

Natural Gas for Transportation

An Affordable Way to Reduce Canada's GHG Emissions



Government Relations and Advocacy

May 12, 2016

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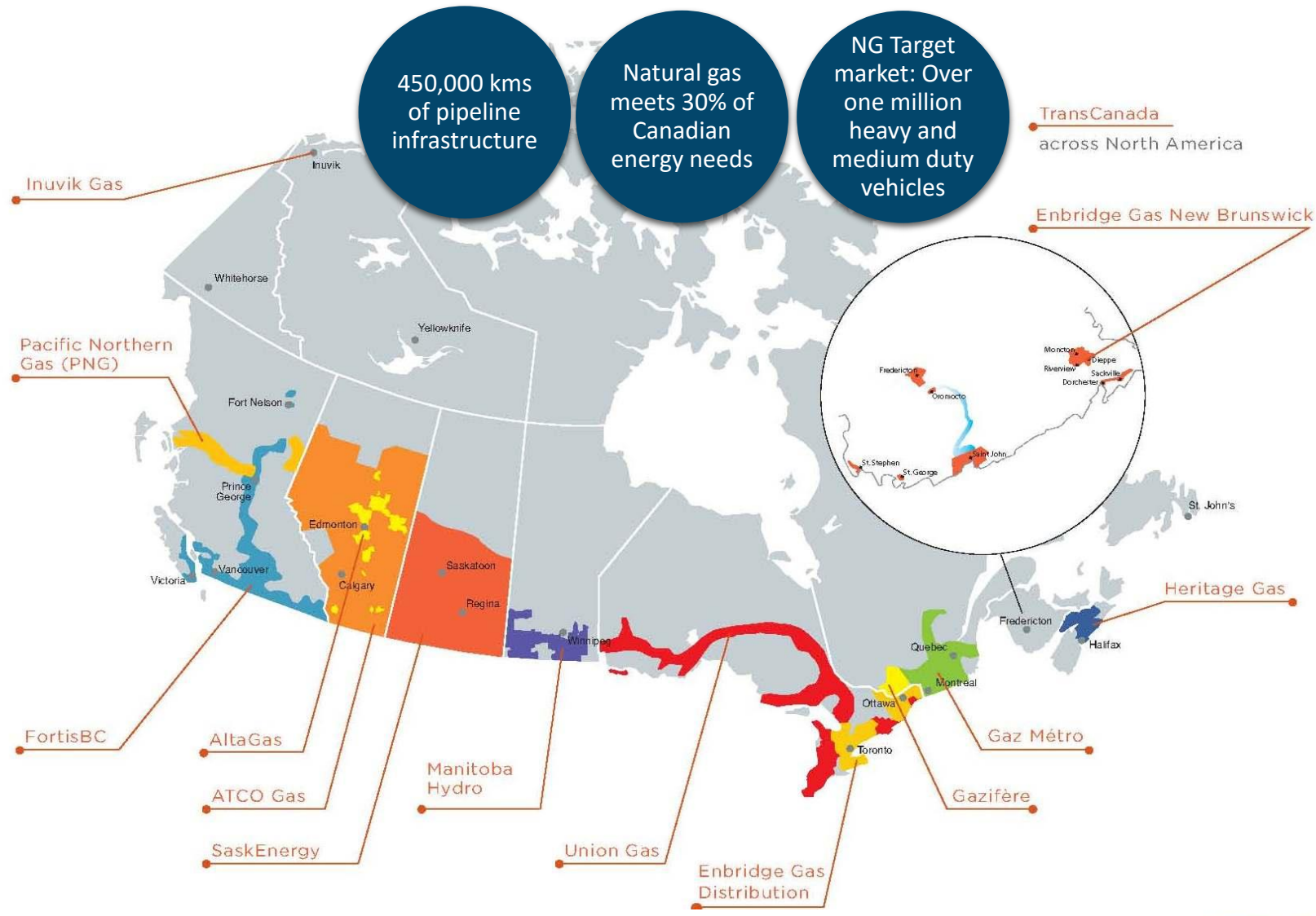
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The Natural Gas Opportunity

Environment	Economy	Innovation
<ul style="list-style-type: none">• Low Carbon: 10-25% lower GHG emissions• Low Emissions: Ultra-low NOx and SOx• Clean burning: Significantly reduced particulate matter	<ul style="list-style-type: none">• Transportation sector accounts for \$70 billion in economic activity• Employs 900,000 Canadians• Natural gas is 10 -20% cheaper than gasoline and diesel, and can help lower operational costs in this sector	<ul style="list-style-type: none">• Made in Canada: Cummins-Westport Engine Solutions• Renewable Natural Gas: 100% renewable, natural gas

Natural Gas Infrastructure



Modes

Rail

- CN Rail Pilot between Edmonton and Calgary using Westport Technology
- CN currently uses CNG shunt trucks to load and unload trains
- Codes and Standards development for LNG Rail rigs across North America

On-Road

- Includes long-haul, heavy duty trucks, medium duty applications, waste haulers and transit busses
- Increased adoption in the waste haul sector

Marine

- STQ and BC Ferries are switching ferries to LNG
- Significant cost and emissions reductions



Off-Road opportunities for natural gas include high-horsepower and high-emission applications such as trucks and equipment at mining sites, shunt trucks at multi-modal sites, and other applications that currently use diesel, gasoline or other liquid fuel. Seen here is a Teck LNG mining truck being piloted in B.C.



GHG Profile: Transportation

Fuel Sales

- Gasoline: 40 billion Liters
- Diesel: 17 billion Liters

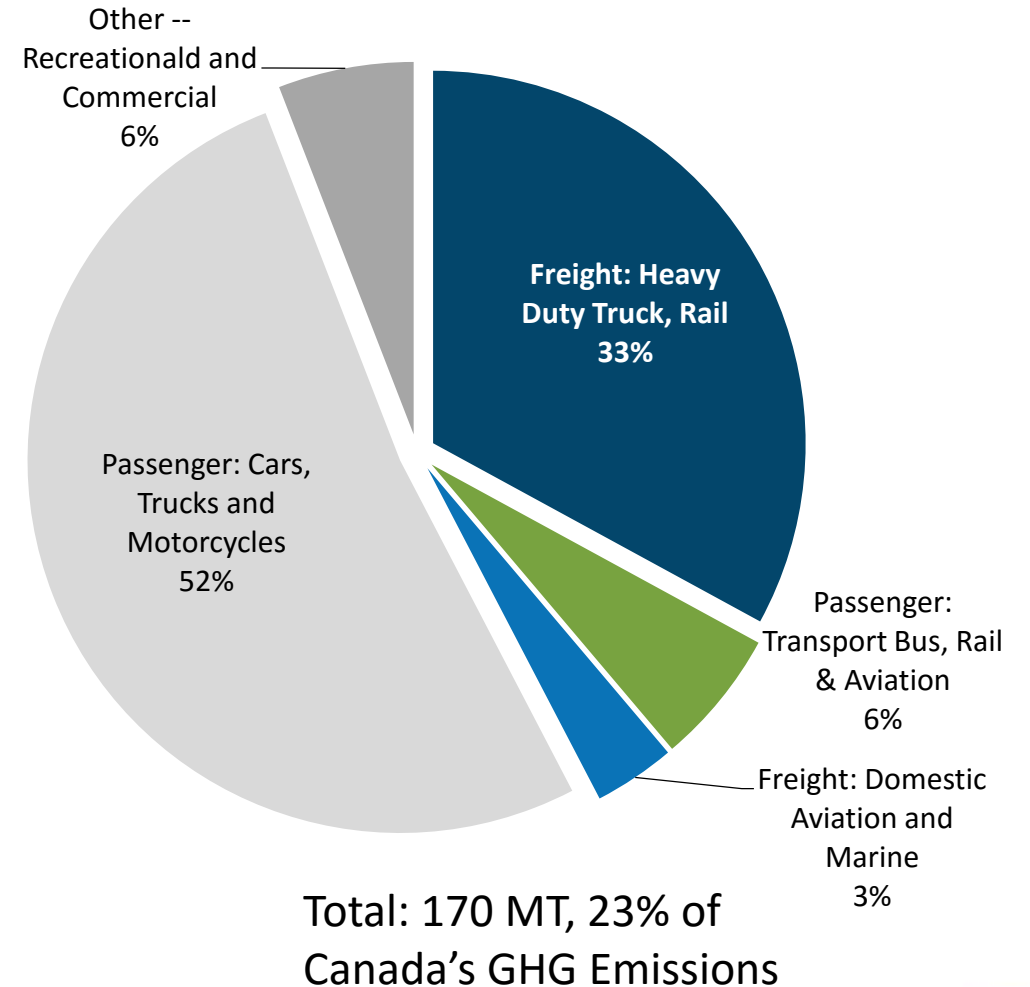
Vehicle Statistics

- 575,000 medium duty vehicles
- 455,000 heavy vehicles
- 90,000 busses

Emissions Reductions Potential

- 6.8 MT: Medium duty vehicles
- 12 MT: Heavy vehicles
- 2.5MT: Busses

Transportation Emissions by type



Compression

- Use of Compressed Natural Gas requires compression – 3,000 to 3,600 psi
- Cost of natural gas per litre equivalent can range according to the cost of this equipment and ongoing maintenance and operations
 - Right capacity to serve fleet
 - Utilization approaching 75 to 90 percent
 - Amortizing costs per year & per fill reduces cost of compression per litre equivalent

Component of price per litre equivalent

- | | |
|---------------------|-------------------|
| • Commodity cost | \$0.150 |
| • Gas delivery cost | \$0.171 |
| • Retailer margin | \$0.134 |
| • Taxes (HST) | \$0.085 / \$0.111 |
| • Compression | \$0.200 / \$0.400 |

Liquefaction

- Use of Liquefied Natural Gas requires liquefaction and cryogenic supply chain
- Cost of natural gas per litre equivalent can range according to the cost of liquefaction and supply chain
 - Distance from Liquefaction
 - Utilization of liquefaction – other uses
 - Amortization of assets
 - On site retention of LNG

Current Canadian average price per litre equivalent: \$0.750

Component price per litre of Diesel

- | | |
|-------------------------------|---------|
| • Crude cost | \$0.274 |
| • Refining and Transport cost | \$0.292 |
| • Retail & Marketing cost | \$0.134 |
| • Taxes | \$0.313 |

Innovation

Engine Solutions	Renewable Natural Gas	Infrastructure
<ul style="list-style-type: none">• Cummins-Westport Engines• Over 40% class 8 vehicles were 12L or greater, 182,000 vehicles are 9-12 L• Government Role: Foster innovation by partnering with industry to develop Canadian engine solutions and help reduce the incremental cost of switching to natural gas	<ul style="list-style-type: none">• 100% Renewable• Canadian potential: 1400 billion cubic feet• Government Role: Support the innovation and development of RNG technologies, and partner with municipal, provincial governments, and gas utilities to increase the use of the fuel	<ul style="list-style-type: none">• Align codes and standards with US to promote the safe use of Natural Gas• Improved compression and liquefaction technologies• Government Role: Support the rollout of Natural Gas refueling infrastructure

Government Role: Fueling with Natural Gas

The Opportunity: A cleaner and more affordable transportation fuel for Canada

Role of Government: Support research and development, advancement of natural gas in the transportation sector, and encouraging the use of this clean fuel via partnerships with industry

Issue

Emission from heavy duty transportation are one of the fastest growing sources of GHG emissions in Canada. Market adoption of natural gas vehicles in Canada has been growing at only a modest pace

Recommendations:

\$100 million over five years to support natural gas vehicle technology innovation to support research, development and deployment of natural gas solutions to challenges that are unique to the Canadian transportation market

Continued federal fuel tax exemption on natural gas (LNG and CNG) as a transportation fuel until natural gas vehicles have a viable share of the fleet market

\$75 million in clean energy infrastructure funding to partner with natural gas utilities and municipal and provincial governments to increase the development of new RNG facilities

\$650 million over five years to help de-risk the upfront cost of natural gas vehicles (NGV) through incentives that cover a portion of the incremental cost of natural gas vehicle, marine, or rail engines to encourage deployment

Benefits

Significantly reduce GHG emissions from a segment of the market where there are limited options for lower emissions. Supports more competitive trucking market for Canada



Continued Partnership

Liquefied Natural Gas: A Marine Fuel for Canada's West Coast



April 2014

Natural Gas Use in the Canadian Transportation Sector

Deployment Roadmap

PREPARED BY THE
NATURAL GAS USE
IN TRANSPORTATION
ROUNDTABLE

DECEMBER 2010

RENEWABLE NATURAL GAS TECHNOLOGY ROADMAP FOR CANADA



December 2014
Glenmore Landfill Biomethane plant in Kelowna, BC
Photo courtesy of FortisBC