Summary of findings

What Does the Future Hold for Natural Gas?

Considering the role of natural gas and the gas system in Canada's low-emissions future

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POLLUTION PROBE
CLEAN AIR. CLEAN WATER.

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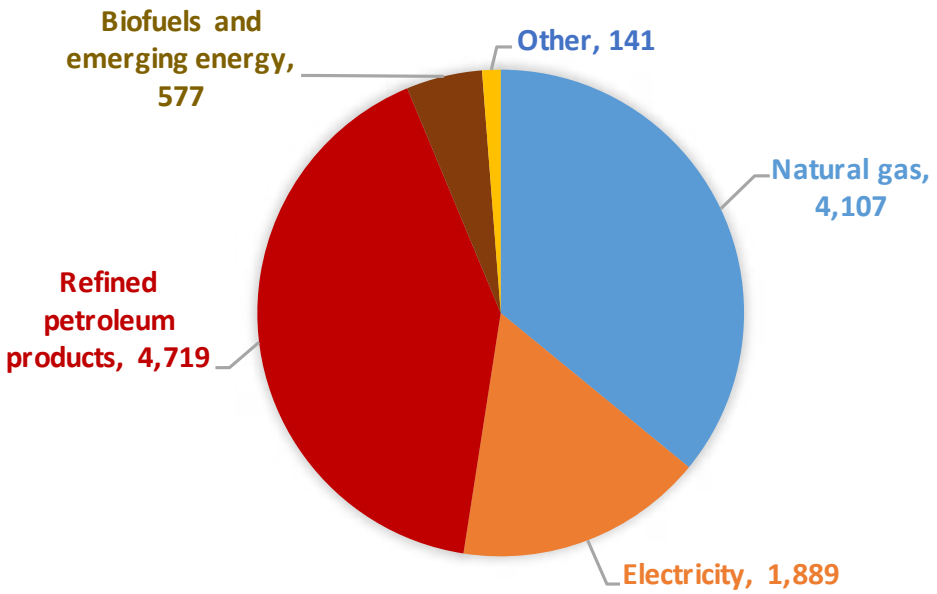
We need to talk about natural gas

Canada is establishing aggressive targets to reduce greenhouse gases (GHGs) over the coming decades as it transitions to a low-emissions and sustainable energy system. To achieve our targets we need to assess how we produce, source and deliver our energy, what energy supplies and technologies are needed, and how all existing energy infrastructure could contribute to the transition.

The natural gas system provides major benefits to Canadians. Natural gas is one of the only fuels to supply almost every sector of a modern economy – from industrial processes, to creating fertilizer for agriculture, to generating electricity, to providing space and water heating and fueling trucks and marine vessels for transportation. Figure 1 shows Canada's reliance on natural gas, which provides over double the energy that electricity does, and at a much lower cost.

Figure 1: Canada's secondary energy use (final demand) by energy source in petajoules (PJ), 2017[1]



The natural gas system also has the added advantages of having nationwide infrastructure already in place, including large storage facilities. Through storage alone, Canada can meet 63 days' worth of natural gas winter demand.[2]

Due to our long heating season energy demand is very seasonal and rises considerably in winter. For example, peak demand on the natural gas system to meet heating requirements in Ontario is three times that of the peak energy demand on the electricity system.[3] Storage provides the flexibility to quickly ramp up supply to meet this high seasonal energy need at a reasonable cost.

Given this high heating demand in Canada, full electrification, even using high-efficiency cold climate heat pumps, could lead to large seasonal imbalances in power demand. The need for large new

[1] Canada Energy Regulator, "End-Use Demand," *Canada's Energy Future 2018: Energy Supply and Demand Projections to 2040*, 2017. At https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA.
[2] Canada Energy Regulator, *Market Snapshot: Where does Canada store natural gas?*, May 23, 2018. At https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/snpsht/2018/05-03whrdscncstrngrlgs-eng.html. Conversion based on CER conversion factors, available at https://apps.cer-rec.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA#s1ss2.
[3] Enbridge Gas, *2017 LTEP Submission*, December 16, 2016.

electricity infrastructure to meet this new electricity demand could be problematic in some urban areas that are already facing electricity capacity constraints. In addition, it could take decades to build and it would also be extremely costly.

Yet the issue remains that natural gas is still a fossil fuel. The emissions from its use have come under increased scrutiny and are subject to legitimate questioning, especially as global trends and government policies point to a low-emissions energy future. The nature and use of both the gas itself and the gas system will need to be changed, but considering the reliance that many Canadians have on natural gas to provide affordable energy, this change will have to be done efficiently and fairly.

It is important to note that it is not inevitable that the gas system will play a role in a low-carbon world. There are benefits to continuing to use the gas system as we transition to a low-emissions energy system. But in the end it will be up to the utility sector, energy regulators and government policy makers to demonstrate commitment to playing a role in reducing emissions, and helping Canada transition to a lower-emissions energy system.

To understand the issues and barriers around the transition in the downstream gas sector, Pollution Probe convened a workshop in spring 2019 with over 40 stakeholders from across Canada, including representatives from gas distributors from across Canada, electrical utilities, all levels of government, regulators, and the businesses and financial sectors. Following on from that, a public webinar was also held to gather more feedback.[4]

[4] Note that this paper will focus only on the downstream natural gas industry which is the transmission, storage and distribution of natural gas by mid-stream and gas distribution companies using a network of local distribution pipelines. Industrial users of gas outside the oil and gas sector, some of whom are connected to the gas transmission networks, will also be considered. The upstream production of gas and electricity generation, while important, are not considered here.

What we can do

We will need to consider how, when and where we use natural gas and the gas system if Canada is to meet its emissions targets and transition to a low-emissions economy.

To meet our targets we'll likely need to

- reduce gas demand as much as possible through conservation and more efficient end uses
- start introducing low-carbon gases into our energy system.

Increasing efficiency is a good first step, and helps control costs for all consumers. But we will need more than just reduced demand. It is also necessary to examine how to introduce low-carbon gases at the same time.

Reducing natural gas demand

Energy efficiency and conservation programs

Reducing natural gas demand through conservation and energy efficiency programs, including improving building envelope design, is crucially important to help reduce energy bills, supply energy more sustainably and help Canada meet its GHG targets. It clearly makes sense that the first course of action should be to reduce natural gas demand as much as possible through conservation and energy efficiency.

According to the International Energy Agency (IEA), residential buildings in Canada consume 10% more energy per square meter than buildings in similar climates, such as Norway and Sweden, and 15% more than those in the USA, when adjusted for climate. To meet targets, it is projected that investments in energy efficiency would need to double from current levels, yet end-user costs would remain stable due to increased efficiency. Government and regulatory policies will need to evolve from today's business-as-usual approach to prioritizing energy efficiency and being more proactive in advancing both low-emission benefits and maintaining end-user cost stability.[5]

A report for the Canadian Gas Association said that Canada would be able to reduce our emissions by nearly 50% by 2050 primarily though promoting conservation and demand side measures as well as introducing more efficient end-use technologies.[6]

District energy and combined heat and power

Another efficiency technology is district energy (DE), the production and supply of thermal energy that is then distributed through a "district" or a region of a city — or even a single building. Hot and chilled water are produced at central plants and distributed via a closed-loop pipeline distribution system. Another form of DE uses waste heat produced from other processes, such as heat produced from a data centre, waste water, or an industrial process such as cement making. The thermal energy delivered to the buildings is used for space and water heating.

Combined heat and power (CHP) is another technology that can be used with DE, in which both heat and electricity are generated together.

[5] International Energy Agency, *Energy Efficiency Potential in Canada to 2050*, 2018. At https://www.iea.org/publications/freepublications/publication/Insights_Series_2018_Energy_Efficiency_Potential_in_Canada.pdf.
[6] ICF, *Implications of Policy-Driven Electrification in Canada: A Canadian Gas Association Study*, October 2019. At http://www.cga.ca/.

Innovation

New and innovative consumer-side technologies are also changing the way some consumers use natural gas, and can be used for improving efficiency. This includes:

- hybrid heating (air source heat pumps plus natural gas)
- natural gas heat pumps
- micro-CHP
- micro carbon capture and storage.

Low carbon gases

Renewable natural gas and hydrogen are two low-carbon gases that have strong potential to supplement or replace conventional natural gas.

Renewable natural gas

Renewable natural gas (RNG) is gas formed from renewable resources that is chemically identical to conventional natural gas. RNG can be produced from wet agriculture waste, as well as from landfills and waste water treatment plants.[7] Wood waste and other solid waste can also be converted to gas.

Some provinces have already begun to set RNG targets. The BC government introduced a target for 15% of gas consumption to come from RNG by 2030.[8] Quebec has recently set a target of 1% of gas distributed to come from RNG by 2020, and 5% by 2025.[9] Ontario and others have voluntary programs or dedicated RNG suppliers.

The Canadian Gas Association is proposing a standard of meeting 5% of Canada's natural gas demand through RNG by 2030, which would equate to 187 PJ.[10] Such an action would reduce GHG emissions by 11 $MtCO_2e$ annually,[11] accounting for 1.5% of national emissions.[12]

Hydrogen

There is growing interest both in Canada and internationally in using hydrogen as an energy carrier.

Hydrogen can be produced in two ways. The most common and commercially viable method for obtaining hydrogen is steam methane reformation (SMR), where conventional natural gas is heated with steam and the carbon and hydrogen is separated. If the carbon produced from SMR is then captured and stored, the hydrogen produced is carbon neutral and is called "blue hydrogen."

Another technique is electrolysis, which involves running an electric current through water, producing hydrogen and oxygen. If the electricity used to produce the hydrogen comes from a non-emitting source, the hydrogen produced is called "green hydrogen." Currently, electrolysis is a much more expensive method for producing hydrogen than SMR, although costs are expected to decline in line with reductions in renewable electricity generation.

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[7] The gas produced from these process is known as biogas, and has a lower methane content than conventional natural gas. To become RNG, this biogas is upgraded to contain the same composition as conventional natural gas in the pipeline.

[8] BC Government, *CleanBC*, March 2019. At https://blog.gov.bc.ca/app/uploads/sites/436/2019/02/CleanBC_Full_Report_Updated_Mar2019.pdf.

[9] *Regulation respecting the quantity of renewable natural gas to be delivered by a distributor, CQLR c R-6.01, r.4.3*, Canlii, July 1, 2019. At https://www.canlii.org/en/qc/laws/regu/cqlr-c-r-6.01-r4.3/latest/cqlr-c-r-6.01-r4.3.html.

[10] Canadian Gas Association, *Federal Policy Proposal: The Canadian Renewable Gas Initiative*, August 2018. At http://www.cga.ca/wp-content/uploads/2018/08/Renewable-Gas-Proposal_Final_August-28.pdf.

[11] Emissions associated with natural gas combustion as 57.94 kg CO_2e/GJ. (S&T) Squared Consultants, GHGenius 5.0d, 2018. At https://ghgenius.ca/index.php/downloads. Calculations conducted by BC Ministry of Energy, Mines and Petroleum and cited in Zen and the Art of Clean Energy Solutions, *BC Hydrogen Study*, 2019. At https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/ministries/zen-bcbn-hydrogen-study-final-v5_noappendices.pdf.

[12] Emissions figures from Environment and Climate Change Canada, *Greenhouse Gas Emissions*. At https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions.html.

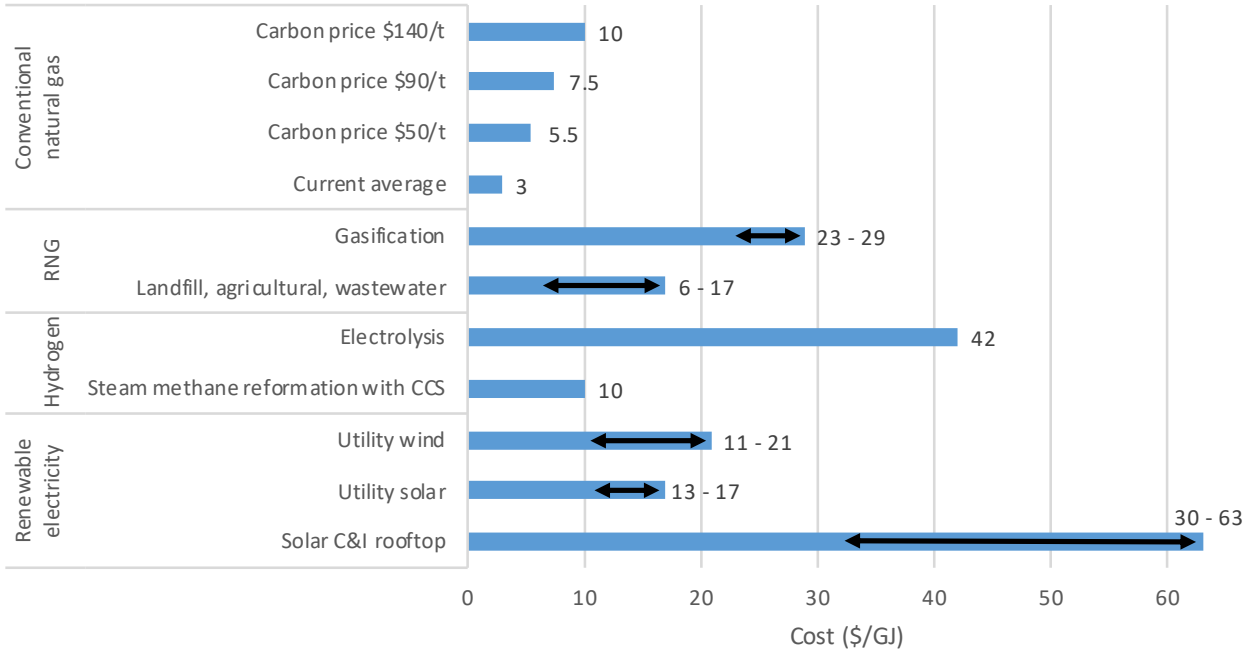
Hydrogen could be supplied directly to consumers through the current gas system, either blended with natural gas or as a substitute for it. There are a number of pilots in Europe looking at blending 20% hydrogen into the gas system, and even complete substitution. Enbridge Gas is proposing to start blending hydrogen in a pilot in Ontario.

Costs

Regardless of the technology, the costs of low-carbon alternatives to conventional natural gas are much higher. While costs for low carbon gases are expected to decline in the future, even with carbon pricing the price differential is likely to remain significant for the near- and medium-term.

It is also important to compare the costs of low-carbon gases with other renewable alternatives, and not only to conventional natural gas. Figure 2 shows a comparison of current costs of different energy sources. As shown below, low-carbon gases are cost-competitive to other forms of clean energy, such as solar and wind.

Figure 2: Cost comparison of low-carbon natural gas and renewable electricity (in Canadian dollars per GJ)[13]



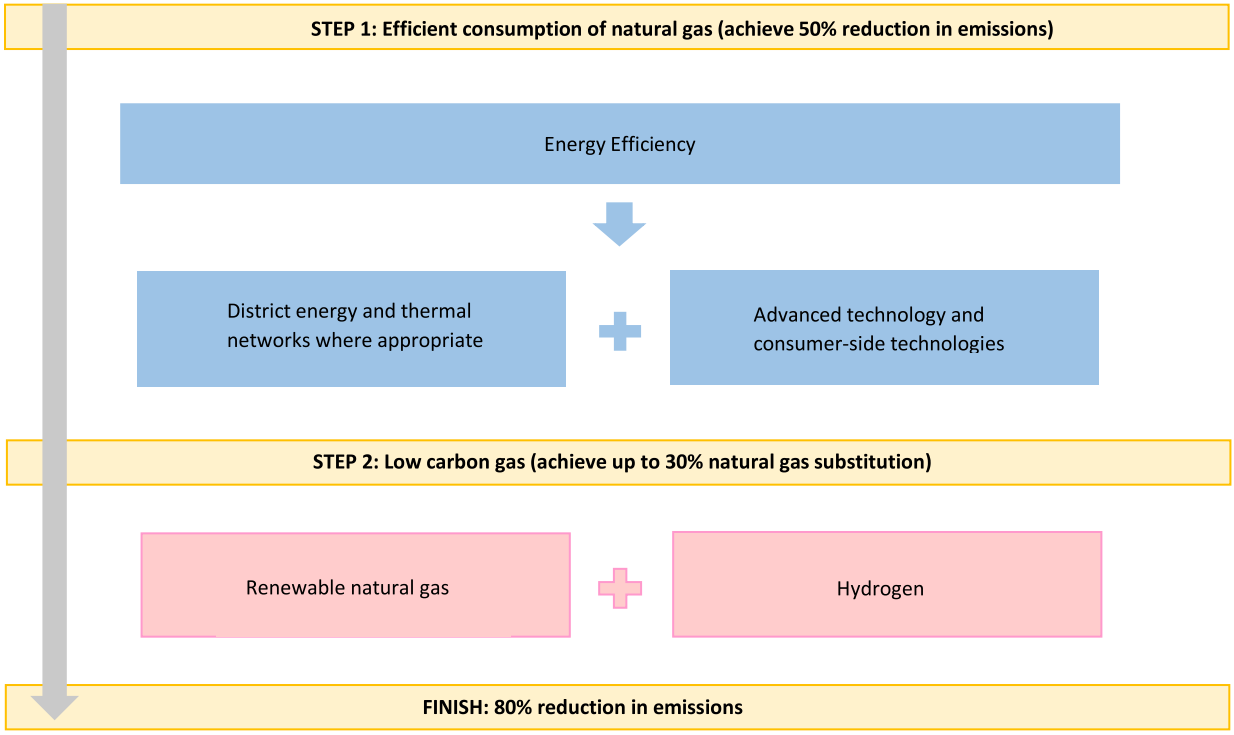
[13] See Pollution Probe, *What Does the Future Hold for Natural Gas? Considering the role of natural gas and the gas system in Canada's low-emissions future*, Full Report, November 2019. At https://www.pollutionprobe.org/future-hold-natural-gas-report for data on RNG and hydrogen. Renewable electricity costs from the unsubsidized costs from Lazard, *Lazard's Levelized Cost of Energy Analysis*, version 12, November 2018. At https://www.lazard.com/media/450784/lazards-levelized-cost-of-energy-version-120-vfinal.pdf. US dollar to Canadian dollar conversion based on the average rate of the first six months of 2019 of $1.33.

What we can do now

The first step should be to ensure customers are using natural gas as efficiently as possible, followed by examining new technologies that could provide needed energy services with lower carbon intensities.

Yet even that does not get us to the 2050 target of an 80% reduction. To achieve greater reductions in emissions, we will have to consider a role for low-carbon gases, such as RNG or hydrogen. Given the timescale we are operating in both – increasing efficiency and introducing low-carbon gases – need to be done concurrently (Figure 3).

Figure 3: A potential pathway for using the gas system to reduce emissions



Moving towards a lower-carbon energy system will require action by a number of players. Based on research and feedback from stakeholders, Pollution Probe devised a matrix of action to highlight the areas, actions and players that need to be considered as we look at next steps. Six areas of action were identified (Table 1).

Table 1: Areas of action for decarbonizing the gas system

Areas of Action	Description
Policy and regulatory reform	Policy makers need to develop a consensus and a vision on the future of energy, a vision that demonstrates long-term commitment while also allowing for flexibility in achieving it. Any plan needs to account for regional differences in Canada and there needs to be long-term policy certainty.
Conservation and efficiency	The first step should be to reduce the amount of energy needed and increase innovation on the customer side that encourages energy efficiency. New business models to increase conservation and energy efficiency should be considered.
Move to low-carbon gas	At the same time, low-carbon gases, be that RNG, hydrogen or some mixture, will need to displace conventional natural gas in part or in whole. The choice of low-carbon gas will depend on regional and jurisdictional factors. New infrastructure should be "hydrogen ready" to allow for any future developments.
Education and marketing	It will be up to utilities, regulators and governments to increase their public engagement with energy consumers and to demonstrate that they are actively working toward a low-carbon energy system vision. One way would be to change the way energy is billed and have it communicated into consistent units instead of having electricity billed in kWh and natural gas in cubic metres of PJ.
Finance	One of the major barriers to the financing of new projects is the lack of long-term commitment by many governments — federally, provincially and municipally. Government commitment and support for utilities offering long term contracts for RNG would increase the number of projects getting off the ground. Another option would be to include efficiency and innovation in the Clean Fuel Standard so they can benefit from the compliance market.
Integrated energy planning	Holistic all-energy planning that integrates electricity and thermal energy needs and considers all potential alternatives is needed to adequately assess cost-benefits of different solutions. Planning will need to be done on a regional basis and based on the needs of the region.

The transition to a low-carbon world is already underway. The gas system can support this transition and continue to supply energy to Canadians. But to do so, we need to start now to improve energy efficiency and to introduce more low-carbon gases into the mix.

It is important that we develop policy frameworks that focus on goals and outcomes, allows for innovation and multiple technological pathways for achieving those goals and outcomes, maintains customer choice and preserves the benefit of a competitive marketplace.

We are at the point where it is necessary to move beyond a pipes-versus-wires debate and see how all sectors can play a collaborative part in the energy systems transition.[14] The advancement of a low-carbon energy future would clearly benefit from holistic energy planning that embraces both increased electrification and the development of renewable gas supplies. We will likely need both – clean electricity and clean gas.

For more information the full report is available on the Pollution Probe website at

https://www.pollutionprobe.org/future-hold-natural-gas-report

[14] Dave Elliott, *Rethinking power: pipes versus wires*, March 6, 2019. At https://physicsworld.com/a/rethinking-power-pipes-versus-wires/.

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Pollution Probe is solely liable and responsible for the contents of this report. All opinions in this report are solely those of Pollution Probe and do not necessarily reflect those of our funders or the participants in the workshop.

About Pollution Probe

Pollution Probe is a national, not-for-profit, charitable organization established in 1969 that exists to improve the health and well-being of Canadians by advancing policy that achieves positive, tangible environmental change. Pollution Probe has a proven track record of working in successful partnership with industry and government to develop practical solutions for shared environmental challenges.