Reducing GHG Emissions in HRM with Natural Gas

January, 2018

Reducing GHG Emissions by Heating Homes With Natural Gas

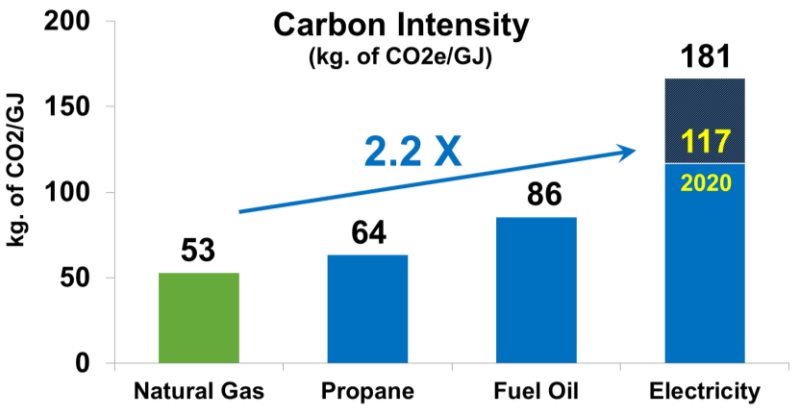
Opportunity:

Households contribute almost half of Canada's total GHG emissions and these emissions can be reduced in HRM by heating homes with natural gas instead of with furnace oil or electricity. While vehicles also contribute to total household GHG emissions, home heating – both space heat and domestic hot water – accounts for almost 60% of household GHG emissions while a household vehicle accounts for approximately 22%.

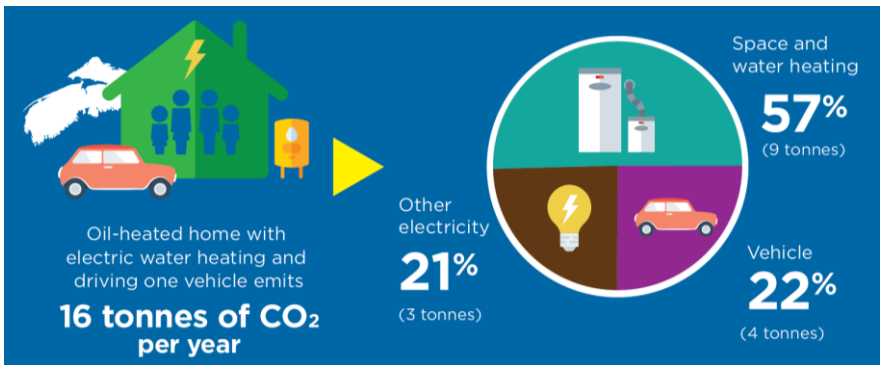
When an average HRM home converts from oil for space heat and electricity for domestic hot water to natural gas, total household GHG emissions are reduced by about 23%, or almost 4 tonnes – equivalent to trading in a gasoline vehicle for a bicycle.

Background:

While all fossil fuels emit GHGs, natural gas is the lowest-emitting fossil fuel, producing 53 kg. of CO_2/GJ, which is 68% lower than electricity generation in Nova Scotia, 38% lower than furnace oil, and 17% less than propane. In 2020, when 40% of Nova Scotia's electricity is generated from renewable sources, the GHG emissions intensity of electricity generation will decline by approximately 35%, but the GHG emissions from natural gas will still be 55% lower than electricity in Nova Scotia.



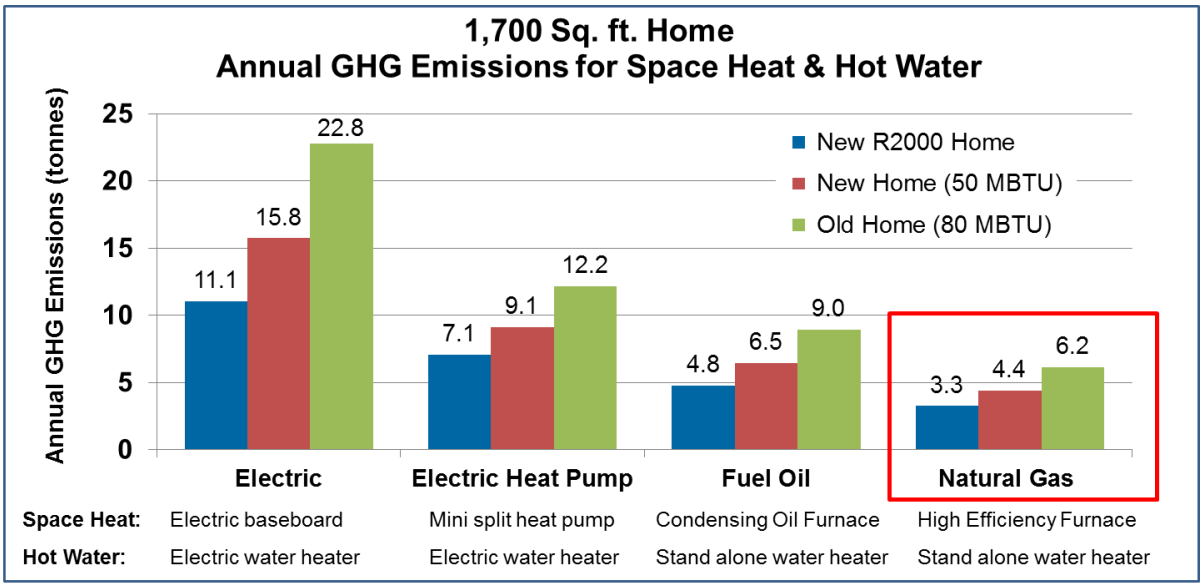
An average 4 person family living in an oil-heated home in HRM with electric water heating and driving one vehicle will emit approximately 16 tonnes of GHGs each year. Space & water heating accounts for about 57% of total GHG emissions (9 tonnes), other electricity accounts for about 21%, and a vehicle accounts for about 22%.



Households in HRM can reduce their GHG emissions by using less energy and shifting their energy use to sources that emit fewer GHGs. When an average 1,700 ft.^{2} oil-heated home in HRM with electric water heating converts to natural gas, total household GHG emissions are reduced by about 23%, or almost 4 tonnes – equivalent to trading in a gasoline vehicle for a bicycle.

Based on Efficiency Nova Scotia data, natural gas is the lowest-emitting fuel for space heating and domestic hot water for new home construction. An average 1,700 ft.^{2} 50 MBTU new construction home in HRM that uses a mini-split heat pump for space heat and an electric domestic hot water heater is projected to produce 9.1 tonnes

of GHG emissions, while the same home that uses natural gas for both space heat and domestic hot water would produce 4.4 tonnes of GHG emissions (52% less than electricity). The same home that uses furnace oil for space heat and domestic hot water would emit 6.5 tonnes of GHGs, compared to 4.4 tonnes for natural gas (32% less than furnace oil).



- Heat pumps reduce GHG emissions in homes heated with electric baseboards, but natural gas achieves lowest overall GHG emissions for space heat and domestic hot water.

Source: Efficiency N.S.- https://www.efficiencyns.ca/guide/heating-comparisons/

Renewable Natural Gas in HRM

Opportunity:

The production of renewable natural gas (RNG) in Nova Scotia is a significant opportunity to help meet Nova Scotia's energy needs and GHG emissions reduction targets. RNG can be a source of locally-produced, 100% renewable energy that can be produced at competitive or lower costs compared to other renewable energy sources in Nova Scotia like wind, solar, biomass, and tidal.

Background:

Due to the decline of off-shore natural gas from Sable and Deep Panuke and Nova Scotia's moratorium on high-volume hydraulic fracturing, Nova Scotia will soon have few sources of locally-produced natural gas. Renewable Natural Gas (RNG) can help meet Nova Scotia's energy needs with a locally-produced, competitively-priced, 100% renewable energy source.

RNG is natural gas that is produced from organic waste from farms, organics composting, landfills, forests, and water treatment plants. RNG is a low-carbon fuel that is created by capturing biogas that would otherwise escape into the atmosphere. The biogas is captured, cleaned, and blended to pipeline-quality renewable natural gas that is injected into distribution pipelines and used in the same way as conventional natural gas.

RNG could be injected into the Heritage Gas natural gas distribution system to provide a 100% renewable energy source for industrial processes, power generation, space or hot water heating, or transportation. RNG can be produced at a cost that is competitive with, or in many cases, lower than the cost of other renewable energy sources including wind, solar, biomass, and tidal.

British Columbia and Quebec have created programs and policies to promote the generation and use of RNG to reduce GHG emissions. Heritage Gas has been working with and supporting local organizations to develop an RNG market in Nova Scotia.

Financial Considerations:

A report prepared by ICF International estimates that by 2030 up to 1,700 TJs of RNG, enough to meet approximately 10% of projected 2030 Nova Scotia natural gas demand, could be produced in Nova Scotia[1]. Based on calculations from the Canadian Gas Association, RNG is estimated to cost between $10 and $25 per gigajoule (GJ) depending on the source, or 4-9 cents per kilowatt hour (kWh)[2]. Recent renewable rates for utility scale wind and Combined Heat & Power (CHP) biomass projects included in Nova Scotia's COMFIT program range from 13.1 cents/kWh for wind projects over 50 kW, to 17.6 cents for CHP biomass[3].

Environmental & Health Considerations:

Over 33,000 tonnes of CH4 (methane) – the equivalent of 843,000 tonnes of CO2 are released into the atmosphere annually in Nova Scotia from landfills, municipal green bin collection, livestock manure, food waste, waste water treatment, and solid waste disposal[1].

Since the GHG emissions from methane that is produced when organic material decomposes is 25 times higher than the CO_2 emitted from burning RNG, capturing and upgrading biogas to RNG results in a significant reduction in GHG emissions. As a CO_2 neutral fuel that displaces conventional natural gas, RNG can assist communities and governments in meeting GHG emission reduction and energy sustainability targets. Production

of RNG in N.S. can also promote municipal green bin organics collection programs by demonstrating the environmental and economic benefits of “closed-loop” integrated organics waste management.

Conclusion:

The production of RNG in Nova Scotia should be encouraged and supported by HRM and the Province of Nova Scotia along with other renewable energy sources like wind, solar, biomass, and tidal. Whether it’s used for power generation or heating, renewable natural gas can be produced at costs that are competitive or lower than other sources of renewable energy and can help Nova Scotia achieve its GHG emissions reduction targets.

Sources:

[1] ICF International: The Canadian Natural Gas Opportunity: GHG Reduction Potential to 2030 (2016).http://www.cga.ca/wp-content/uploads/2016/10/ICF-Report-Reducing-GHG-Emissions-Final-2016.pdf.

[2] The Canadian Gas Association: Renewable Natural Gas – Affordable Renewable Fuel for Canada (2016). http://www.cga.ca/wp-content/uploads/2016/05/RNG-publication-FINAL-April-2016-EN.pdf

[3] Province of Nova Scotia, COMFIT Facts Newsletter

Natural Gas Vehicles

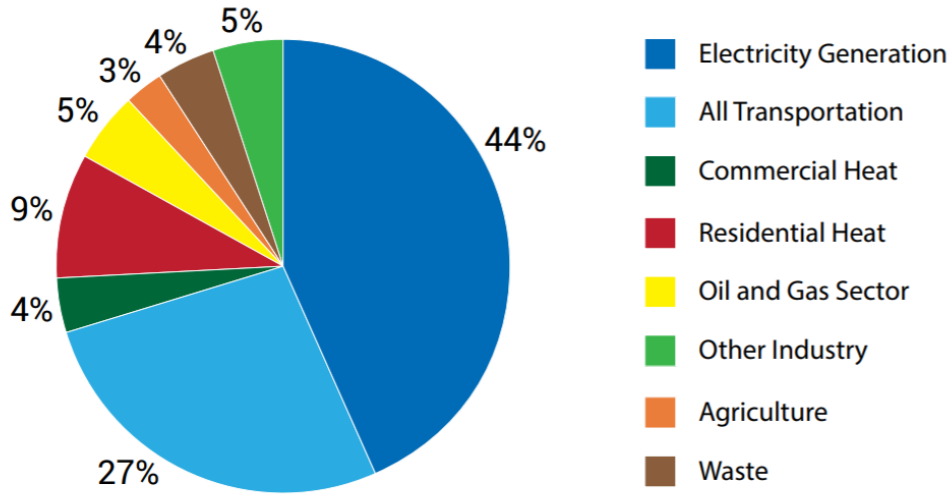
Opportunity:

The use of compressed natural gas (CNG) as a clean and affordable transportation fuel for heavy-duty and medium-duty trucks, transit buses, solid waste vehicles, and marine vessels can help HRM and local businesses to reduce GHG emissions while reducing vehicle fuel & maintenance costs.

Background:

Transportation is the second largest source of GHG emissions in Nova Scotia, accounting for 27% of total emissions[1].

Figure 1. Nova Scotia GHG Emissions 2014
(Source: National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada)



There are significant opportunities to reduce GHG emissions and support economic growth in the transportation sector through the use of compressed natural gas (CNG) as a transportation fuel. Natural gas in the form of CNG can be used as fuel in many types of vehicles including heavy-duty and medium-duty truck fleets, transit buses, solid waste vehicles, and marine vessels. CNG is made by compressing natural gas to less than 1% of its original atmospheric volume, usually between 2,900 – 3,600 psi, enabling a given volume of natural gas to be stored in a small space, which makes it easier to use for transportation.

Natural Gas Vehicles (NGVs) offer several benefits over diesel or gasoline vehicles:

- 15-20% lower fuel cost per litre equivalent than gasoline or diesel,
- Superior engine performance and 20-35% lower maintenance costs compared to diesel,
- Burns cleaner with 18-25% lower GHG emissions than gasoline or diesel[2],
- Up to 90% reduced engine noise to reduce noise pollution in urban areas,
- CNG is safer than diesel because it is lighter than air so it rises and quickly dissipates rather than accumulating near the ground.

The recently released Pan Canadian Framework on Climate Change and Growth recognizes natural gas as a fuel for transportation. CNG as a transportation fuel is becoming more popular, powering over 22[3] million

vehicles worldwide and 14,000[3] in Canada. In North America, CNG is now used in more than 250,000[4] transit buses. Several Canadian cities are converting their transit bus fleets to CNG including Vancouver, Surrey, Kamloops, Calgary, Toronto, Ottawa, Hamilton, Mississauga, and London. Green for Life (GFL) is operating a fleet of solid waste collection trucks in HRM that is fueled by CNG. Converting trucks and buses to CNG for transportation will reduce GHG and air pollution emissions due to the lower carbon content and the reduced level of impurities in CNG compared to diesel.

Natural gas vehicles are also capable of operating on 100% renewable natural gas (RNG) with no vehicle modifications required. RNG is produced by upgrading biogas from waste biomass sources to pipeline quality so it can be safely injected into the natural gas distribution system. Once upgraded, RNG can be used interchangeably with conventional natural gas. The biogas may come from many sources including organics processing, landfills, on-farm organic material, or wastewater treatment plants.

Financial Considerations:

While the initial cost to purchase natural gas vehicles can be higher, the lower operating costs can make natural gas an attractive transportation fuel option over the useful life of the vehicle. For example, CNG buses currently cost approximately $30,000 - $40,000 or 5-7% more than a similar diesel-powered buses, but the higher capital cost is more than offset by 15-20% lower fuel costs and 20-35% lower maintenance costs.

Compressed natural gas (CNG) re-fuelling stations can be installed wherever there is a natural gas pipe in the ground. Stations may be publicly accessible at retail sites or installed at private sites to serve fleets whose vehicles return to the yard at night. There are currently about 80 CNG stations in British Columbia, Alberta, Saskatchewan, Ontario and Quebec. Some public stations are co-located with existing gasoline retailers, while many of the new stations are private and are supported by fleets, gas distribution utilities and municipalities.

Environmental & Health Considerations:

The heavy-duty gasoline and diesel fleet of approximately 9,000 vehicles in Nova Scotia emitted over 1,170,000t CO_2 in 2014. Many heavy-duty vehicles could be converted to CNG by 2030 during the typical vehicle replacement cycle of 7-15 years. Conversion of 25% of the heavy-duty diesel and gasoline fleet would reduce GHG emissions in Nova Scotia by almost 59,000 t CO_2e/year. Nova Scotia Power has indicated in their 10-year plan that they intend to run 5 of their 7 coal-fired generating stations at medium to high utilization factor out to 2027[5]. Based on this report, electric battery buses will have a higher carbon footprint in Nova Scotia than CNG buses for at least the next decade.

Sources:

[1] Environment Canada, GHG Emissions Summary (2013)

[2] Natural Resources Canada's (NRC) GHGenius model, Westport Innovations Inc., 2015 Sustainability Report

[3] NGV Journal (2017). http://www.ngvjournal.com/worldwide-ngv-statistics/

[4] Transit Fleet – Business Case for Transit Fuel and 2013 Budget Mitigation, City of Hamilton (2013)

[5]http://oasis.nspower.ca/site/media/oasis/20170630%20NSPI%20to%20UARB%2010%20Year%20System%20Outlook%202017%20Report.pdf, pages 22-26.

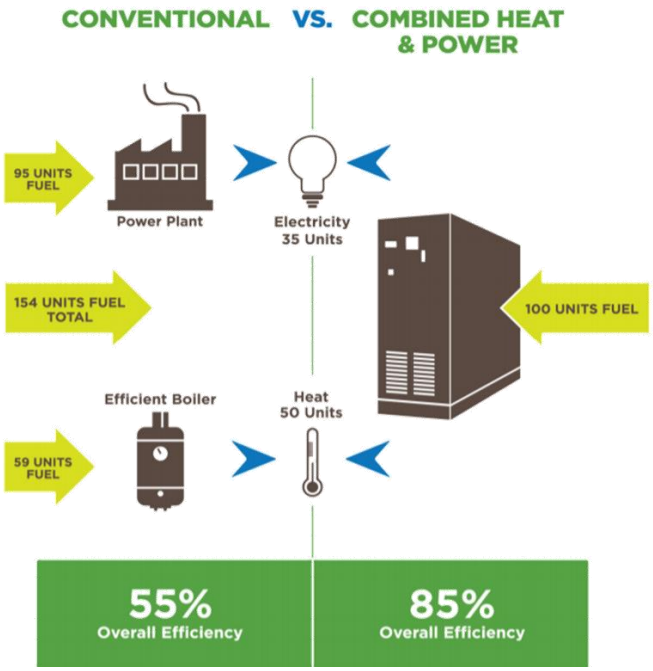
Combined Heat & Power

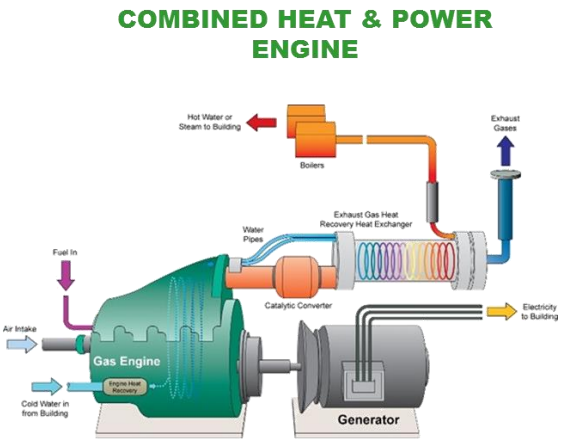
Opportunity:

The development of Combined Heat & Power (CHP) generation in HRM can help local universities, hospitals, sports & recreation centres, manufacturing operations, hotels, and multi-unit residential buildings in Nova Scotia to reduce energy costs, GHG emissions, and demand for electricity from the electrical grid.

Background:

Over the past several years Nova Scotia has improved the efficiency of electric energy use through the implementation of demand side management policies and programs. Similar improvements and cost reductions in **thermal energy** use can also be achieved with Combined Heat & Power (CHP) generation.
Thermal energy typically accounts for 60% of total building energy use, while electricity accounts for the remaining 40%. CHP integrates the production of thermal energy (heat) and electricity (power) in a single, highly efficient process. CHP systems generate electricity while capturing and using waste heat to produce thermal energy, achieving efficiency ratings of 80-90%. Conversely, when electricity to a building comes from the local power utility and heat from a boiler, only about 55% of the fuel is converted to usable thermal energy and electricity. This 25-35% increase in efficiency results in both economic and environmental benefits.





Because CHP produces more useful energy output from each unit of fuel input, thermal and electrical energy generated with CHP results in higher energy efficiency, thereby reducing energy costs, lowering electricity demand from the grid, and improving energy security. CHP systems are suitable for large industrial applications (> 1 MW) or small scale (< 1 MW) for large buildings including hospitals, schools, sports and recreation centers, multi-unit residential buildings, and emergency services buildings.
CHP offers several benefits to building owners that result in more affordable and secure energy:

- **Improved efficiency:** Compared to energy produced by the electricity utility and in-building hot water boilers which delivers overall efficiency of approximately 55%, CHP energy generation is up to 90% efficient.

- **Energy savings:** By using outputs and waste from one process as inputs to other processes, CHP systems are highly efficient, resulting in financial savings due to the efficient use of primary fuel.
- **Reduced GHG Emissions:** Most CHP units run on natural gas, which is the cleanest fossil fuel, reducing CO2 and NOx emissions. The energy generated on site is cleaner and more consistent than electricity produced by the utility.
- **Improved Energy Security:** CHP units can provide a back-up source of on-site electricity during power disruptions from the electric grid.

Financial Considerations:

To be successful, many HRM businesses and industries must compete against other businesses located in regions where energy costs are lower. By reducing the cost of both thermal and electrical energy for building owners, CHP can improve business competitiveness, productivity, and growth.
Efficiency Nova Scotia currently offers a Custom Solutions program for commercial customers that provides rebates and incentives of up to $0.10/kWh for each kWh of annual electricity consumption saved, to a maximum of $500,000. CHP projects can be eligible to participate in this program to improve the payback of CHP projects.

Environmental & Health Considerations:

Generating thermal and electrical energy with CHP reduces GHG emissions by 35% or more compared to conventional energy generation through:

1. **Improved energy efficiency:** 80-90% efficiency with CHP compared to approximately 55% with conventional generation,
2. **On-site generation of electricity using natural gas** which reduces GHG emissions by approximately 70% compared to electricity generated centrally by Nova Scotia Power. CHP could reduce GHG emissions from electricity generation by approximately 409 gCO_2e/kWh[1].

Electricity generated by CHP is available even during power outages from the electrical grid, providing a reliable source of backup power that is isolated from the electric grid for users who may be critically impacted by loss of power (i.e. hospitals, manufacturing operations, emergency services, assisted living residences).

Sources:

[1] Based on data from Environment Canada [Electricity Generation and GHG Emission Details for Canada], the GHG emissions intensity of electricity generation in N.S. in 2015 was 600 gCO_2e/kWh compared to 191 gCO_2e/kWh for electricity generated with CHP fueled by natural gas. 600g – 191g = 409g reduction in GHG emissions per kWh.