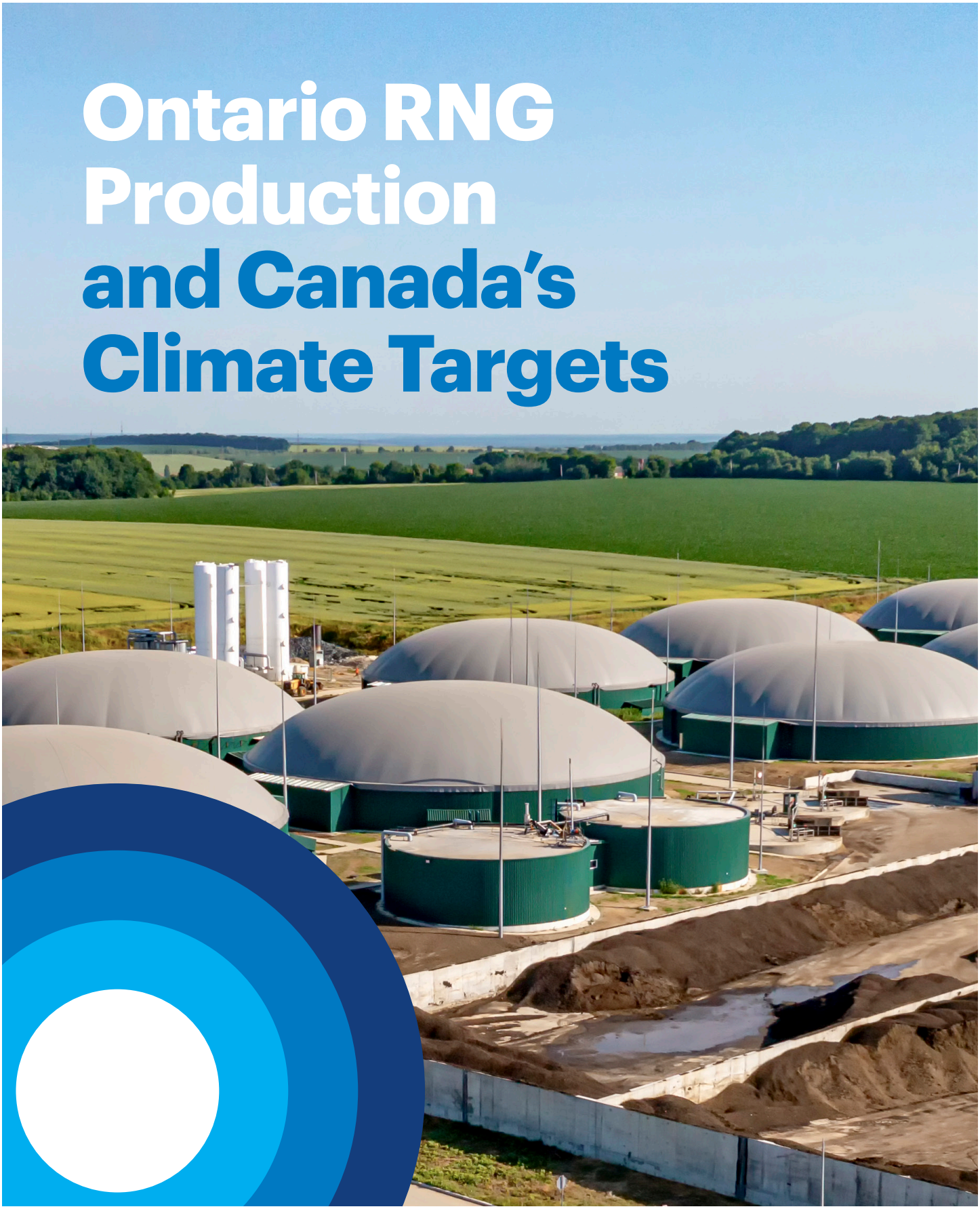
Ontario RNG Production and Canada's Climate Targets



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biogasassociation.ca/climate

Canadian Biogas Association
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Contents

Section A:
Purpose

The Canadian Biogas Association retained Navius Research in early 2022 to forecast and analyze Biogas & RNG production and utilization in Canada under different policy scenarios. The purpose was to understand the extent to which different government policies are capable of unlocking Canada's unused Biogas & RNG feedstocks and to what degree these same actions would reduce greenhouse gas (GHG) emissions.

The broader results of this exercise are available in the report, "Hitting Canada's Climate Targets with Biogas & RNG", which is publicly available at www.biogasassociation.ca/climate.

The modelling also led to a number of insights that apply specifically to RNG production in Ontario. This report unpacks those insights.

The key focus of the Navius modelling was the impact of Biogas & RNG production on national climate goals, and specifically how different policies could induce more contributions from Biogas & RNG in achieving the Government of Canada's three major climate targets: (1) Reducing GHG emissions 40-45% by 2030, (2) Reducing methane emissions 30% by 2030, and (3) Achieving net zero emissions by 2050.

Through the supplementary analysis presented here, we have also been able to determine some important results for RNG in Ontario, including how much clean RNG energy could be produced in Ontario under different policy scenarios, and how this RNG helps contribute towards each of Canada's climate targets.

Section B:
Key Assumptions

In order to forecast Ontario RNG production under different policy scenarios, the model made a number of evidence-based assumptions.

1. Biogas & RNG Production Potential

The model assumes a maximum Biogas & RNG production potential in Ontario. This maximum potential is the upward limit of how much Biogas & RNG energy (PJ/yr) could be feasibly produced under any future scenario.

In order to ascertain the maximum Biogas & RNG production potential, the model draws on a range of literature and analysis, in particular the comprehensive RNG feedstock analysis conducted by TorchLight Bioresources in 2020[1], supplemented with the analysis compiled by Kelleher Environmental in 2013.[2] Ontario's maximum potential Biogas & RNG energy potential was determined for 2020 and then scaled over time to reflect population and sector growth. The numbers in Figure B-1 represent total Biogas & RNG potential in 2020, including heat, electricity and RNG. The maximum potential of just RNG is a subset of this total and is implied in the modelling.

Figure B-1:
Ontario Biogas & RNG Production Potential by Feedstock

	Maximum Biogas & RNG production potential (2020)
Landfills	11.1 PJ/yr
Livestock (manure co-digestion)	9.2 PJ/yr
Source separated organics	4.4 PJ/yr
Municipal wastewater treatment	4.3 PJ/yr
Pulp mill effluent	2.5 PJ/yr
Corn silage and crop residue	No fixed maximum, constrained only by physical and economic factors

2. RNG Demand Potential

The model assumes a maximum amount of potential RNG demand in Ontario. The absolute maximum is equivalent to the projected residential and commercial demand for all forms of natural gas in Ontario over time under current policies (see Figure B-2). In theory, the Ontario RNG production modelled in this study is not constrained by this limit since it can also be exported to other jurisdictions. However, no policy scenario modelled for

this study sees demand for RNG rising close to the maximum level of Ontario demand.

Different policy scenarios unleash different amounts of RNG demand.

Figure B-2:
Ontario Natural Gas Demand (Residential and Commercial)
Under Current Policies , 2025-2050

	2025	2030	2035	2040	2045	2050
Natural Gas Demand	529 PJ/yr	492 PJ/yr	470 PJ/yr	457 PJ/yr	450 PJ/yr	446 PJ/yr

3. RNG Production Costs

To determine RNG production costs, Navius Research consulted a wide range of literature and analysis, including but not limited to TorchLight Bioresources (2020)[3], Deloitte & WSP (2018)[4], International Energy Agency (2013 & 2020)[5,6], Hallbar Consulting (2017)[7], BiogasWorld (2022), IRENA (2013)[8], US Environmental Protection Agency (2021)[9], S&T Consultants (2021)[10], and Rajendran et al (2016)[11].

Navius evaluated the range of costs for two key sources: (i) landfill gas, and (ii) anaerobic digestion (AD), where the AD production costs are differentiated by feedstocks, including on-farm manure co-digestion versus digestion primarily of crop residues or silage, as well as AD of source-separated organics (SSO) and AD at wastewater treatment plants (WWT).

Figure B-3:
RNG Production Costs (2020 CAD)

	RNG ($/GJ)
AD on Farms	17.50 – 25.60
AD with SSO & WWT	19.80 – 28.00
Landfill Gas (Collection & Utilization)	12.00
Landfill Gas (Only utilization, LFG already collected)	6.70

4. Carbon Intensities

The carbon intensity of Biogas & RNG is important for measuring the impact on GHG reductions. Carbon intensities are used within the Navius model in two ways. First, they are used to define credit generation potential per unit of RNG supplied under policies such as clean fuel standards. Second, and more importantly, they define the parameterization of biogas production pathways in terms of how much energy those pathways consume and what methane (or other GHG) emissions they produce or emit per unit of energy produced.

The carbon intensity values presented in Figure B-4 exclude any credit given for methane abatement. While some policies are designed to recognize the methane abatement that is implicit in many forms of RNG production, and as such lead to even stronger lifecycle carbon assessments, other policies do not. This study models one policy scenario in which methane abatement is valued in addition to the inherent carbon intensity of RNG (see: "GHG offset system in which carbon credits are generated for methane utilization in landfills and agriculture").

Figure B-4:
Carbon Intensities of RNG

Source	Carbon Intensity
Anaerobic Digestion	10-40 gCO_2e/MJRNG
Landfills	30-40 gCO_2e/MJRNG

Section C:
Modelling Results

This study modelled the impact of five different policy scenarios on Ontario RNG production. The policy scenarios were selected based on their immediate feasibility in the Canadian context. They are all policies that have Canadian precedent and that are generally consistent with federal and provincial policy directions.

They are examined here in the order of least impactful on Ontario RNG production to most impactful.

1. **Current policies**
2. **Clean fuel standard (as currently proposed by the federal government)**
3. **Carbon credits for methane utilization in landfills and agriculture**
4. **Renewable gas mandate**
5. **Combination: Renewable gas mandate + Carbon credits for methane utilization in landfills and agriculture**

For each policy scenario, this report is able to forecast the impact specifically on RNG production in Ontario. It is also able to forecast the ensuing GHG reductions. However, note than when it comes to GHG reductions, the model results are unable to separate the impact of RNG from other biogas energy outputs (ie. heat and electricity), and so the GHG reductions calculated here are for all these energy outputs from Ontario produced Biogas & RNG collectively.

1. Current policies

The Current Policies scenario modelled for this study includes both federal and provincial policies that are already implemented. The important policies influencing RNG production in Ontario include:

i. Carbon pricing, including the Output Based Pricing System, in which the price of carbon pollution rises incrementally according to the announced federal schedule, reaching \$170/tCO_2e in 2030. The Current Policies scenario assumes the carbon price remains at \$170/tCO_2e through to 2050.

ii. Renewable gas mandates in British Columbia (15 percent by 2030) and Québec (5 percent RNG by 2025-2026 and 10 percent by 2030), which can drive RNG production outside of those jurisdictions, including in Ontario.[12]

iii. Landfill gas regulations in Ontario, in which landfills larger than 1.5 million cubic metres are required to collect landfill gas and to flare it or utilize it.

Under the Current Policies scenario, Ontario RNG production increases only modestly in the medium term, growing 5 percent over 2020 levels by 2030, to 5.8 PJ/yr, before dropping off from 2035 to 2050. Figure C-1a shows the growth of Ontario RNG production under the Current Policies scenario, while Figure C-1b shows the contribution of different RNG sources to this total production.

Figure C-1a:
Ontario RNG Production
Under Current Policies

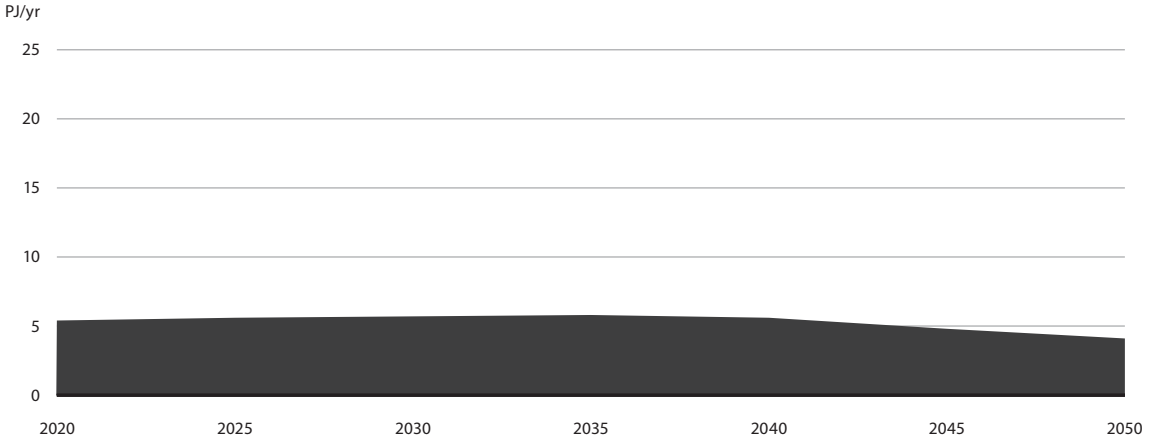
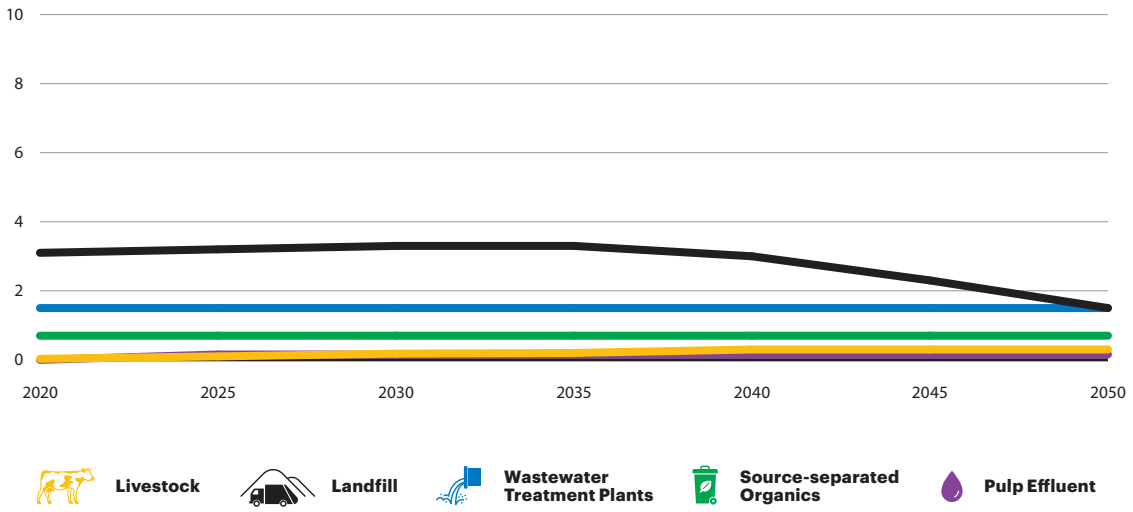


Figure C-1b:
Ontario RNG Production by Source
Under Current Policies



The modest growth in Ontario RNG production in the Current Policies scenario results in limited contributions to Canada's climate targets.

Figure C-1c:
Ontario Biogas & RNG Contribution to Canada's Climate Targets Under Current Policies*

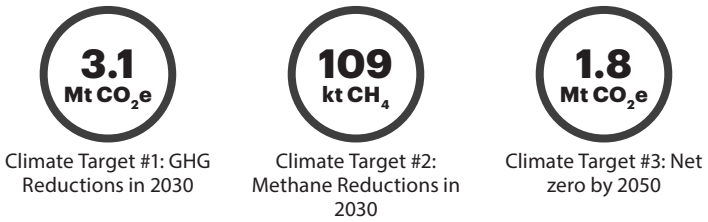
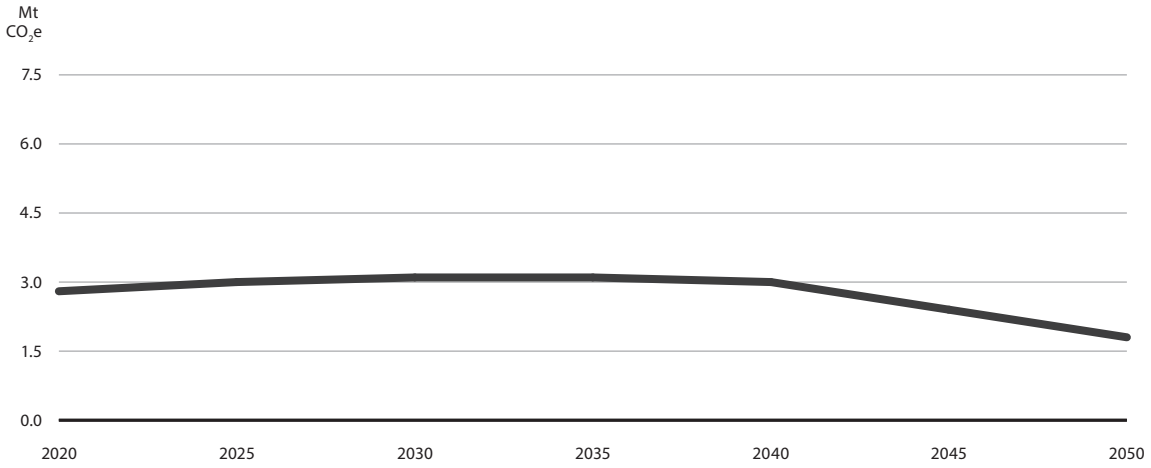


Figure C-1d:
GHG Reductions from Ontario Biogas & RNG Under Current Policies



2. Clean fuel standard

The second policy scenario modelled for this study is one in which a clean fuel standard is layered on to current policies. This scenario is expected to materialize shortly, with a federal government clean fuel standard coming into effect in 2022. The federal Clean Fuel Standard has undergone significant revisions since its initial design, including the elimination of a dedicated gaseous stream and the move to a primary focus on liquid fuels. However, the federal government's latest design does allow liquid fuel suppliers to meet up to 10 percent of their compliance needs through gaseous fuels. This is the policy scenario modelled here.

The modelling suggests that the federal Clean Fuel Standard will have almost zero effect on Ontario-produced RNG, resulting in changes of at most 10,000-40,000 GJ of Ontario RNG production compared with the Current Policies scenario over the long term.

* Note: The model does not separate the role of RNG from other Biogas & RNG energy outputs, so these are collective GHG reductions from RNG, biogas-to-electricity and biogas-to-heat

Figure C-2a:
Ontario RNG Production
Under Clean Fuel Standard

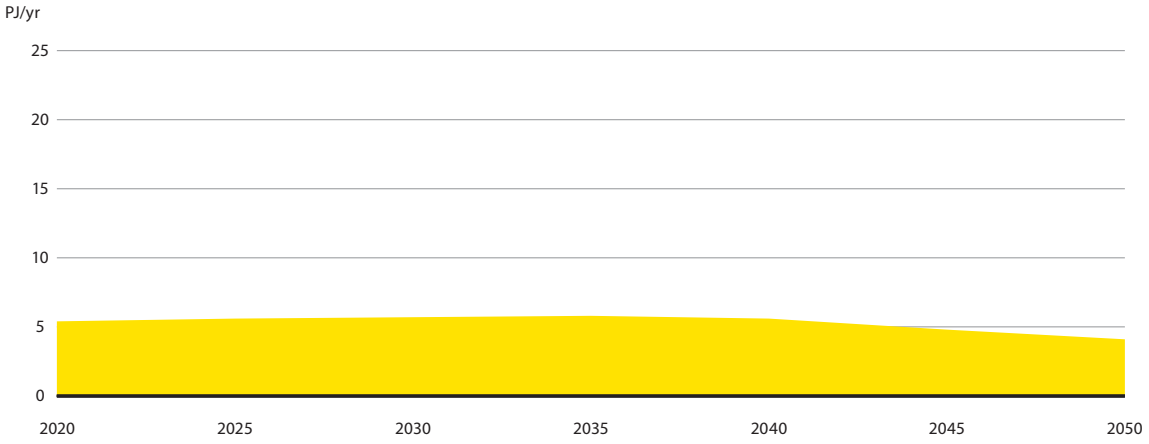
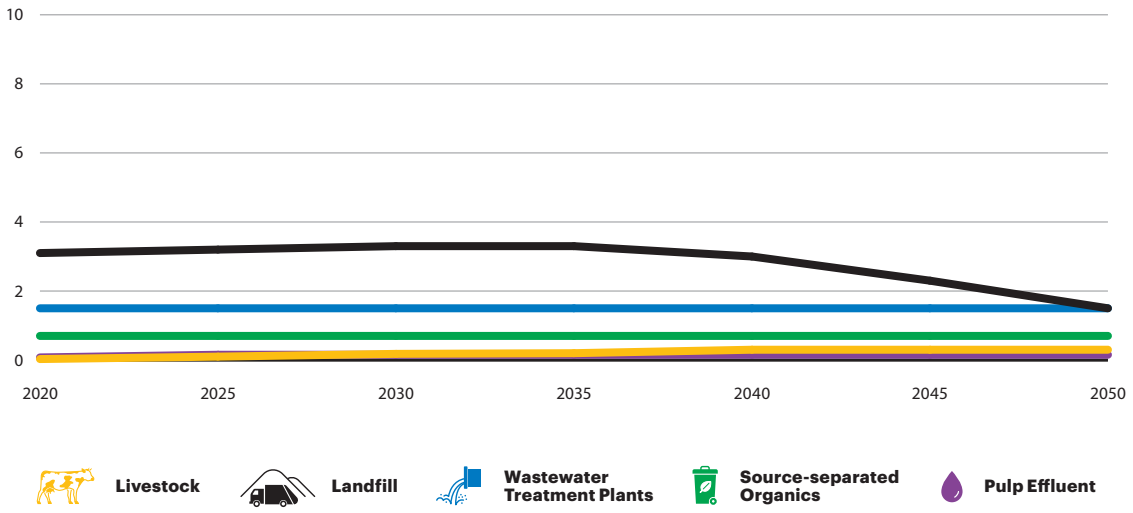


Figure C-2b:
Ontario RNG Production by Source
Under Clean Fuel Standard



As a result of the limited impact of the federal Clean Fuel Standard on RNG production and adoption, the contribution to Canada's climate targets remains unchanged under this policy scenario.

Figure C-2c:
Ontario Biogas & RNG Contribution to Canada's Climate Targets
Under Clean Fuel Standard

3.1
Mt CO_2e

Climate Target #1: GHG Reductions in 2030

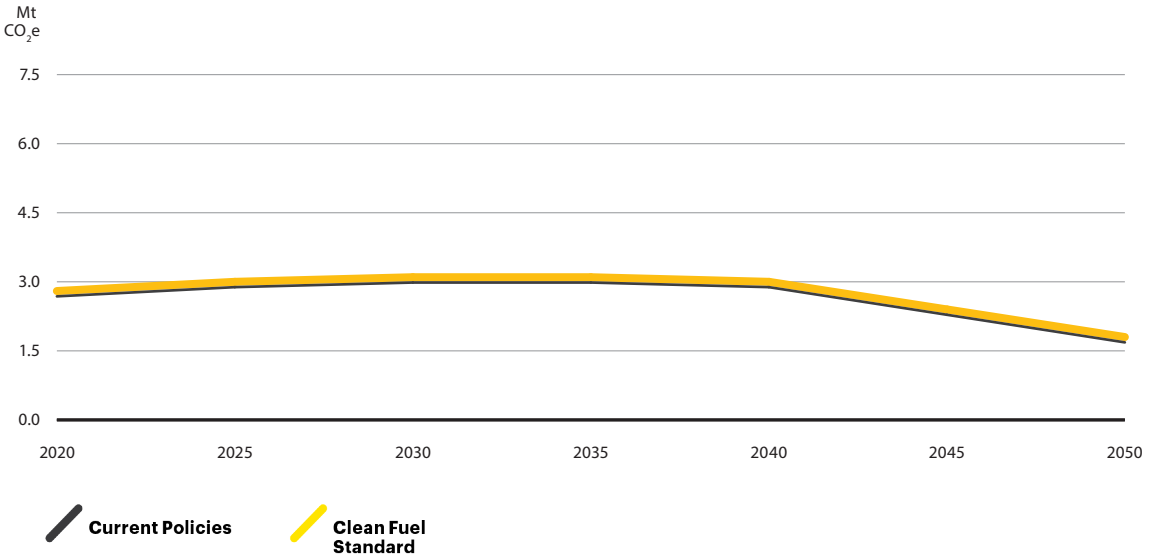
109
kt CH_4

Climate Target #2: Methane Reductions in 2030

1.8
Mt CO_2e

Climate Target #3: Net zero by 2050

Figure C-2d:
GHG Reductions from Ontario Biogas & RNG Under Clean Fuel Standard



3. Carbon credits for methane utilization in landfills and agriculture

The third policy scenario evaluated for this study is one in which there is a GHG offset system that allows carbon credits to be generated for methane utilization in landfills and agriculture.

The specific policy scenario modelled for this study is based on the emerging Federal GHG Offset System, which will allow offsets to be used by industrial firms regulated under the Output Based Pricing System in order to meet their compliance obligations. By allowing voluntary GHG reduction activities to generate carbon credits under this system, it effectively extends the price signal from the OBPS, which is set to rise incrementally to \$170/tCO_2e in 2030, to these activities.

The policy modelled here implies that RNG production using methane collected from both the landfill sector and the agriculture sector be eligible for generating credits. This is a policy which has important precedents at the provincial level in both Alberta[13] and Québec.[14]

A policy scenario in which carbon credits can be generated for methane utilization in landfills and agriculture drives significant growth in Ontario RNG production. Figure C-3a shows Ontario RNG production reaching 8.5 PJ/yr in 2030. That amounts to 57 percent more production than today's production and 50 percent more production than what current policies will achieve on their own. As noted in Figure C-3b, this growth is driven primarily by RNG production using methane from livestock manure and from landfills.

Figure C-3a:
Ontario RNG Production
Under Carbon Credits System

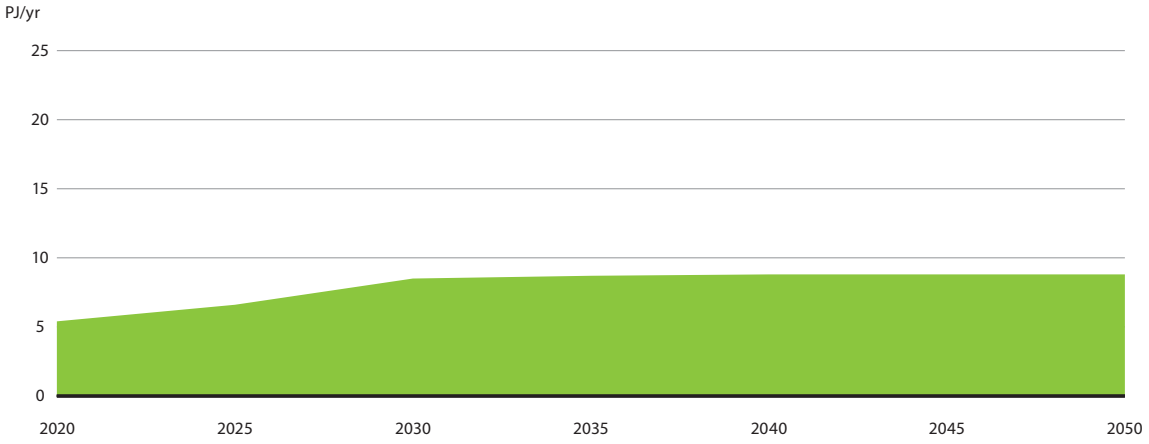
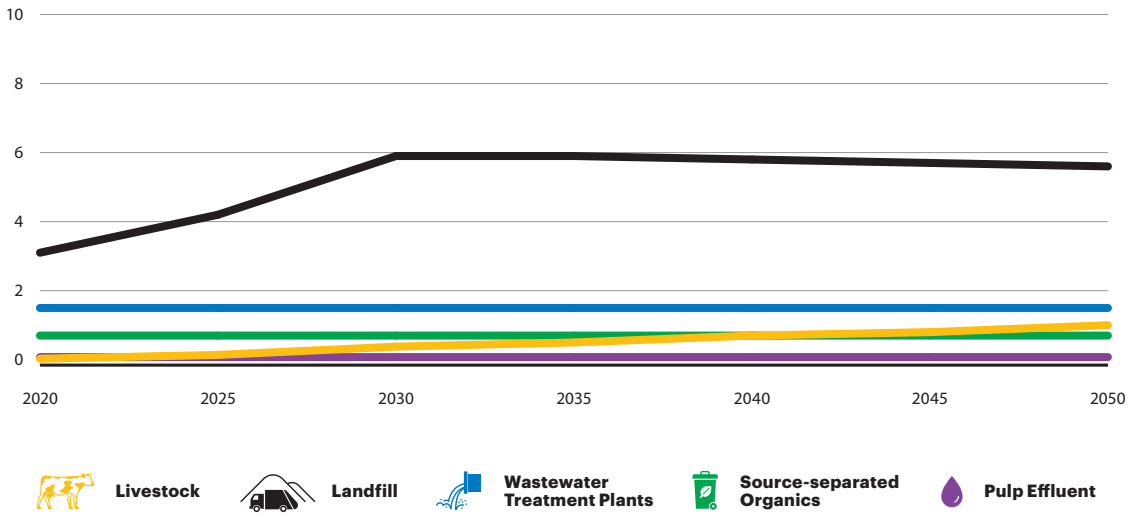


Figure C-3b:
Ontario RNG Production by Source
Under Carbon Credits System



The additional methane abatement that is triggered by a carbon credits system on top of the additional displacement of conventional natural gas with the resulting RNG leads to much bigger GHG reductions. GHG reductions in this policy scenario are nearly double today's GHG reductions by 2030. This effect tapers off after 2030 due to a plateauing of the price signal in the GHG Offsets System that was modelled.

Figure C-3c:
Ontario Biogas & RNG Contribution to Canada's Climate Targets Under Carbon Credits System

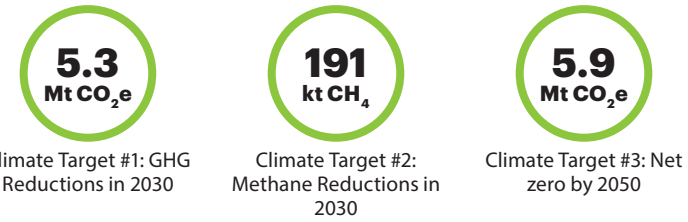
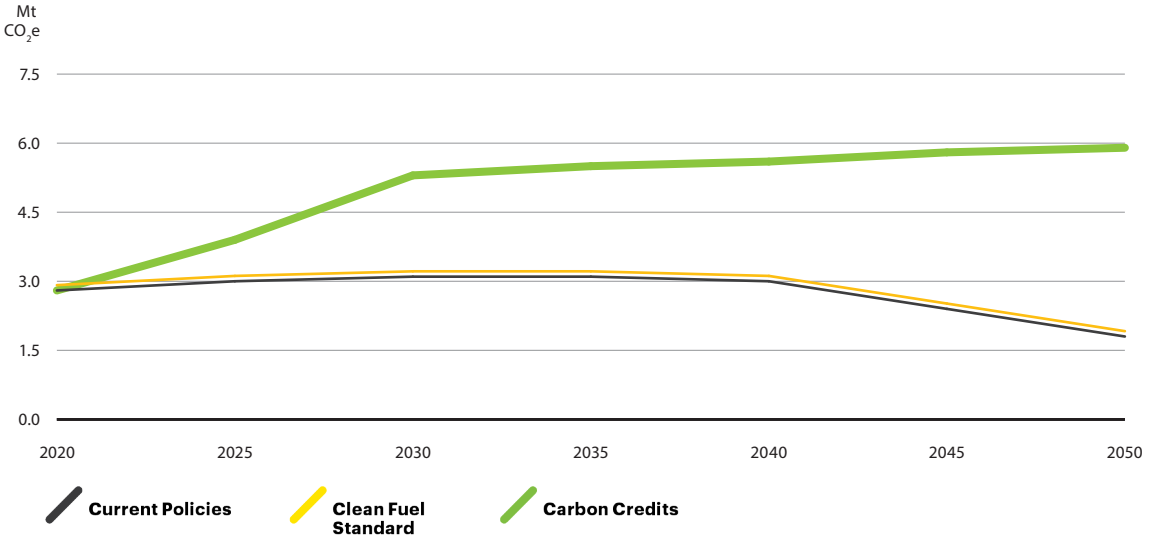


Figure C-3d:
GHG Reductions from Ontario Biogas & RNG Under Carbon Credits System



4. Renewable Gas Mandate

The fourth policy scenario modelled for this study is a renewable gas mandate. Renewable fuel mandates have important precedents in Canada. These include the federal mandate for renewable content in liquid fuels, which has been in place since 2011 and which requires a minimum 5-percent renewable blend in gasoline and 2-percent blend in diesel fuel.[15] Precedents also include provincial renewable gas mandates in Québec[16] and British Columbia[17].

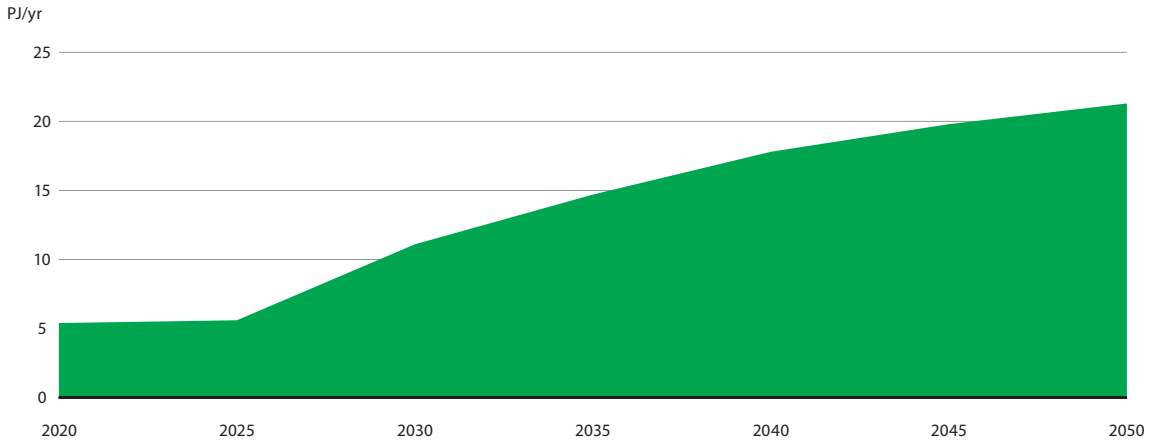
For this study we modelled a country-wide renewable gas mandate designed like British Columbia's policy, in which natural gas suppliers are required to achieve a minimum 15-percent renewable blend by 2030. The policy scenario then requires that the renewable blend be increased steadily to 30 percent by 2040. Similar to British Columbia, the policy scenario modelled here allows for a variety of renewable gases to contribute to that mandate, including biogas-based RNG, low-carbon hydrogen and synthetic natural gas.

The Renewable Gas Mandate policy scenario sees a different dynamic play out with respect to Ontario RNG when compared with the Carbon Credits System scenario described above.

First, the renewable gas mandate policy unlocks more Ontario RNG. Figure C-4a shows that annual RNG production in Ontario more than doubles in 2030 compared with today's levels, to 11.1 PJ/yr, and then almost doubles again by 2050, to 21.3 PJ/yr, as a result of a renewable gas mandate. This is a function of two things: on one hand, the Renewable Gas Mandate incentivizes the production exclusively of RNG with biogas feedstocks as opposed to other potential energy outputs. For example, landfill gas that might be more cost effectively utilized to generate electricity under a system of carbon credits, is being used for RNG under a renewable gas mandate. Meanwhile, the renewable gas mandate is also simply a more ambitious policy that increases in stringency from 2030 to 2040. As a result, Ontario RNG production is pushed to new levels in order to hit demand targets.

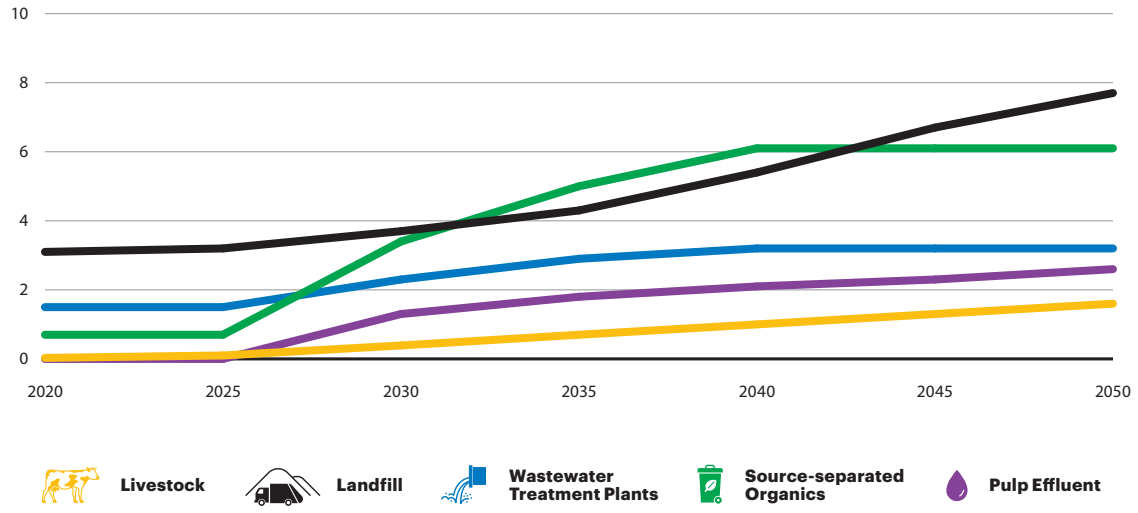
The second dynamic that changes under the Renewable Gas Mandate policy scenario, when compared with the Carbon Credits scenario, is that the renewable gas mandate activates a broader pool of RNG production sources in Ontario. Unlike the Carbon Credits scenario, which stimulates RNG production exclusively in the landfill and agriculture sectors, the renewable gas mandate unlocks underutilized RNG feedstocks in other sectors. Figure C-4b shows a renewable gas mandate driving a doubling of RNG production from wastewater treatment plants by 2050, more than eight times more RNG production from source-separated organics by 2050, and new opportunities from pulp effluent.

Figure C-4a:
Ontario RNG Production
Under Renewable Gas Mandate



While the Renewable Gas Mandate policy scenario results in more RNG production in Ontario compared with the Carbon Credits scenario, it does not achieve the same level of GHG reductions. Figure C-4c and Figure C-4d

Figure C-4b:
Ontario RNG Production by Source Under Renewable Gas Mandate



show that a renewable gas mandate can achieve important GHG reductions, including more than 2.5 times more than under current policies in 2050. However, it does not achieve as many GHG reductions as a carbon credits policy due to it stimulating less activity in the landfill sector, where methane destruction can result in powerful GHG reductions.

Figure C-4c:
Ontario Biogas & RNG Contribution to Canada's Climate Targets Under Renewable Gas Mandate

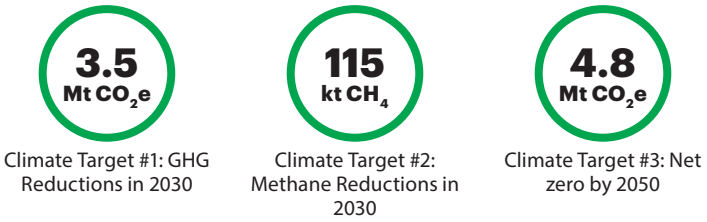
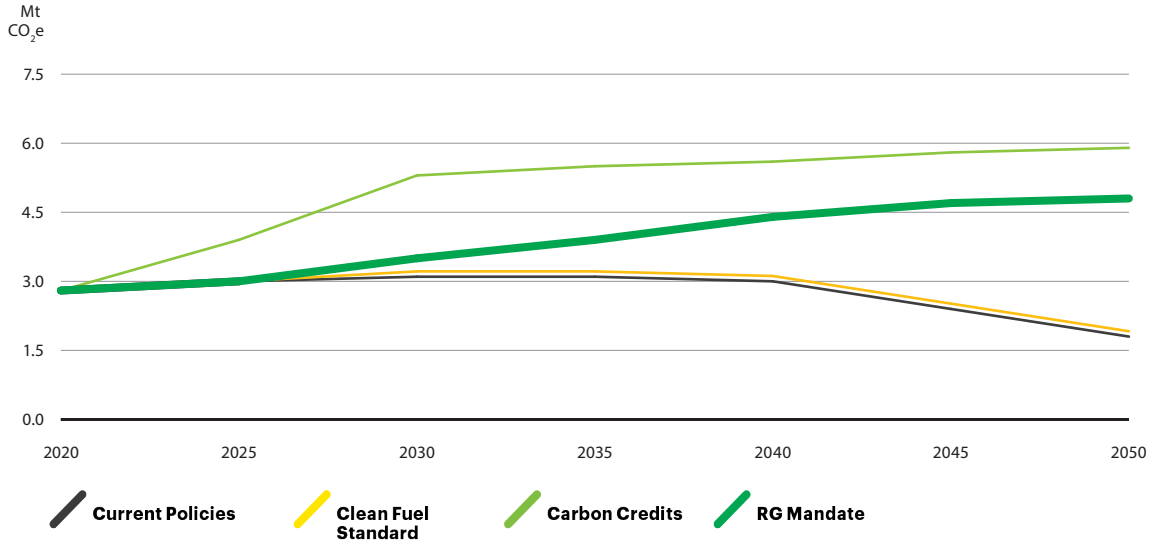


Figure C-4d:
GHG Reductions from Ontario Biogas & RNG Under Renewable Gas Mandate

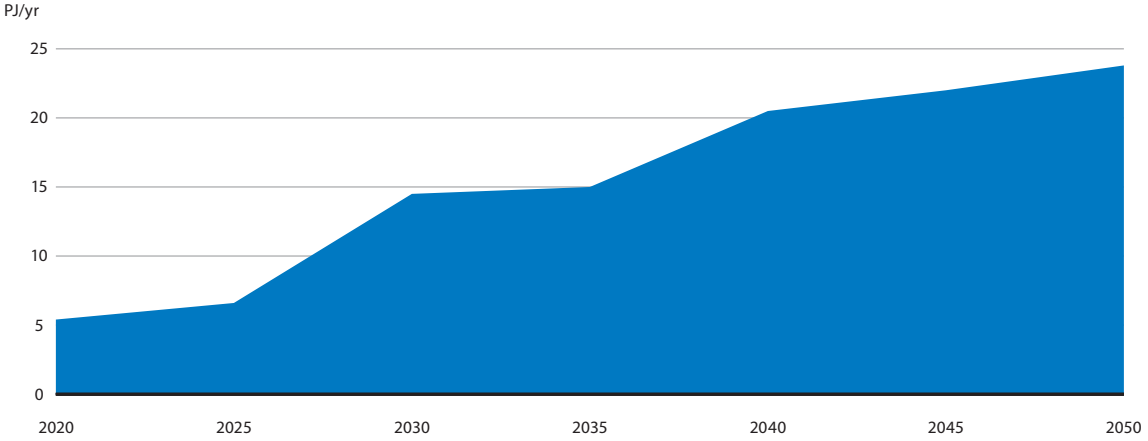


5. Renewable gas mandate + Carbon credits for methane utilization in landfills and agriculture

The final policy scenario evaluated for this study, and the policy scenario showing the greatest impact on RNG production in Ontario, is a combination of the previous two policy scenarios: a renewable gas mandate combined with a GHG offset system that allows credits to be generated for methane utilization in landfills and agriculture.

This policy scenario harnesses the strengths of both individual policies. It supercharges Ontario RNG production in the short term through a price signal for methane utilization, achieving 14.5 PJ/yr in 2030, while also sustaining growth in RNG production over the longer term through a renewable gas mandate, resulting in 23.8 PJ/yr in 2050. Under this policy scenario, the majority of Ontario's feasible RNG feedstocks from traditional sources is being harnessed.

Figure C-5a:
Ontario RNG Production
Under RG Mandate + Carbon Credits



The combination of a renewable gas mandate and a GHG offsets systems that allows credits to be generated for methane utilization in landfills and agriculture results in the biggest GHG reductions modelled in this study. These are shown below in Figure C-4c and Figure C-4d. Note again that these are national GHG reductions resulting from both RNG and other biogas energy outputs produced in Ontario.

Figure C-5b:
Ontario RNG Production by Source
Under RG Mandate + Carbon Credits

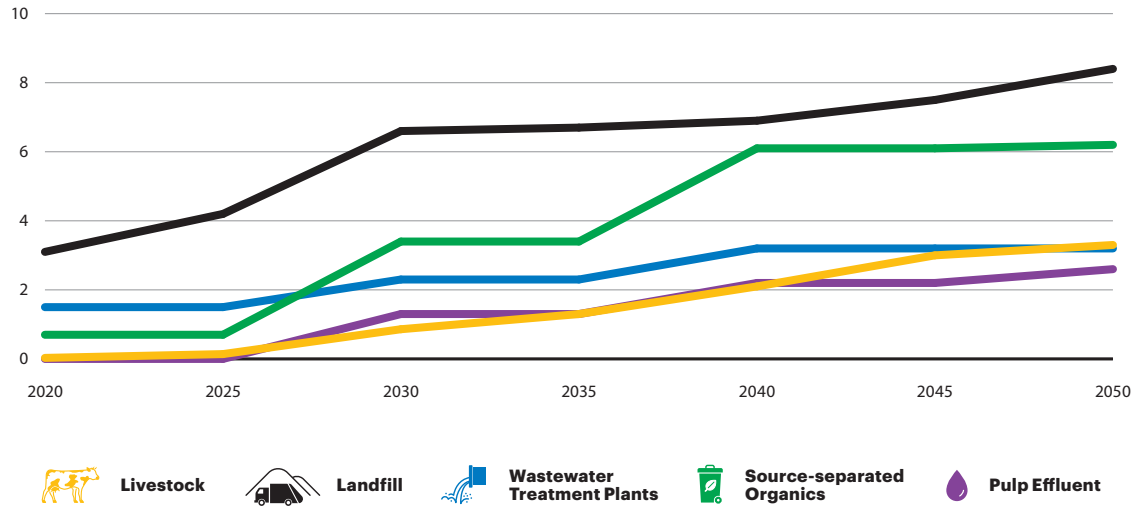


Figure C-5c:
Ontario Biogas & RNG Contribution to Canada's Climate Targets
Under RG Mandate + Carbon Credits

5.6 Mt CO_2e

Climate Target #1: GHG Reductions in 2030

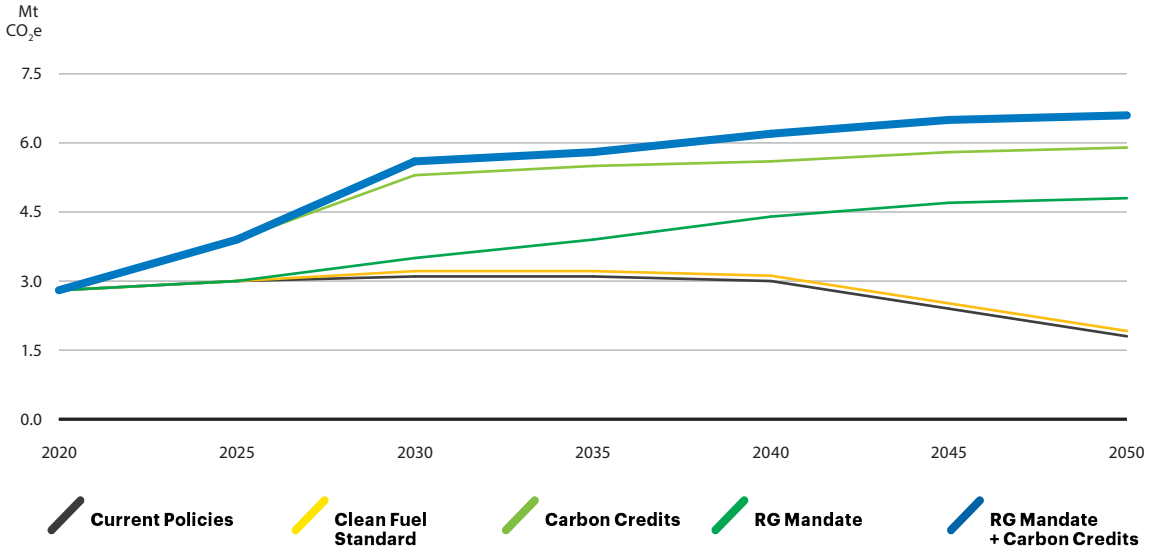
192 kt CH_4

Climate Target #2: Methane Reductions in 2030

6.6 Mt CO_2e

Climate Target #3: Net zero by 2050

Figure C-5d:
GHG Reductions from Ontario Biogas & RNG
Under RG Mandate + Carbon Credits



Conclusion:

Three Takeaways for Enbridge

Three immediately pertinent takeaways stand out from this analysis for Enbridge.

1. Proven policies can unlock almost two thirds of Ontario's feasible RNG potential

The first takeaway is that the majority of Ontario's feasible RNG feedstocks can be unlocked through tested and proven policies. The combination of a renewable gas mandate and a GHG offset system that allows credits to be generated for methane utilization in landfills and agriculture, both of which have important precedents in other provinces, unlocks 14.5 PJ/yr of Ontario RNG production in 2030, 20.5 PJ/yr in 2040, and 23.8 PJ/yr in 2050. This amounts to harnessing roughly 56 percent of Ontario's feasible RNG feedstocks from traditional sources in 2030, 66 percent of feasible feedstocks from traditional sources in 2040, and 65 percent of feasible feedstocks from traditional sources in 2050.

Additional policies, or increased stringency of the proposed policies, would be needed to activate Ontario's remaining RNG feedstocks from traditional sources.

When it comes to Ontario's non-traditional RNG feedstocks, namely crop residues and purpose-grown energy crops, TorchLight Bioresources calculates an additional 183 PJ/yr of potential in Ontario in 2020. However, because of the competing demands for these feedstocks, including for food, the modelling in this study did not see this feedstock being harnessed for RNG through to 2050. However, it's a feedstock that other government policies might be capable of triggering for Ontario RNG production.

2. Ontario RNG can make a significant contribution to Canada's climate targets

The second takeaway is that Ontario-produced RNG can make a significant contribution to Canada's climate targets. Different government policies unlock this potential with varying degrees of success. The most impactful policy scenario looked at in this study, in which there is a renewable gas mandate in effect across Canada as well as a GHG offset system that allows credits to be generated for methane utilization in landfills and agriculture, results in 5.6 Mt CO_2e of GHG reductions in 2030 and 6.6 Mt CO_2e in 2050.

Because this analysis focused on Biogas & RNG production rather than

consumption, the model can't confirm that all of those GHG reductions happen in Ontario. In theory, some of Ontario's RNG could be exported to other provinces, resulting in GHG reductions in those provinces. However, given the level of natural gas demand in Ontario, which outstrips other provinces, it's most likely that Ontario-produced RNG would be consumed in Ontario under the policy scenarios analyzed, and that the GHG reductions that have been calculated here would indeed factor into Ontario's GHG inventory.

3. Ontario-produced RNG can help satisfy renewable gas demand

The final key takeaway is that Ontario-produced RNG can help the province meet ambitious renewable gas demand goals.

According to the modelling, the optimal policy scenario, in which a renewable gas mandate is combined with a GHG offsets system that allows credits to be generated for methane utilization in landfills and agriculture, would unleash enough RNG production in Ontario to satisfy 2.9 percent of all Ontario's residential and commercial natural gas demand in 2030. This amount of RNG would meet almost 20 percent of renewable gas demand under a 15-percent renewable gas mandate. In 2040, Ontario-produced RNG is satisfying 4.3 percent of total Ontario residential and commercial natural gas demand, and meeting 14.5 percent of renewable gas demand under a 30-percent renewable gas mandate. And by 2050, Ontario-produced RNG is satisfying 5.3 percent of total Ontario residential and commercial natural gas demand, and meeting 17.8 percent of renewable gas demand under a 30-percent renewable gas mandate.

Meanwhile, the model shows that under the optimal policy scenario, there is surplus RNG being produced economically in other provinces, especially in Alberta and Saskatchewan, that could help fill the gap to meet Ontario's renewable gas demand. The model also sees emerging renewable gases, like synthetic natural gas and low-carbon hydrogen, playing an increasing role in meeting Ontario's renewable gas demand from 2030 to 2050, although RNG continues to be relied on for satisfying the majority of Ontario's demand.

Notes

1 Stephen et al, (2020). *Renewable Natural Gas (Biomethane) Feedstock Potential in Canada*. TorchLight Bioresources.

2 Kelleher M, (2013). *Canadian Biogas Study: Benefits to the Economy, Environment and Energy*. Canadian Biogas Association.

3 Stephen et al (2020)

4 Deloitte & WSP, (2018). *Renewable natural gas production in Québec: A key driver in the energy transition. Assessment of technical and economic potential in Québec (2018–2030)*.

5 IEA - Energy Technology Systems Analysis Program, (2013). *Biogas and Bio-syngas Production*.

6 IEA, (2020). *Advanced Biofuels – Potential for Cost Reduction*.

7 Hallbar Consulting, (2017). *Resource Supply Potential for Renewable Natural Gas in B.C*.

8 IRENA - International Renewable Energy Agency, (2013). *Road transport: the cost of renewable solutions*.

9 US EPA, (2021). *Landfill Projects. Available from: https://www.epa.gov/lmop/landfill-technical-data - Landfill and Project level data*.

10 S&T Consultants, (2021). *GHGenius 5.01d model, RNG from landfill gas pathway default value*.

11 Rajendran K, Brian Ó Gallachóir BO, Murphy JD, (2016). *The role of incentivizing biomethane in Ireland using anaerobic digestion. Prepared for the Environmental Protection Agency, Ireland*.

12 See: Stanton Bros. Ltd project in Ilderton, ON, at: https://farmtario.com/news/stanton-bros-ltd-set-to-become-first-agricultural-supplier-into-ontario-grid/

13 Environment and Parks Alberta, (2020)

14 Gouvernement du Québec, (2011)

15 Environment and Climate Change Canada, (2019). *Federal Renewable Fuels Regulations Overview*. Government of Canada.

16 Government of Quebec, (2020). *2030 Plan for a Green Economy: Framework policy on electrification and the fight against climate change*.

17 Government of British Columbia, (2018). *CleanBC: Our nature, our power, our future*.

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