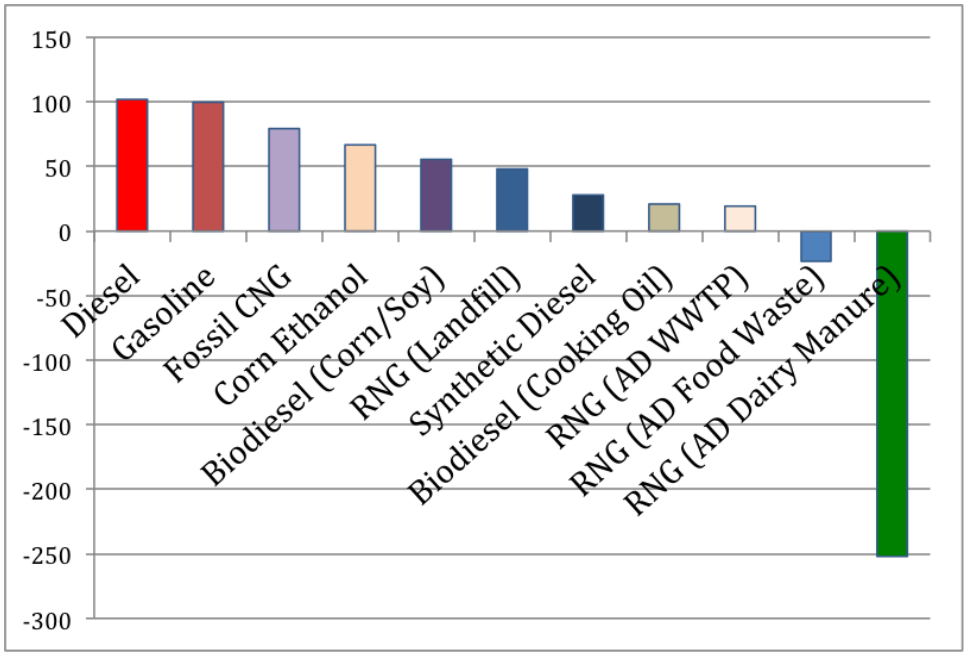
TURNING ORGANIC WASTE INTO CLEAN & LOW-CARBON ENERGY AND FUEL

The Potential for Renewable Natural Gas in Ontario

BACKGROUND

Over the last few years, at multiple locations across North America, an exciting new green industry is emerging – one that is producing the cleanest, lowest carbon fuel available today: **renewable natural gas (RNG)**. RNG is made by capturing and upgrading methane-rich biogas emitted from decomposing organic materials like food scraps, animal manure and sewage. This fuel is interchangeable with geologic natural gas, but requires no drilling. It can be used in the same applications since it can be conditioned to meet or exceed pipeline specifications. As an energy source, RNG can "decarbonize" the gas grid. As a transportation fuel, RNG can readily replace high-carbon diesel in trucks and buses. According to the California Air Resources Board (see table), on a lifecycle basis, vehicular RNG (also called R-CNG) use achieves a **70%-300% reduction in greenhouse gas emission**s compared to diesel. As shown below, it is **carbon negative** when the fuel is derived from food waste or dairy manure, as RNG captures methane emissions from organic waste and displaces GHG emissions from burning fossil fuels.

Lifecycle Carbon Intensity (g CO2e/MJ); Petroleum & Alternative Fuels (Source: CARB 2017)



ONTARIO HAS TAKEN STEPS TOWARD A LOW-CARBON ENERGY AND FUEL FUTURE

The Province has set GHG reduction goals of 15% (1990 baseline) by 2020, 37% in 2030 and 80% by 2050.[1] In its "**2016 Climate Change Action Plan**," Ontario outlined its intent to introduce a renewable natural gas content requirement for gas utilities, [2] a goal iterated in its 2017 "**Long Term Energy Plan**."[3] The specifics are still being ironed out, with utilities aiming for 2% content and the Canadian Biogas Association (CBA) and the Canadian Gas Association (CGA) asking for a 5% RNG requirement.[4] The Climate Change Action Plan also announced the **Green Commercial Vehicle Program**, with a

$170 million budget to promote accelerated adoption of green vehicle technologies, including natural gas.[5] The Action Plan also laid out the Province's intent to work with the Ontario Trucking Association and industry to establish a network of natural gas fueling stations.[6]

The "**Strategy for a Waste-Free Ontario**" seeks to reduce greenhouse gas emissions specifically from the waste sector by diverting 30% of waste from landfills by 2020, 50% by 2030 and 80% by 2050, paving the way for a consistent supply of organics for anaerobic digestion.[7] The "Strategy" also includes a goal of encouraging capture and use of landfill gas.[8] In November 2017 the proposed **Food and Organic Waste Framework** was released, which "views food and organic waste as a resource." Federally, a proposed **Clean Fuel Standard** (CFS) would require petroleum suppliers to reduce emissions from their products by increasing the content of lower-emission biofuels, including RNG, or to purchase surplus credits from other producers who have successfully done so.[9]

ROOM FOR PROGRESS IN TRANSPORTATION

In 2015, gasoline and diesel remained the dominant fuels in transportation in Ontario, accounting for 85% of total fuel consumption – more than 20 billion litres.[10],[11] Ontario mandates 5% ethanol content in gasoline and 2% renewable content in diesel fuel.[12] Between 2005 and 2015, use of biofuels in transportation tripled to nearly 3% of the transportation total.[13] The province is working with public and private sector partners to create a network of almost 500 electric vehicle charging stations at 300 locations.[14] However, there are less than 1,000 natural gas fueled trucks and buses in Ontario and only 15 operational/planned stations in the province dispensing Compressed Natural Gas (CNG).[15] Any of those 15 CNG stations could also dispense RNG with no alteration required.

WHY FOCUS ON TRANSPORTATION?

Transportation is the largest energy use sector and the largest source of greenhouse gas emissions in Ontario, at about 35% of the total, or 60 Mt CO2e.[16] Approximately 200,000 heavy trucks and buses travel Ontario's roads and consume 5.1 billion litres of diesel fuel annually.[17],[18] While these heavy-duty vehicles represent a relatively small number of total vehicles, they account for a disproportionately large percentage of total fuel use —25%— and greenhouse gas emissions in addition to smog-forming nitrous oxides (NOx) and health-threatening particulate matter (PM).

ONTARIO HAS THE RESOURCES FOR PRODUCING RNG AND IS PRODUCING IT NOW

According to the Canadian Biogas Association, in Ontario there are currently over 65 municipal, commercial and agricultural anaerobic digester facilities (producing ~28MW) contracted to produce biogas, and 17 landfill projects (another 55MW). The continued interest and capacity to build anaerobic digesters in Ontario is demonstrated by the 73 on-farm biogas applications representing 16.4 MW. Currently, there is only one wastewater facility in the province generating RNG, the Woodward Avenue Wastewater Treatment Plant in Hamilton,[19] but additional organic resources exist in the province to generate enough RNG to displace more than 20% of road diesel fuel. They include:

- Ontario's roughly 318,000 dairy cows[20] produce about 16 million kilograms of manure daily;[21] enough to generate over 360,000 cubic meters of biogas.[22] If upgraded to RNG, that's enough fuel to displace more than **108 million litres of diesel** in transportation,[23] and eliminate over **290,000 tonnes of CO2e emissions** annually.[24]
- In 2014, Ontario sent 11.1 million tonnes of waste to landfills[25]. About one third of that—3.7 million tonnes—was food waste and other organics.[26] Processed in anaerobic digesters, this could produce enough RNG to displace **another 291 million litres of diesel** annually, by conservative estimates.[27]
- As of 2014, Ontario had approximately 880 active landfills and another 1,500 closed sites.[28] Landfill gas capture is mandated at all new or operating landfills of more than 1.5 million cubic meters of capacity.[29] According to a 2013 Canadian Biogas Association study, landfill gas has the potential to generate the equivalent of **675 million litres of diesel fuel** per year.[30]
- Ontario has about 750 wastewater treatment plants, "all of which have some potential to produce biogas."[31] It is estimated that Ontario treats about 2 billion m^3 of municipal sewage per year, giving an estimated 68 million cubic meters annually in potential RNG production from anaerobic digestion of municipal sewage—the equivalent of **66.3 million litres** of diesel fuel.[32]
- Moving forward, Ontario RNG production – including forestry waste and agricultural crop residues – could displace up to **16% of total natural gas demand** in the province by 2030.[33]

FOR MORE ON RNG, ON WHERE IT IS PRODUCED AND USED, AND ON EV'S PUBLICATIONS, PLEASE CONTACT:

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NOTES

1 Canadian Biogas Association, "Renewable Natural Gas Developments in Ontario: An Evolving Outlook." August 2017. https://biogasassociation.ca/resources/canadian_biogas_study

2 Ibid.

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6 Ontario Ministry of the Environment and Climate Change, "Climate Change Action Plan," "Increase the use of low carbon trucks and buses." https://www.ontario.ca/page/climate-change-action-plan#section-3

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17 Ontario Trucking Association, http://ontruck.org/freight-economy/

18 Ontario greenhouse gas emissions by sector, https://www.ontario.ca/data/greenhouse-gas-emissions-sector

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20 "Number of Dairy Cows and Heifers by Province," Canadian Dairy Information Centre, http://aimis-simia-cdic-ccil.agr.gc.ca/rp/index-eng.cfm?action=pR&r=219&pdctc=

21 Based on 112 pounds per dairy cow per day, USDA Natural Resources Conservation Service, Animal Manure Management, RCA Issue Brief #7, December 1995; http://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs143_014211

22 Based on a "a net daily biogas output of 40 cubic feet (1.2 m3) per cow." Penn State College of Agricultural Sciences, http://extension.psu.edu/natural-resources/energy/waste-to-energy/resources/ biogas/projects/biogas-from-manure

23 Energy Vision calculation based on 90 DGE/cow/year.

24 Based on 22.4 lbs of CO2 per gallon diesel. US EIA, Frequently Asked Questions, "How much carbon dioxide is produced from burning gasoline and diesel fuel?" https://www.eia.gov/tools/faqs/faq.php?id=307&t=9

25 "State of Waste In Ontario: Landfill Report," Ontario Waste Management Association, https://www.owma.org/articles/first-annual-state-of-waste-in-ontario-landfill-report; includes waste exported to the US.

26 "Ontario wants to ban food waste form trash bags in five years," Canadian Broadcasting Corporation, Aug. 14, 2017, http://www.cbc.ca/news/canada/london/banning-food-waste-ontario-organic-compost-1.4244374

27 Energy Vision calculation based on empirical evidence; avg. digester produces ~19 DGEs/ton of food waste.

28 Ministry of the Environment and Climate Change figures cited in "State of Waste In Ontario: Landfill Report," Ontario Waste Management Association, https://www.owma.org/articles/first-annual-state-of-waste-in-ontario-landfill-report

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