-zero targets set by the Government of Canada, one must first understand the scale of Canada's current reliance upon natural gas. Natural gas, and its infrastructure system, is an important part of daily life for many Canadians. Through a network of more than 573,000 kilometers of buried infrastructure, the gas system provides energy for more than two-thirds of Canadians.

Natural gas currently provides 38% of Canada's overall energy needs. Further, natural gas is the main source of energy in all sectors except transportation – representing roughly 50% of the energy needs in the residential, commercial, and industrial sectors. **Exhibit 3** compares the consumption of natural gas to other energy sources, based on data for 2020 from the Canada Energy Regulator 2020 Energy Futures report.

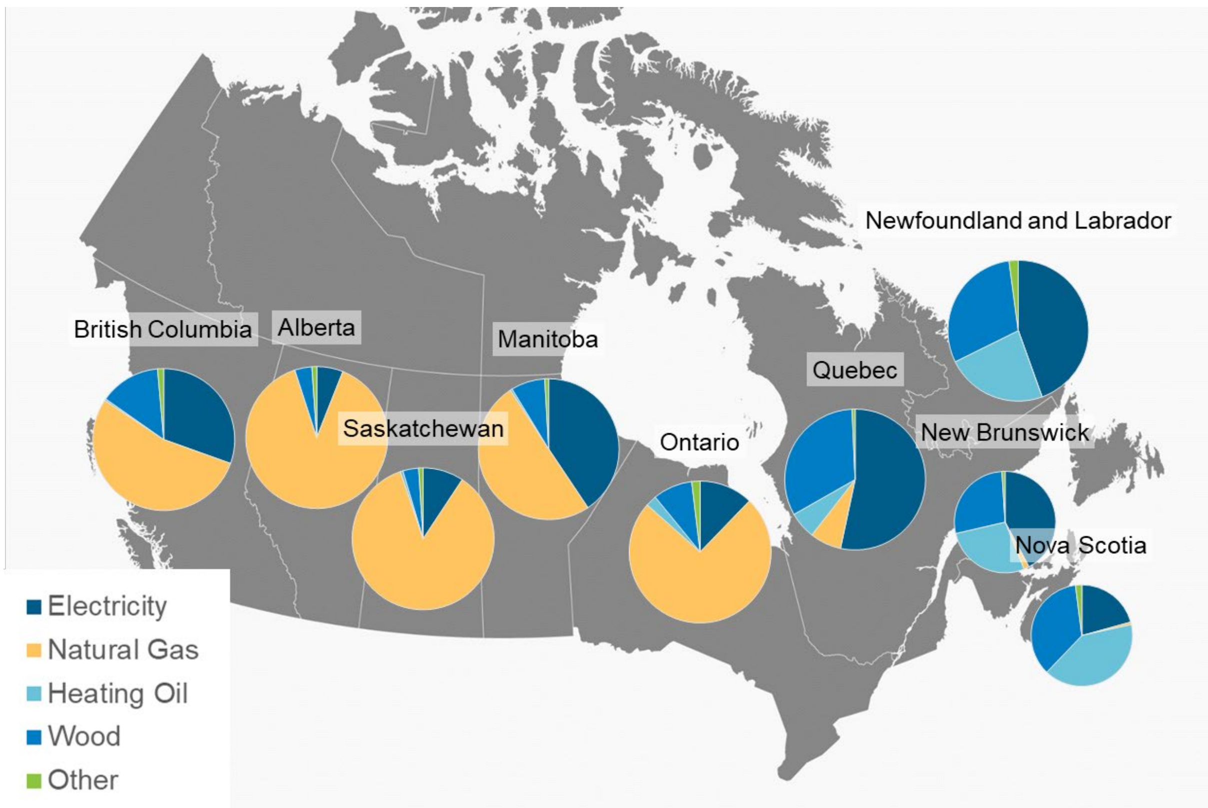
*Exhibit 3 - Breakdown of 2020 End Use Consumption in Canada*[4]




[4] Canada Energy Regulator (CER), "Canada's Energy Future 2020: Energy Supply and Demand Projections to 2040", https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA

Space heating represents the largest use of natural gas in the residential and commercial sectors. About 7 million households[5] (50%) in Canada use natural gas as their primary source of heat. There are, however, significant differences in the level of natural gas use across the country. **Exhibit 4** shows how natural gas is the primary energy source for residential heating in half of the Canadian provinces. Natural gas utilities, also known as local distribution companies (LDCs), are regulated entities that build and maintain the gas infrastructure that serves most residential and commercial gas customers.

*Exhibit 4 - Comparison of primary residential heating fuel source by province*[6]




Natural gas consumption is highly seasonal in Canada, driven by the large volumes of gas that are used for space heating in the winter. The existing gas energy storage and delivery infrastructure was designed to reliably serve customers through large spikes in consumption during cold winter periods.

[5] Natural Resources Canada (NRCan), "Comprehensive Energy Use Database – Residential Sector, Table 20", https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ca&rn=20&page=0

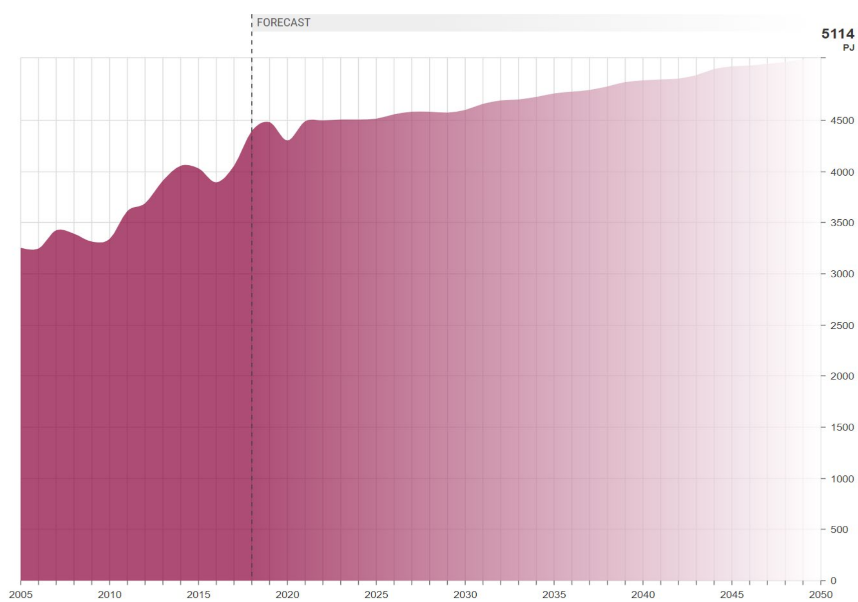
[6] 2018 data from the NRCan Comprehensive Energy Use Database; map image courtesy Free Vector Maps

The amount of energy that the gas system delivers on a cold day is typically underappreciated. To put the peak capacity and role of gas infrastructure in context, consider the extreme example of the energy systems in Saskatchewan. In Saskatchewan, the utility's record for peak day natural gas demand is more than four times higher than the utility's record for peak hourly electric demand when scaled to a full day:

- SaskPower's peak electric consumption record is roughly 4 GW [7]
- SaskEnergy's record daily consumption of natural gas is equivalent to about 18 GW [8] of electricity

Natural gas consumption in Canada has increased significantly over the last two decades, as highlighted by **Exhibit 5**. This chart from the CER 2020 Energy Futures also shows a 'Reference Case' forecast that would continue to see growth in natural gas demand over the coming decades.

*Exhibit 5 – Historical Growth in Natural Gas Demand and Reference Case Forecast for Continued Growth* [9]




Particularly given the current scale of gas consumption, the analysis documented in this report is based on a presumption that planning for a net-zero future does not necessitate a choice between one energy system or another energy system (gas or electric). Integrated 'both/and' systems thinking rather than 'either/or' binary thinking about the role of various energy sources

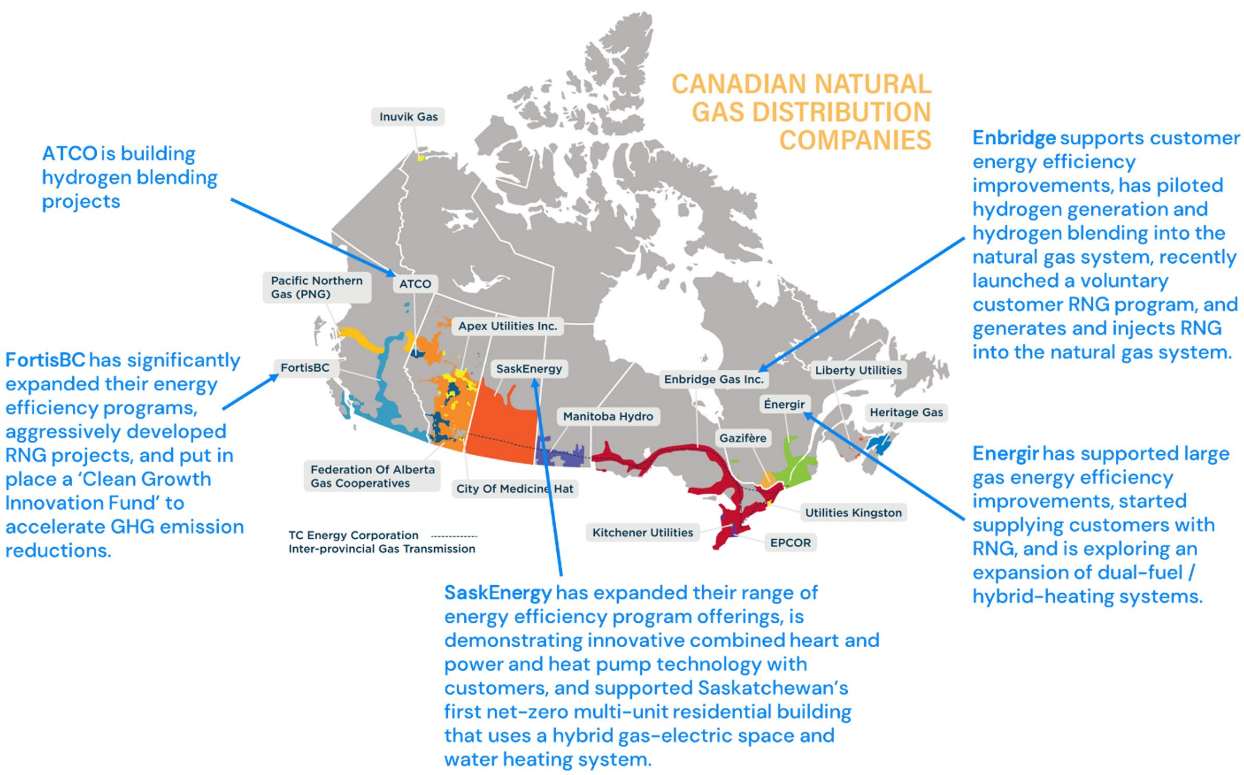
[7] 3,792 MW record set on December 29, 2017. https://www.saskpower.com/about-us/media-information/news-releases/2018/03/saskatchewan-breaks-power-use-record-during-holiday-cold-snap
[8] 1.57 GJ daily consumption on February 8th, 2021 (is equivalent to 436 GWh, divided by 24 hours in that day gives roughly 18 GW on average). https://globalnews.ca/news/7631002/natural-gas-record-saskenergy/
[9] Exploring Canada's Energy Future - Canada.ca (cer-rec.gc.ca)

is crucial. A net-zero future will likely require the coordinated efforts of gas and electric utilities, particularly in order to maintain energy system resiliency and reliability, reduce negative customer impacts, accelerate emission reductions, and create opportunities for emerging technologies (such as power-to-gas and hydrogen). Leveraging both systems for their relative strengths should allow for a lower-risk pathway to reducing emissions, while also maintaining the flexibility to adapt to new technologies and policies in the future.

## 1.2 Examples of Natural Gas Utility Emission Reduction Initiatives

Natural gas utilities in Canada are already taking steps to help their customers reduce their GHG emissions. This includes gas energy efficiency programs, but also procuring RNG, pilot testing hydrogen blending and gas heat pumps, exploring hybrid gas-electric heating options to minimize grid impacts from electrification, and launching innovation funds to drive further emission reductions. A few of these examples are highlighted in **Exhibit 6**.

*Exhibit 6 – Selection of Canadian Gas Utility Efforts in Support of Emissions Reductions*



# 2. Gas LDC Strategies to Support Customer Emissions Reductions

## 2.1 Key Customer Emissions Reductions Strategies

There are a variety of gas technologies and low/no carbon gas supplies that can be leveraged to reduce GHG emissions for residential and commercial customers. Local distribution companies (LDCs) are well positioned to support their customers in adopting these measures. Several of the key emission reduction strategy options are discussed in this section, including:

- Energy efficiency
- Gas heat pumps
- Hybrid gas-electric heating systems
- Energy building codes
- Renewable natural gas
- Hydrogen
- Carbon capture, negative emissions technologies, and offsets

Although not intended to be exhaustive, this list describes some of the most common measures that many gas utilities are already able to support, as well as additional opportunities that offer the potential for significant emissions reductions. It's also worth noting that this report does not focus on gas consumption in the industrial or power generation sectors, where additional measures may be needed to address emissions.

### *Energy Efficiency*

Energy efficiency is a critical universal mechanism to decarbonize the building sector. Energy efficiency is typically the least expensive strategy and therefore should be the first action taken to decarbonize. Most jurisdictions have been pursuing energy efficiency for years, but opportunities remain to drive further adoption of a wide-range of measures to help customer use less energy, as well as to support the deployment of new, more efficient technologies like dual-fuel and natural gas heat pumps. In recent years, low gas prices have made it challenging in some regions to pursue expanded efficiency measures based on traditional cost-effectiveness tests. However, that does not mean that there are no new opportunities for natural gas efficiency; as researchers note in a 2020 American Council for an Energy-Efficient Economy (ACEEE) paper titled Sustaining Utility Natural Gas Efficiency Programs in a Time of Low Gas Prices,[10] "based on our review and analysis, we conclude that natural gas energy efficiency programs are sustainable and worth pursuing for both economic and environmental reasons." Also, the cost of all forms of

[10] ACEEE Report

energy are expected to go up if pursuing net-zero pathways, making energy efficiency measures increasingly important going forward.

**Exhibit 7** provides some insight into the historical performance of gas energy efficiency programs in Canada.[11] For example, efficiency programs for fuels achieved savings of 0.94% of demand in Quebec during 2019.

*Exhibit 7 – Gas Utility Energy Efficiency Program Score Card*

| Province | Annual Incremental Savings (PJ) | | | | | Score (5 pts.) | Evaluated by a third party (+1 pt.) |
|---|---|---|---|---|---|---|---|
| | Savings year | Savings, natural gas | Savings, NRFs | Savings, fuel switching | Savings as % of demand | | |
| Québec~ | 2019 | 2.62 | 0.96 | - | 0.94% | 2.5 | 1.0 |
| Prince Edward Island*~ | 2019 | - | 0.01 | 0.03 | 0.90% | 2.5 | 0 |
| Nova Scotia | 2019 | - | 0.22 | - | 0.53% | 1.5 | 1.0 |
| Ontarioǃ | 2018 | 4.04 | - | - | 0.37% | 1.0 | 1.0 |
| New Brunswick | 2019 | 0.00 | 0.08 | - | 0.35% | 1.0 | 1.0 |
| British Columbia | 2019 | 0.84 | 0.00 | 0.28 | 0.33% | 0.5 | 1.0 |
| Manitoba*~ | 2019 | 0.25 | 0.00 | - | 0.23% | 0.5 | 1.0 |
| Alberta | 2019 | 0.21 | 0.20 | 0.00 | 0.06% | 0 | 1.0 |
| Saskatchewan | 2019 | 0.05 | - | - | 0.02% | 0 | 0 |

### *Gas Heat Pumps*

Natural gas heat pumps represent a promising technology in the early stages of commercialization[12] Utilities like FortisBC are launching pilot programs to test and demonstrate the technology.[13] Gas heat pumps use thermal energy to drive a refrigeration cycle to provide space and water heating and cooling. Like an electric heat pump, a gas heat pump has an efficiency of more than 100% (most units in the range of 130% to 140%). As compared to many electric heat pumps, gas-fired heat pumps better retain their heat-delivery capacity and efficiency at very low temperatures without relying on supplemental heat sources.

### *Hybrid Gas-Electric Heating Systems (Dual-Fuel)*

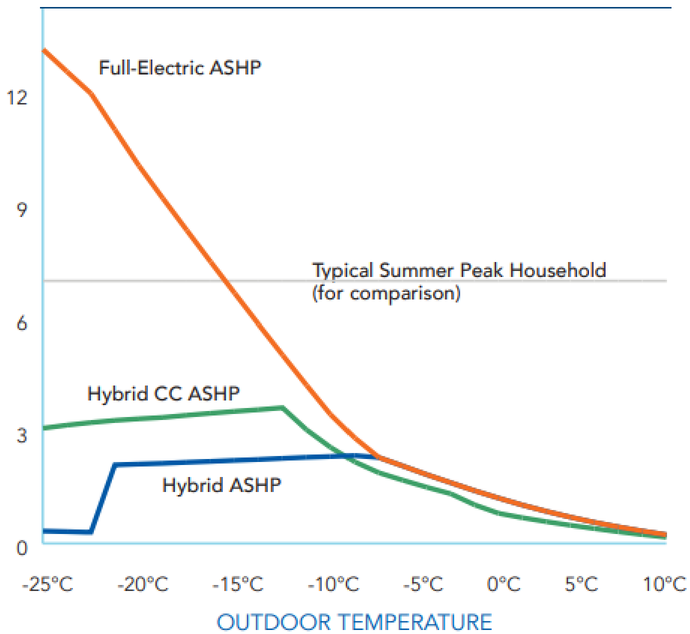
[11] Efficiency Canada, "2020 Canadian Provincial Energy Efficiency Scorecard", https://www.scorecard.efficiencycanada.org/2020

[12] Gas heat pumps are commercially available for commercial building applications, while commercialization of residential gas heat pumps is expected by industry to start in in 2023.

[13] https://www.newswire.ca/news-releases/thermolift-and-fortisbc-launch-first-residential-gas-heat-pump-field-trials-831514641.html

Hybrid heating systems, sometimes referred to as dual fuel systems, consist of an electric air source heat pump (ASHP) paired with a natural gas furnace (or, in some cases, other gas heating technologies such as combi heating systems) that can utilize integrated controls to optimize the energy consumption, emissions, and cost of the system throughout the year. These systems can be configured such that the air source heat pump acts as an air conditioner in the summer and only services the space heating load when it has sufficient capacity to do so efficiently.

*Exhibit 8 – Example of Effect of Outdoor Temperature on ASHP Electric Load*




Hybrid systems are advantageous because the heating capacity and efficiency of electric air source heat pumps are dependent on outside temperature and weather conditions. With electric air source heat pumps, efficiency and capacity drops as outdoor temperatures drop, so they are may not be able to meet the full space heating load beyond a balance point temperature, and their energy consumption significantly rises if they begin to rely on backup electric resistance heating. Whereas in a hybrid heating system, the heat delivery systems can be programmed to switch from the electric air source heat pump to the natural gas furnace below the balance point temperature. A hybrid approach reduces electric demand spikes in the winter (particularly when the use of electric resistance heating can be avoided entirely) – as illustrated in **Exhibit 8**, where electric demand from the hybrid ASHP peaks around 3 kW, as opposed to around 13 kW for the ASHP with electric resistance back-up.[14] The optimal outdoor temperature at to switch from the ASHP to the gas system will depend on whether the system is optimizing to minimize customer costs, minimize emissions, or to optimize other parameters. One option is called the economic balance point temperature (e-BPT), which will vary based on local electricity and gas rates, along with a variety of system-specific factors. NRCan offers guidance for calculating the e-BPT of a given system in its Air-Source Sizing and Selection Guide.[15]

Quebec is the province in Canada with the most electric space heating and has long recognized the challenges posed by winter peak electric space heating loads. To mitigate this issue, Hydro-Québec currently has about 200,000 customers enrolled in a "dual energy program." These customers get a special rate plan in exchange for automatically switching heating off electricity

[14] https://taf.ca/wp-content/uploads/2018/04/MaRS_Report_Future_of_Home_Heating_2018-04-02.pdf
[15] Air-source Heat Pump Sizing and Selection Guide (nrcan.gc.ca)

to other fuels, like natural gas or heating oil, when temperatures drop to a certain level.[16] In July 2021, due to a mandate for collaboration from the Province of Québec, Hydro-Québec and Énergir proposed to offer common electricity and gas rates to the Régie de l'Énergie for customers that opt-in for the dual-energy heating. The collaboration aims to further promote dual energy heating, with the goal of reducing natural gas consumption for participating customers by more than 70% and ultimately helping to offset 540,000 tonnes of CO2 equivalent by 2030. This measure is part of the provincial "Plan for a Greener Economy," and coordinates both utilities to mitigate the impact of GHG emissions from residential, commercial, and institutional buildings by half by 2030.

According to a study by Natural Resources Canada[17]overall lifetime expenditures (equipment and energy costs) from hybrid systems can be smaller than full electric ones for both retrofit and new construction scenarios when a high-efficiency gas appliance is used, depending on how the ASHP is operated.

### *Energy Building Codes*

Building energy codes establish minimum energy efficiency requirements for new construction and renovations. Energy codes represent a significant opportunity because it is significantly easier and less expensive to design a new building to be more efficient and have lower HVAC energy requirements than to retrofit an existing building for similar reductions. Another reason such codes are important is that a significant level of new construction is expected by 2050. Building energy codes can be divided into two primary frameworks, *prescriptive* and *performance*.

- **Prescriptive codes** assign specific minimum criteria that must be met when constructing a building (e.g., minimum heat reflectivity [R-value] for insulation and installation and control requirements for HVAC systems).
- **Performance codes** set a minimum energy performance target, giving building architects and engineers flexibility in how they meet the targets. For example, a building in a cold climate may achieve more benefit by emphasizing high-performance insulation over window design. In a marine climate, designing windows to take advantage of natural sunlight may provide more benefits than upgrading insulation.[18]

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[16] Hydro-Québec, " Rate DT – Dual Energy for residential and agricultural customers", https://www.hydroquebec.com/residential/customer-space/rates/rate-dt.html

[17] Natural Resources Canada, "The future of home heating: Hybrid home heating systems offer energy savings and reduce GHG emissions", https://www.nrcan.gc.ca/simply-science/the-future-home-heating-hybrid-home-heating-systems-offer-energy-savings-and-reduce-g/22236

[18] https://www.aceee.org/sites/default/files/zeb-codes.pdf

One jurisdiction with a leading energy building code is British Columbia. The BC Energy Step Code, pictured in **Exhibit 9**, phases in a plan to shift the construction industry to 'net-zero energy-ready' buildings over three building code cycles.[19] Each phase has progressively greater levels of energy efficiency requirements over the 2018 base building code in 2022 (20% more energy efficient), 2027 (40% more energy efficient) and 2032 (80% more energy efficient). This performance code focuses on achieving 80% energy reductions, not limiting customer choice, or regulating the types of energy customers can use for the significantly lower building energy requirements. FortisBC has demonstrated how natural gas can still be used to heat qualifying 'net-zero energy-ready' homes, and how the company can provide incentives and guidance to help builders in the transition and offer customers the choice of renewable natural gas to achieve further GHG emission reductions.

*Exhibit 9 – BC Energy Step Code*

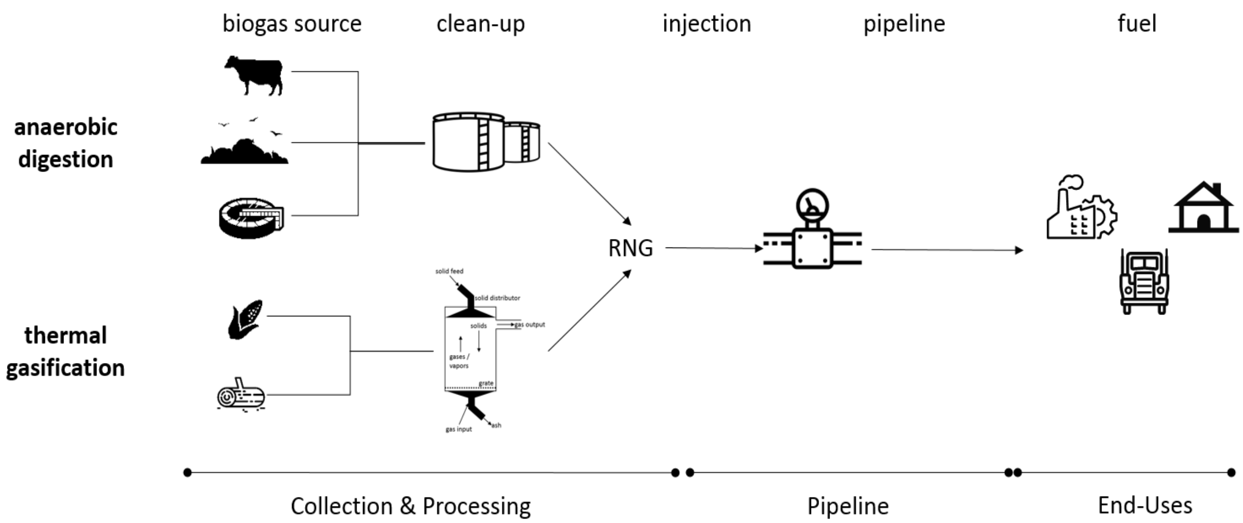

### *Renewable Natural Gas*

RNG is derived from biomass or other renewable resources and is a pipeline-quality gas that is fully interchangeable with conventional natural gas. As shown in **Exhibit 10**, RNG is produced over a series of steps: collection of a feedstock, delivery to a processing facility for biomass-to-gas conversion, gas conditioning, compression, and injection into the pipeline. In this project ICF considers two production approaches: anaerobic digestion (AD) and thermal gasification (TG).

- **Anaerobic Digestion:** the most common way to produce RNG today is via anaerobic digestion, whereby microorganisms break down organic material in an environment without oxygen.
- **Thermal Gasification:** Biomass like agricultural residues, forestry and forest produce residues, and energy crops have high energy content and are ideal candidates for RNG production through thermal gasification, a technology at the early stages of commercialization.

[19] https://energystepcode.ca/how-it-works/

*Exhibit 10 – RNG Production Process via Anaerobic Digestion and Thermal Gasification*




RNG can be produced from a variety of renewable feedstocks, as described below in Table 1. These feedstocks match what was included in the 2019 RNG Supply and Emissions Reduction Assessment that ICF conducted for the American Gas Foundation.[20]

For the customer GHG emissions pathways in this analysis, RNG uses the 'combustion approach' to GHG accounting. A combustion GHG accounting framework is the standard approach for most volumetric GHG targets, inventories, and mitigation measures (e.g., carbon taxes, cap-and-trade programs and renewable portfolio standard [RPS] programs) as they are more closely tied to a particular jurisdiction—where the emissions physically occur. Using the combustion framework, the $CO_2$ emissions from the combustion of biogenic renewable fuels are considered zero, or carbon neutral. In other words, RNG has a CO2 emission factor of zero. This includes RNG from any biogenic feedstock, including landfill gas, animal manure, and food waste. Upstream emissions, whether positive (electricity emissions associated with biogas processing) or negative (avoided methane emissions), are not included in the customer emissions pathways in this study.

[20] https://gasfoundation.org/2019/12/18/renewable-sources-of-natural-gas/

*Table 1 – RNG Feedstock Types*

| Feedstock for RNG | | Description |
|---|---|---|
| Anaerobic Digestion | **Animal manure** | Manure produced by livestock, including dairy cows, beef cattle, swine, sheep, goats, poultry, and horses. |
| | **Food waste** | Commercial, industrial and institutional food waste, including from food processors, grocery stores, cafeterias, and restaurants. |
| | **Landfill gas (LFG)** | Anaerobic digestion of organic waste in landfills produces a mix of gases, including methane (40–60%). |
| | **Water resource recovery facilities (WRRF)** | Wastewater consists of waste liquids and solids from household, commercial, and industrial water use; in the processing of wastewater, a sludge is produced, which serves as the feedstock for RNG. |
| Thermal Gasification | **Agricultural residue** | The material left in the field, orchard, vineyard, or other agricultural setting after a crop has been harvested. Inclusive of unusable portion of crop, stalks, stems, leaves, branches, and seed pods. |
| | **Energy crops** | Inclusive of perennial grasses, trees, and annual crops that can be grown to supply large volumes of uniform and consistent feedstocks for energy production. |
| | **Forestry and forest product residue** | Biomass generated from logging, forest and fire management activities, and milling. Inclusive of logging residues, forest thinnings, and mill residues. Also, materials from public forestlands, but not specially designated forests (e.g., roadless areas, national parks, wilderness areas). |
| | **Municipal solid waste (MSW)** | Refers to the non-biogenic fraction of waste that would be landfilled after diversion of other waste products (e.g., food waste or other organics), including construction and demolition debris, plastics, etc. |

### *Hydrogen*

Low- and no-carbon hydrogen production pathways are available – their products are known as blue and green hydrogen. Combined with the fact that hydrogen's combustion yields no GHG emissions, hydrogen has drawn interest as a valuable form of clean energy storage. After production, developing approaches to facilitate the distribution and end-use of hydrogen will be critical to its success in the market.

Three approaches to leveraging hydrogen in gas infrastructure are discussed below:

- **Hydrogen Blending in Existing Infrastructure:** Hydrogen can be blended into the natural gas supply, with a 20% volume blend (closer to 7% on an energy basis) commonly discussed potentially as an upper blending limit without requiring significant upgrades to customer equipment or the gas distribution system.

- **Methanated Hydrogen:** Hydrogen can be converted to methane by reacting it with $CO_2$ and injected into the natural gas system. A methanation process is used to convert hydrogen into methane using a variety of sources of $CO_2$ (could include byproduct $CO_2$ produced from ethanol fermentation or biogas upgrading into RNG processes, or captured from the air. Methanated hydrogen could increase renewable gas supplies, leveraging hydrogen while avoiding the need for new infrastructure and equipment.
- **Dedicated Hydrogen Infrastructure:** Another approach is converting customers to dedicated hydrogen infrastructure. This involves either building new hydrogen-specific infrastructure or converting existing natural gas infrastructure to be used exclusively for hydrogen.

These options align with NRCan's Hydrogen Strategy, which includes a vision for 2050 that ">50% of energy supplied today by natural gas is supplied by hydrogen through blending in existing pipelines and new dedicated hydrogen pipelines".[21] A number of Canadian utilities (ATCO, Enbridge) have already launched hydrogen blending pilots, while others are investigating hydrogen use on their systems. Canada is not alone in supporting hydrogen decarbonization pathways. Europe is advancing many of the leading projects on hydrogen use, while the U.S. Department of Energy recently launched an 'Earthshot' Initiative, aiming to reduce the cost of green hydrogen to $1/kg (USD) by 2030.[22] Cost reductions of this magnitude, could dramatically transform the industry.

### *Carbon Capture, Negative Emissions Technologies, and Offsets*

Carbon dioxide capture and sequestration (CCS) is a set of technologies that can greatly reduce $CO_2$ emissions from new and existing coal- and gas-fired power plants and large industrial sources. CCS is a three-step process that includes the capture of $CO_2$ from power plants or industrial processes, transport of the captured and compressed $CO_2$ (usually in pipelines[23]), and underground injection and geologic sequestration (also referred to as storage) of the $CO_2$ into deep underground rock formations that sit below impermeable, non-porous layers of rock that trap the $CO_2$ and prevent it from migrating upward.[24]

There are a number of strategies that can be leveraged to reduce GHG emissions in other parts of the economy or extract $CO_2$ from the atmosphere and sequester it. These strategies can

[21] https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf
[22] U.S. Department of Energy, 2021. https://www.energy.gov/articles/secretary-granholm-launches-energy-earthshots-initiative-accelerate-breakthroughs-toward
[23] https://edmontonjournal.com/business/energy/alberta-carbon-trunk-line-depleted-oilfields-finished
[24] https://19january2017snapshot.epa.gov/climatechange/carbon-dioxide-capture-and-sequestration-overview_.html

enable economy-wide emission reduction pathways to reach carbon neutrality without all customers fully decarbonizing, providing some flexibility to governments in pursuit of climate targets. While there is uncertainty on the timeline for some of these developing options, there is also the potential for certain strategies listed below to develop into relatively cost-effective opportunities and play a significant role in the achievement of carbon neutral targets. Some commonly discussed options for this are touched on below.

Direct air capture carbon capture is a technological method that uses chemical reactions to capture carbon dioxide ($CO_2$) from the atmosphere. When air moves over these chemicals, they selectively react with and remove $CO_2$, allowing the other components of air to pass through. Once the carbon dioxide is captured from the atmosphere, heat is typically applied to release it from the solvent or sorbent. Doing so regenerates the solvent or sorbent for another cycle of capture. The captured $CO_2$ can be injected underground for permanent storage in certain geologic formations or used in various products and applications.[25]

With a carbon offset, a business, a government, or an individual can pay someone else to cut or remove a given quantity of greenhouse gases from the atmosphere. The carbon offset approach to capturing the value of emission reductions can be used as a market mechanism for many different types of projects. Some examples of carbon offsets include buying cleaner-burning cookstoves in developing countries that reduce deforestation for firewood, or the destruction of high global warming potential ozone depleting substances that would have otherwise been released to the atmosphere. It can also come as a credit for restoring a section of forest that takes in carbon from the atmosphere.

A recent study from the Pembina Institute highlighted the potential for nature-based climate solutions, showing that Canada's natural assets could provide significant carbon offsets.[26]

## 2.2 Emissions Reduction Potential of Gas Technologies

The technologies introduced above can drive significant emissions reductions in support of net zero targets. To demonstrate this, different combinations and assumed adoption levels of gas measures were developed into three pathways to support net-zero targets. These national-level pathways for residential and commercial customers in Canada are based on high-level assumptions on the potential impact of different technologies and build off a reference case for gas consumption levels from the Canada Energy Regulator Energy Futures study. Each of the three illustrative gas pathways puts more emphasis on the adoption of different gas emission reduction options. These are not optimized pathways – such analysis needs to be done at the local-level to account for all relevant impacts – but instead highlight the scale of emissions reductions that could be possible through gas technologies and low/no carbon fuels.

[25] Direct Air Capture: Definition, Cost, & Considerations | World Resources Institute (wri.org)
[26] https://www.pembina.org/reports/nature-based-climate-solutions-2021-04.pdf

The three illustrative gas pathways are shown in **Exhibit 11**. All the pathways include expanded savings from gas utility energy efficiency programs, a shift to building codes requiring significantly less energy consumption for new construction, blending of hydrogen within the gas supply (up to 7% by energy content), and large volumes of renewable natural gas (both biogenic RNG and synthetic RNG produced from hydrogen). At a high-level, the pathways are differentiated as follows:

- **Pathway 1 (Gas Energy Efficiency):** In addition to the emissions reduction strategies mentioned above, this pathway also includes potential emissions reductions from significant adoption of gas heat pumps for space and water heating.
- **Pathway 2 (Hybrid Gas-Electric Heating):** In addition to the emissions reduction strategies mentioned above, this pathway also includes potential emissions reductions from significant adoption of hybrid heating arrangements that pair electric air-source heat pumps with natural gas furnaces.
- **Pathway 3 (Carbon Neutral Fuels):** In addition to the reduction strategies mentioned above, this pathway includes a small portion of residential and commercial customers converting to use 100% hydrogen by 2050, as well as higher RNG consumption levels.

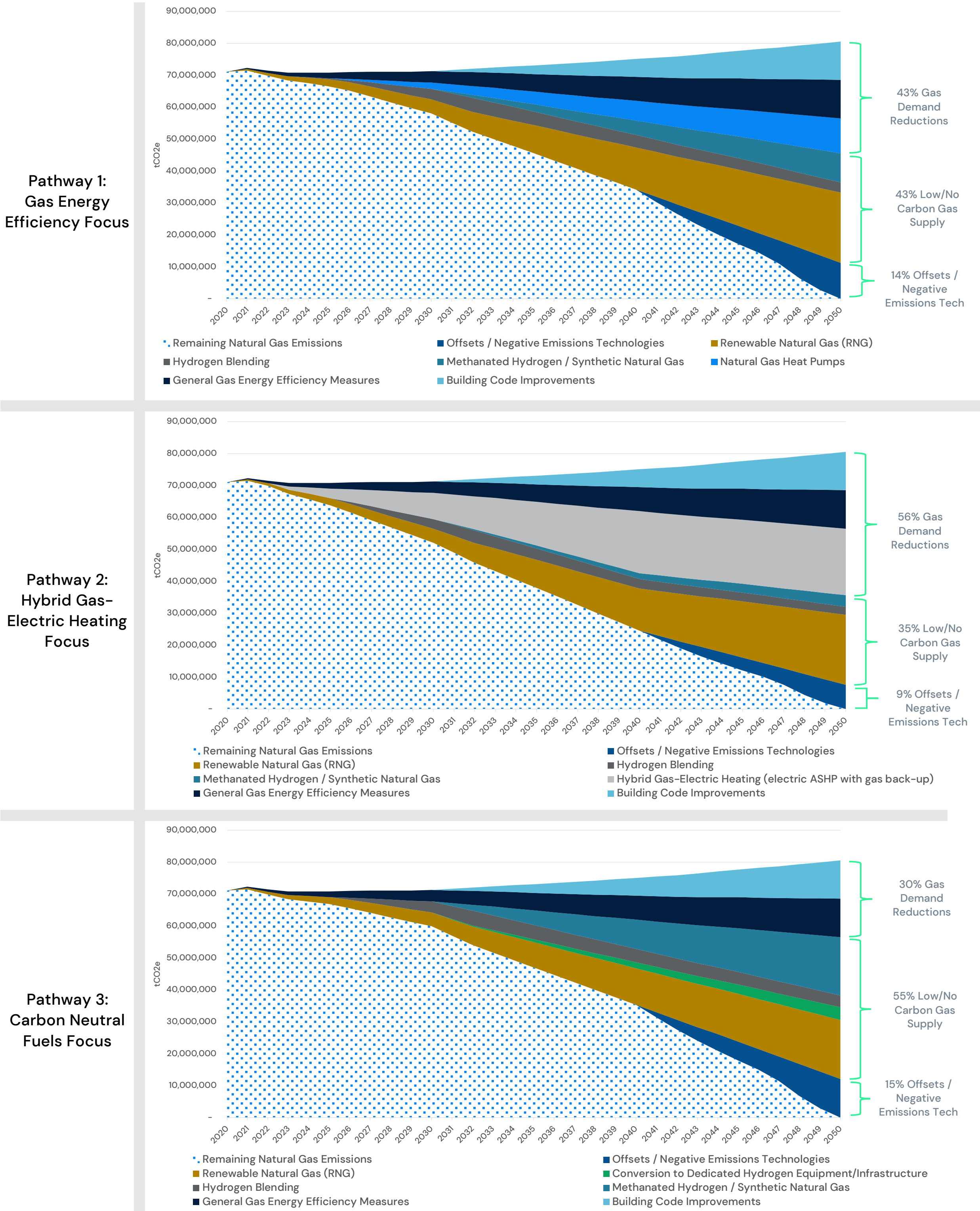
These pathways are meant to be illustrative of the kinds of combinations of emission reduction strategies that a given utility or region might prioritize, but are not intended to be prescriptive. Many other pathways combining emission reduction strategies differently could also be possible, and this study does not attempt to establish an 'optimized' pathway. Particularly given the diverse array of measures available, the optimal pathways for a specific region and utility will vary based on highly localized factors, such as climate/temperatures, energy prices, the composition of the housing stock, and commercial and industrial base, as well as the capacity, age and GHG intensity of existing electricity generation, transmission, and distribution infrastructure. The other emission reduction pathways adopted in a given area, including for sectors outside the scope of this work (e.g., power generation and transportation), as well as the speed of change, will also impact the optimal pathway for a given region.

These pathways are not intended to downplay the challenges involved in reaching net zero targets or make such a transformative change look easy. The challenges to shifting all energy systems and our economy to net-zero GHG emissions should not be underestimated. Other studies highlighting what might be required to reach net zero often highlight the need for aggressive action to reach these targets. For example, the IEA's Net Zero by 2050 report assumed for buildings that "retrofit rates will increase in advanced economies from less than 1% per year today to about 2.5% per year by 2030,"[27] representing a significant increase in the adoption of such energy efficiency measures and might include large upfront costs for customers. Gas utilities can

[27] https://www.iea.org/reports/net-zero-by-2050

be a constructive partner that help break down barriers to adoption and advance emissions reduction technologies.

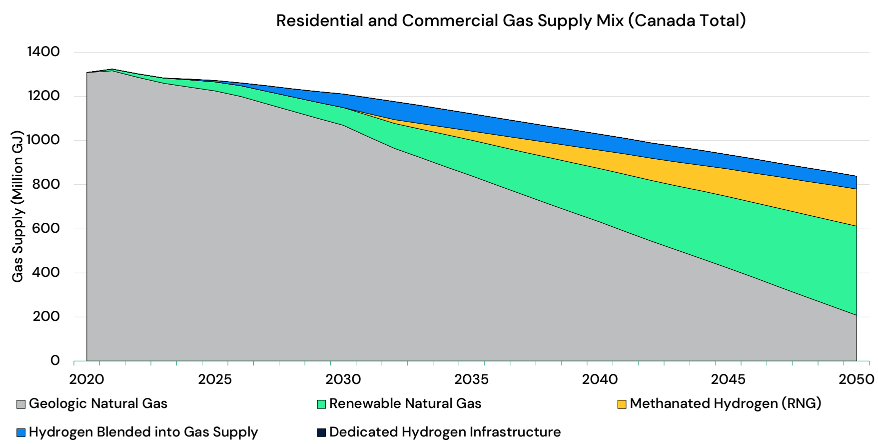
*Exhibit 11 – Illustrative Emissions Reductions Pathways for Gas Infrastructure to Support Net-Zero Targets*



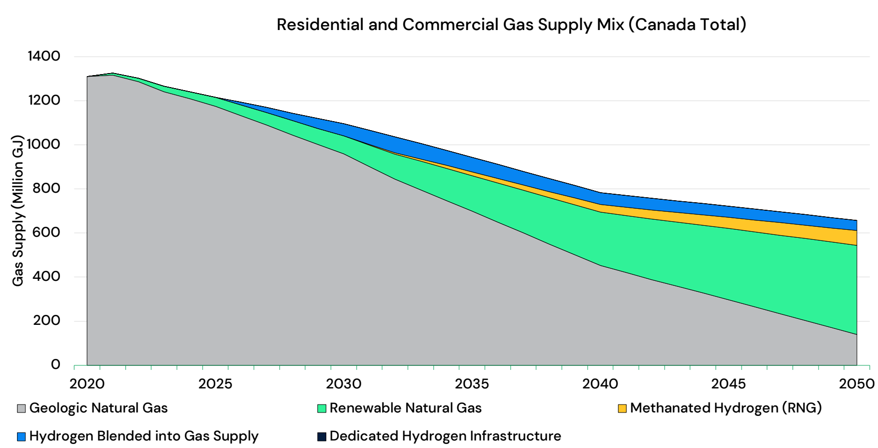
The gas supply mix diagrams in **Exhibit 12** correspond to the same three illustrative gas emission reductions pathways as **Exhibit 11**, but instead show potential implications for the different types of gases utilities might be supplying their residential and commercial customers under these scenarios. These diagrams do not cover all the natural gas use in Canada; for example, they do not capture gas volumes for industrial customers, power generation, or exports.

*Exhibit 12 – Illustrative Gas Supply Mix Pathways to Support Net-Zero Targets for Buildings*

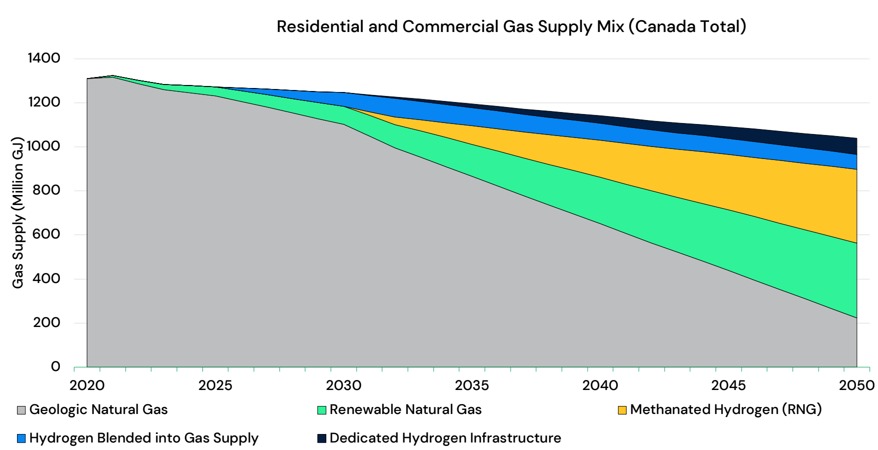
Pathway 1:
Gas Energy
Efficiency Focus




Pathway 2:
Hybrid Gas-
Electric Heating
Focus




Pathway 3:
Carbon Neutral
Fuels Focus



# 3. Impact of Federal Carbon Pricing Policy

## 3.1 Updated Federal Carbon Pricing Policy

As part of Canada's 2016 Pan-Canadian Framework on Clean Growth and Climate Change, provinces and territories must adhere to the national carbon pricing policy or create and implement an equivalent system considering their individual characteristics. The original plan included expectations for the carbon price to be increased April 1st of each year, starting from $20 per tonne of $CO_2$ emitted in 2019 and ramping up until reaching $50 per tonne of $CO_2$ emitted in 2022.

The Greenhouse Gas Pollution Pricing Act[28] was passed in 2018, and the provinces and territories where the fuel charge is being levied directly by the federal government are: Alberta, Manitoba, Ontario, Saskatchewan, Prince Edward Island, Newfoundland and Labrador, Yukon, and Nunavut. Those provinces and territories have not presented (and had approved) an equivalent plan for their region.

More recently, the Federal Government has proposed a modification to this policy that would see the carbon price increase by $15 per tonne of $CO_2e$ beginning in 2023 and continue to increase through 2030, when it would reach $170 per tonne of $CO_2$ emitted, as shown in **Exhibit 13**.

*Exhibit 13 - Federal carbon pricing proposal until 2030*

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carbon Price ($/tonne $CO_2$) | $20 | $30 | $40 | $50 | $65 | $80 | $95 | $110 | $125 | $140 | $155 | $170 |

Despite the significant increase in carbon price, plans for the program appear to remain 'revenue neutral,' with all proceeds being returned directly to Canadian families and communities through 'Climate Action Incentive' payments. For example, **Exhibit 14** provides an estimate of what these payments might be in 2030, based on the $170/tCO_2$ carbon price. As the carbon prices rise, the frequency of customer 'refunds' is planned to become quarterly, to mitigate the lag in payments.

[28] G-11.55.pdf (justice.gc.ca)

*Exhibit 14* - Illustrative Estimates of Climate Action Incentive Payment Amounts for 2030 ($170/tonne) [29]

| Amount | Ontario | Manitoba | Saskatchewan | Alberta |
|---|---|---|---|---|
| First adult | $ 1,009 | $1,317 | $ 1,914 | $ 1,621 |
| Second adult | $ 505 | $ 658 | $ 957 | $ 811 |
| Child | $ 252 | $ 329 | $ 479 | $ 405 |
| Example: Baseline amount for a family of four | $ 2,018 | $ 2,633 | $ 3,829 | $ 3,242 |

British Columbia and Quebec took the lead in implementing their own carbon pricing plans in 2008 and 2018, respectively. Provinces like Ontario[30] and New Brunswick recently had their own plans approved (both in 2021), but before that had to comply with the federal guidelines. Nova Scotia and the Northwest Territories also have their own plans and do not participate in the federal plan. It is unclear at this time what the announcement of higher carbon prices will mean for provincial plans maintaining 'equivalency'.

## 3.2 Carbon Pricing Impacts on Gas Rates

The implementation of federal carbon pricing policy will have a significant impact on natural gas bills for residential and commercial customers in Canada. To better understand potential bill impacts, **Exhibit 15** and **Exhibit 16** below highlight the percentage increase in effective commercial and residential natural gas rates from the addition of carbon pricing in 2020 ($30/tCO$_2$) and in 2030 ($170/tCO$_2$) to the Canadian Energy Regulator's Energy Futures forecast of natural gas rates.

While the federal fuel charge will only apply directly in provinces and territories that do not have their own qualifying program, the rate impacts are shown here for all regions with gas distribution systems, since provincial programs will be expected to increase their stringency to keep up with the newly announced plan for carbon pricing to go beyond $50/tCO$_2$.

The exhibits below show that while the initial bill impacts for natural gas customers from carbon pricing will be modest, all other things equal, by 2030 natural gas customers will be faced with significantly higher bills to heat their homes. While the carbon pricing adder to gas rates shown here is the same for all provinces (+$7.58/GJ in 2030), the percentage increase resulting from the carbon price will vary by province. For example, in provinces like Alberta where natural gas rates are particularly low, the carbon price will see residential gas rates increase by 34% and 129% in 2020 and 2030, respectively. Whereas Quebec, where gas rates are currently higher, would see

[29] Climate Action Incentive Payment Amounts for 2021 - Canada.ca

[30] Ontario's "Ontario Emissions Performance Standards" plan is a large industry program meant to replace the Output-Based Pricing System. Ontario is still be subject to the federal fuel charge (part 1 of the Greenhouse Gas Pollution Pricing Act).

12% and 46% increases for the same years and carbon prices. The relative impact for commercial customers will also be higher, again because these customers are used to receiving lower natural gas rates. This will be compounded where the provinces seeing higher percentage increases in their rates are also provinces with higher per customer natural gas consumption.

*Exhibit 15 - Breakdown of residential natural gas rate impacts from Federal Carbon Pricing Policy*

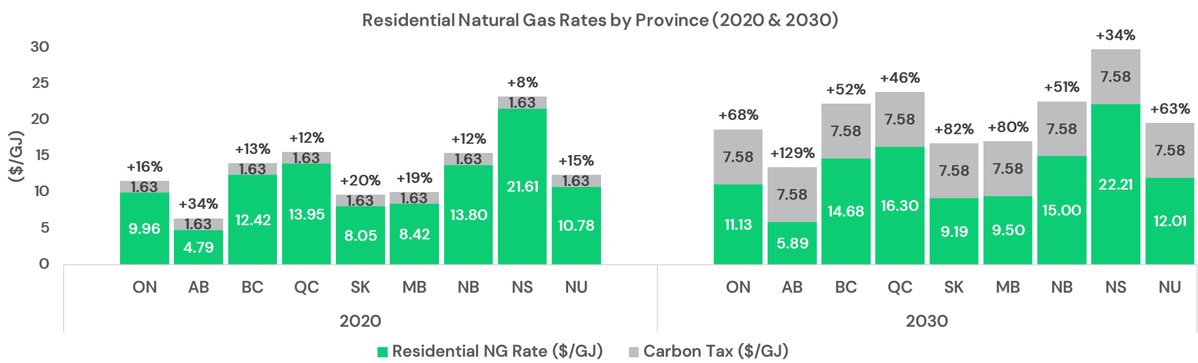
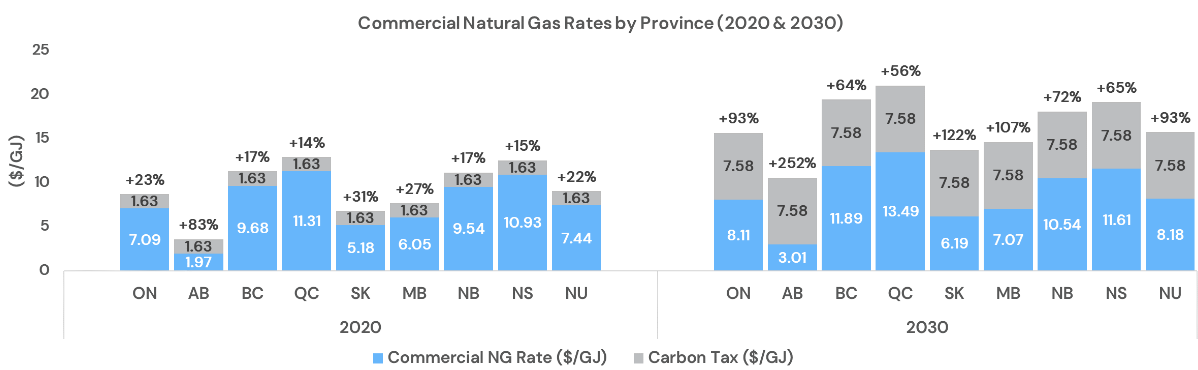



*Exhibit 16 - Breakdown of commercial natural gas rate impacts from the Federal Carbon Pricing Policy*




As noted above, federal carbon pricing policy is designed to offset the increase in customer energy bills from carbon prices by returning money directly to Canadians, structured in a way that aims for most residential customers to receive more money back than their aggregate bill increases. **Exhibit 17** highlights plans for average household payments to outweigh average household cost impacts. Note that the rebates shown below are intended to cover carbon pricing on more than just natural gas consumption – for example, they also factor in average household consumption of gasoline.

*Exhibit 17 – Estimate of Average Climate Action Incentive Payments, per Household, for 2021 ($40/tonne)*[31]

| | Ontario | Manitoba | Saskatchewan | Alberta |
|---|---|---|---|---|
| **Average cost impact per household[1] of the federal system** | $ 439 | $ 462 | $ 720 | $ 598 |
| **Average Climate Action Incentive payment per household[2]** | $ 592 | $ 705 | $ 969 | $ 953 |

## 3.3 Impact of Federal Carbon Pricing Policy

**An important question is whether the increasing carbon prices will change customer behaviour and drive GHG emissions reductions.** Naturally, it can be expected for customers to conserve more energy when faced with higher energy prices. But will these carbon pricing levels, on their own, be enough to drive a significant portion of Canadians to take larger scale change – such as fuel-switching from natural gas to electricity or under-going a deep energy retrofit of their home? It is challenging to predict how much fuel switching or energy efficiency carbon pricing will drive on its own, but some considerations are discussed below:

- **The costs of alternatives to natural gas matter to fuel switching.** Despite the significant increases to natural gas rates, other technologies such as electric heating may still be more expensive options. For example, consider Ontario, where residential gas rates are forecasted to increase by 68% in 2030 due to the carbon price, meaning customers would be paying $18.71/GJ for natural gas, which is equivalent to $0.067/kWh. However, the 2030 residential electric rates for Ontario could still be more than three times higher at $61.95/GJ or $0.22/kWh.[32]
- **The practical implications of emergency furnace replacements.** If a gas customer's furnace breaks in the winter, they are looking to restore their heat as quickly as possible. Installing a new furnace is typically the cheapest and most straightforward option – particularly in the winter, since the change can all be done inside. As opposed to trying to replace an external air-conditioner with an Air-Source Heat Pump, which in some cases may also require electrical upgrades, new piping through the walls, or even installation of larger air ducts.
- **Long equipment lifespans.** Natural gas furnaces, boilers, and water heaters all have relatively long lifespans – in the 10 to 25 year range. The relatively slow natural turnover rate in equipment likely makes it harder for carbon prices to influence equipment decisions in the short term.
- **Customer preferences for gas.** Customer habits and preferences may reduce the impact of carbon pricing on fuel switching, if many Canadians express a preference to continue using gas in their daily activities, such as cooking.

[31] Climate Action Incentive Payment Amounts for 2021 - Canada.ca
[32] Electric rates based on the same CER Energy Futures Reference Case used for base gas rates.

It is difficult to predict the extent to which carbon prices, even large ones, on their own will drive Canadians to fuel-switch away from natural gas or implement deep energy efficiency improvements. Ultimately, with the aggressive 2030 and 2050 emissions reductions targets that Canada is pursuing, Canadians will need to be supported in reducing their emissions, a role that natural gas distribution companies could fill.

## 4. Potential Consumer Energy Cost Impacts Under Different Pathways

This section lays out examples showing potential energy cost impacts for different types of gas customers in 2030. The examples compare customers implementing measures to reduce their gas use and decarbonizing that gas, against a customer who does not reduce emissions and elects to 'just pay the carbon tax'. The examples in **Exhibit 18** indicate the gas consumption and emissions for each customer configuration, as well as the resulting combination of gas energy costs and carbon pricing costs[33] – with numbers shown accounting for different gas rates in each province. The three customer configurations featured in **Exhibit 18** are as follows:

- **Average Home with Conventional Natural Gas:** The first example represents an average Canadian home, assumed to use 90 GJ/year of natural gas, which results in 4.9 tons of $CO_2e$. If this customer did not take any further actions to reduce those emissions by 2030 then their natural gas costs (varies by province, shown here for all) and carbon pricing costs (based on \$170/t$CO_2$ and the specified emissions) can be calculated for this 'just pay the tax' approach.

- **Highly Efficient New Construction Home with Renewable Natural Gas:** The second example represents a highly insulated and efficient new home that is built with significantly lower energy requirements (29 GJ) which is supplied by RNG in order to achieve carbon neutrality. In this example, the gas costs are increased to pay for RNG, but the overall impact of more expensive gas supply is muted by the significant drop in how much gas is required. Since the customer emissions are reduced to zero, no carbon price is applied here.

- **Retrofitted Average Home with Renewable Natural Gas:** In the third example, which represents an average existing building, energy efficiency retrofits reduce the space heating load, while a gas heat pump is also installed, resulting in annual gas consumption of 60 GJ. In this configuration, RNG is again used to decarbonize the remaining gas use and achieve net zero annual emissions.

[33] Note that this simplified comparison of annual costs for a few customer configurations does not account for capital/installation costs, or represent an average of expected costs on net-zero pathways, which are beyond the scope of this analysis.

Of these three configurations, the customer energy costs included here are lowest for the 'highly efficient new construction' home. This was expected, as it is easier to achieve deep energy reductions when designing/constructing a new building. But it is also worth noting that, based on the demand reduction and RNG cost assumptions included here, the Retrofitted Home with Renewable Natural Gas configuration produces a lower energy cost option than the 'just pay the carbon tax' approach for an average existing home. As such, the configuration leveraging RNG is more favourable both for customers and for the achievement of Canada's climate targets, since it drives actual emission reductions (where the first configuration involves paying the government the federal fuel charge while avoiding reducing emissions). There is significant uncertainty surrounding RNG costs at high adoption levels, however even if higher RNG costs made some building configurations more expensive than a customer simply paying the carbon price – the RNG pathways are still preferable in that they drive actual emission reductions.

In addition to the summary and values provided for each configuration in **Exhibit 18**, a visualization of how these example configuration costs compare in each province is provided in **Exhibit 19**. It is important to keep in mind the simplified configurations use the same customer consumption for each province, to make for even comparison, while average per customer consumption is lower in some provinces.

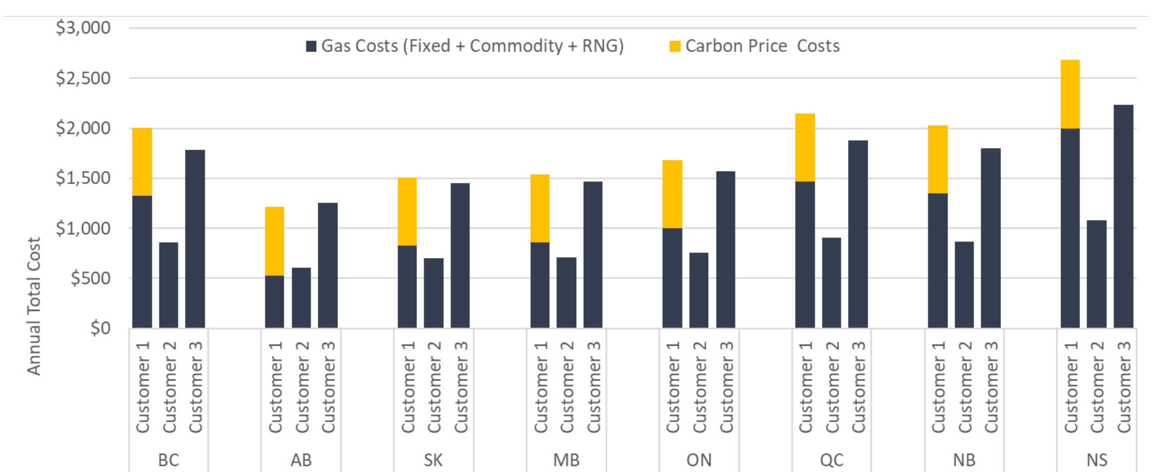
As discussed previously, the Federal Government would also be using Climate Action Incentive payments to support households with increased energy costs. Those payments are not included above because all three customer configurations would receive the same payment amount (assuming same sized family). The Climate Action Incentive payments do not change whether or not the individual household actually has a lower emissions profile. So while the payments will help with the affordability of carbon cost in each of these configurations, they do not change the relative costs of each household configuration to each other, and the impact of the payments on customer behaviour is unclear.

*Exhibit 18 – Energy Cost Impact Examples for Residential Gas Customers in 2030*

| | Average Home with Conventional Natural Gas | | | Highly-Efficient New Home with Renewable Natural Gas | | | Retrofitted Average Home with Renewable Natural Gas | | |
|---|---|---|---|---|---|---|---|---|---|
| **Annual Natural Gas Consumption** | 90 GJ | | | 29 GJ | | | 60 GJ | | |
| **Annual GHG Emissions** | 4.9 tons $CO_2e$ | | | 0 tons $CO_2e$ | | | 0 tons $CO_2e$ | | |
| **Description** | This represents an average Canadian home and a customer paying the carbon price instead of taking action to reduce emissions | | | This represents an extremely well insulated and efficient newly built home, with remaining gas use decarbonized through RNG | | | This represents an averagge existing home that is retrofitted to reduce space heating requirements, installs a gas heat pump, and uses | | |
| **Annual Gas & Carbon Costs** | Gas Costs | Carbon Cost | Total Cost | Gas Costs | Carbon Cost | Total Cost | Gas Costs | Carbon Cost | Total Cost |
| British Columbia | $1,321 | + $682 | = **$2,003** | $861 | + $0 | = **$908** | $1,781 | + $0 | = **$1,781** |
| Alberta | $530 | + $682 | = **$1,212** | $606 | + $0 | = **$606** | $1,253 | + $0 | = **$1,253** |
| Saskatchewan | $827 | + $682 | = **$1,509** | $702 | + $0 | = **$702** | $1,451 | + $0 | = **$1,451** |
| Manitoba | $855 | + $682 | = **$1,537** | $711 | + $0 | = **$711** | $1,470 | + $0 | = **$1,470** |
| Ontario | $1,002 | + $682 | = **$1,684** | $758 | + $0 | = **$758** | $1,568 | + $0 | = **$1,568** |
| Quebec | $1,467 | + $682 | = **$2,149** | $908 | + $0 | = **$908** | $1,878 | + $0 | = **$1,878** |
| New Brunswick | $1,350 | + $682 | = **$2,032** | $870 | + $0 | = **$870** | $1,800 | + $0 | = **$1,800** |
| Nova Scotia | $1,999 | + $682 | = **$2,681** | $1,079 | + $0 | = **$1,079** | $2,233 | + $0 | = **$2,233** |

**Notes:**
1 Assumes a highly-efficient new home consumes 70% less natural gas compared to a code-built home.
2 The home retrofit is assumed to reduce the space heating load by 20% and includes the replacement of a standard efficiency furnace (AFUE 92%) with a gas heat pump (COP 1.3).
3 Natural gas prices based on rates provided in Canada's Energy Future forecast.
4 Assumes an incremental cost of $15/GJ for RNG.

*Exhibit 19 – Comparison of Energy Cost Impact Examples for Residential Gas Customers in 2030*




**Customer Configuration Examples**
Customer 1: Average Home with Conventional Natural Gas
Customer 2: Highly-Efficient New Home with Renewable Natural Gas
Customer 3: Retrofitted Average Home with Renewable Natural Gas

## 5. Regulatory Considerations

Reaching 'net-zero' emissions targets would represent a transformative change to our energy systems and economy. Decarbonization of the economy will require a broad mix of regulatory and policy drivers to initiate, sustain, and support the process. New policies and regulations will be needed to define and structure requirements for reductions and to provide the regulatory support and funding to implement these requirements.

As regulated utilities, the ability of CGA members to implement the pathways discussed in this report will depend on approval and support from policymakers, regulators, customers, and other stakeholders.

Utility regulation has historically focused on providing safe and reliable service at the lowest cost to consumers with relatively limited explicit consideration of environmental impacts. Gas utilities cannot recover the costs of reducing emissions if the costs would increase rates without approval from their regulators. For example, most gas utilities in Canada do not have 'permission' or a regulatory pathway to recover the costs of procuring RNG for their customers. But by 2030 provinces will have in place the federal carbon price of \$170/t$CO_2$, or their provincial 'equivalent' carbon pricing plan. Gas utilities should at a minimum be enabled to implement GHG emission reduction strategies for their customers that will cost less than the carbon price. For example, utility energy efficiency program budget increases could be supported by cost-effectiveness testing that reflects the value of GHG emissions reductions, allowing more measures and programs to meet the required cost-effectiveness criteria.

A successful, cost-effective emission reduction program requires a cooperative, integrated pathway across sectors, energy sources, and levels of government. A key first step would be to revisit and examine the legislative frameworks that govern utility regulatory and permissible utility investments – namely the Utility Acts in each province. These Acts generally do not allow for large scale investments into emission reduction projects, given the economic regulation that governs utilities. Therefore, for natural gas utilities to play a transformative role in getting to net zero, it will be necessary for new legislative frameworks to be developed that recognize a broader set of policy goals – including emission reductions.

Regulatory frameworks and legislation will need to be reformed to enable, incentivize, and reward innovation for emissions reductions. In addition, many of the changes will require consumer acceptance to be implemented, and will raise important consumer equity issues that will need to be addressed. Research and development of emerging technologies will also need the support of regulators and investors. Regulations encourage safe, effective, and coordinated planning, and can best support when framed to facilitate the adoption of a variety of conventional and new technologies that meet emissions guidelines. In turn, policy can spur innovation and save consumers money. A net-zero future will also likely require the coordinated efforts of gas and electric utilities, particularly in order to maintain energy system resiliency and reliability, reduce negative customer impacts, accelerate emission reductions, and create opportunities for emerging technologies (such as power-to-gas and hydrogen).

# 6. Summary

Overall, the results of this study indicate that Canada's natural gas industry has the potential to make important contributions to the nation's energy and climate future. Gas utilities are already making strides on this front with energy efficiency programs, low- and zero-carbon fuel procurement, gas heat pumps and hybrid heating systems, and other investments in innovation. By expanding these initiatives and prioritizing a range of other emerging opportunities, natural gas utilities can help maintain a high quality of energy service while deeply contributing to net-zero emissions and providing Canadians with safe, reliable, and clean energy. Natural gas utilities have a big stake in today's energy sector and can be key players in supporting net-zero commitments. However, gas distribution companies cannot act on their own – many or most of the actions that could be taken by gas distribution companies to reduce carbon emissions will require approval from regulators and policy makers, and acceptance and active participation by gas distribution company customers.

A Canadian Gas Association study
prepared by ICF

October 2021