

# **Proposed Agrifood Renewable Natural Gas for Transportation Demonstration Program**

## **Discussion Paper**

**May 2017**

**Ontario Ministry of Agriculture, Food and Rural Affairs**

# Discussion Paper: Proposed Agrifood Renewable Natural Gas (RNG) for Transportation Demonstration Program

## Contents

1	Background and Purpose of Discussion Paper .....	1
1.1	How to Participate.....	1
2	Using Renewable Natural Gas as a Transportation Fuel to Reduce Greenhouse Gas Emissions.....	2
2.1	Ontario’s Climate Change Action Plan .....	2
2.2	What is Agrifood Renewable Natural Gas?.....	3
2.3	Reducing Greenhouse Gas Emissions with RNG .....	4
2.4	What Types of Transportation Are Suited to RNG Fuelling? .....	5
3	Rationale for the Agrifood RNG for Transportation Program .....	5
3.1	Reducing Transportation GHG Emissions .....	6
3.2	Creating Low-Carbon Fuel by Anaerobically Digesting Agrifood Materials and Diverting Food Wastes from Landfills.....	7
3.3	Demonstrating RNG Business Models for Transportation Fuelling.....	7
3.4	Supporting Successful Demonstration Projects.....	8
4	Complementary Initiatives .....	9
4.1	Green Commercial Vehicle Program.....	9
4.2	Build a Network of Low-Emission Fuelling Stations.....	9
4.3	Establish Renewable Content for Natural Gas.....	9
4.4	Developing a Modern Renewable Fuel Standard for Gasoline in Ontario.....	10
5	Some Helpful Questions .....	10

## Summary

The purpose of this discussion paper is to provide context and to gather information from businesses, stakeholder groups, and the broader public that may be used for a proposed program that aims to increase the use of renewable natural gas as a transportation fuel. The Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) is developing it as a possible demonstration program under Ontario's Climate Change Action Plan. The ministry is seeking information to inform the development of a proposed program to demonstrate how a single company or several can work together to produce renewable natural gas fuel for vehicles. The projects would demonstrate commercial opportunities with different business models such as scale, sources of energy feedstocks, type of technology, location, and ownership of facilities and fleets.

## 1 Background and Purpose of Discussion Paper

The purpose of this discussion paper is to provide context about Renewable Natural Gas (RNG) production and RNG use as a vehicle fuel, and to gather feedback from businesses, stakeholder groups, and the broader public.

The Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) may use this information for a proposed agrifood RNG for transportation demonstration program ("the program") that aims to increase the use of renewable natural gas as a transportation fuel to reduce greenhouse gas emissions. The proposed program has been identified in Ontario's Climate Change Action Plan that was released in June 2016. The establishment of the proposed program is subject to approval from the Province, and funding is dependent on cap and trade proceeds that will be collected in 2017 and onwards. This document is one means by which the ministry is seeking information.

Your feedback to this discussion document, and any other comments, will help us understand the following:

- The level of interest and types of potential participants in an RNG production for transportation fuel supply chain;
- The business relationships that might develop or be necessary for successful RNG for transportation fuel project deployment;
- Possible barriers to success in RNG for transportation fuel projects; and
- Activities that might require government support to enable broader RNG uptake.

### 1.1 How to Participate

This discussion paper is intended to engage a range of stakeholders and the public to provide input and feedback. This paper provides information and context about RNG production and utilization for a transportation fuel. There is a list of questions at the end that you can answer as part of your feedback.

Your responses should be delivered to the Ontario Ministry of Agriculture, Food, and Rural Affairs by 19 June 2017. Please submit your written comments online through the Environmental Registry, registry number 013-0316, or to the ministry by sending them by email to RNG@ontario.ca.

## 2 Using Renewable Natural Gas as a Transportation Fuel to Reduce Greenhouse Gas Emissions

### 2.1 Ontario's Climate Change Action Plan

Ontario's Climate Change Action Plan is a five year plan that will help Ontario fight climate change over the long term. The CCAP will help Ontario meet its short and long term greenhouse gas (GHG) reduction targets through new policies and investment programs that will be funded by proceeds from the cap and trade program. In support of these goals and to assist with reducing transportation emissions (Ontario's largest GHG contributor) the Province is looking to increase the availability and use of lower carbon fuels through potential programs and targets for greenhouse gas reduction.

Under the CCAP transportation action area, there is a specific action item entitled "Increase the availability and use of lower-carbon fuel" which is described as follows:

**Pilot waste and agricultural methane as a fuel source:** The province intends to pilot a program that uses methane obtained from agricultural materials or food wastes for transportation purposes, with funding for commercial-scale demonstration projects.

Subject to necessary approvals being received, OMAFRA is developing this program with the goal described as follows:

To demonstrate competitive systems and business models for the production of Renewable Natural Gas (RNG) from agrifood sources and the use of RNG as a transportation fuel in order to reduce GHG emissions and initiate broader deployment of RNG transportation fuelling.

It is anticipated that the program will demonstrate the business models and technology necessary to help agriculture, food, and bioprocessing businesses develop demonstration projects to produce renewable natural gas, and to support businesses to transition their vehicles and fuelling infrastructure to use RNG. This will help pave the way for other companies wanting to produce or use RNG.

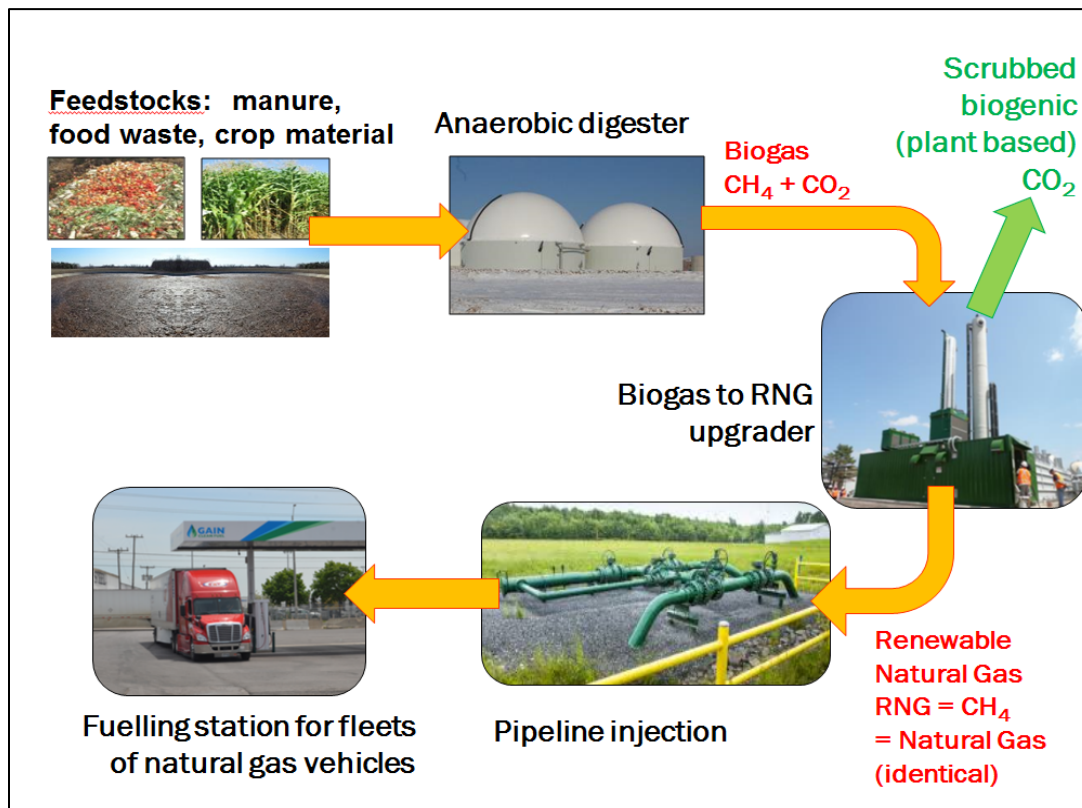
The program aims to demonstrate measurable GHG emissions reductions in the fuel, food waste, and agriculture supply chains as well as to reduce transportation costs. It will communicate lessons learned to other businesses in order to support future expansion of this market.

## 2.2 What is Agrifood Renewable Natural Gas?

RNG is primarily methane produced from biological sources by anaerobic digestion. In this case, agrifood renewable natural gas refers to RNG produced from anaerobic digestion of agricultural and food-based materials such as manure, crop-based materials, food by-products, and waste food materials. Anaerobic digestion is the process by which organic materials in an enclosed vessel are broken down by micro-organisms in the absence of oxygen to produce biogas (consisting primarily of methane and carbon dioxide). Generally, RNG refers to upgraded (cleaned up) biogas that has much of the carbon dioxide removed, resulting in a gas that is primarily methane. RNG may meet or exceed natural gas pipeline quality standards. The natural gas pipeline quality standard is typically 95% methane or higher. RNG is sometimes also referred to as biomethane. RNG can also be used in other natural gas applications beyond transportation. Initiatives to establish renewable content for the province's natural gas supply are outlined in section 4.3 of this document.

Other sources of RNG include landfill gas collection systems and waste water treatment plant digesters. A future source of RNG may be production through thermochemical gasification.

This agrifood RNG for transportation program focusses on RNG produced from anaerobic digestion of agricultural and food-based materials. Figure 1 provides a hypothetical example of an agrifood RNG production and utilization system.



**Figure 1.** Example of a renewable natural gas production system using agriculture and food-based materials for anaerobic digestion, movement of the fuel via a natural gas pipeline, and fuelling of a fleet of vehicles at a public natural gas fuelling station.

## 2.3 Reducing Greenhouse Gas Emissions with RNG

The 2016 Canadian GHG National Inventory Report (NIR) on greenhouse gas emissions<sup>1</sup> shows that road transportation fuels, waste management, and agriculture together make up nearly 45% of Ontario's GHG emissions.

GHG emissions from agriculture are primarily from livestock emissions, loss of organic matter in soils, and emissions from manure management. In 2014, GHG emissions from manure management in Ontario resulted in 1.9 Mt of CO<sub>2</sub>e<sup>1</sup> going into the atmosphere. The manure management emissions are from both the storage of manure, and emissions once it is applied to the land as a crop fertilizer. Other agricultural emissions include the use of fertilizers, and agricultural energy use.

GHG emissions from waste management are primarily from landfill emissions, but there are also emissions from the collection and transporting of these wastes as well as from some composting of organic wastes. Solid waste sent to Ontario landfills emitted 8.5 Mt of CO<sub>2</sub>e in 2014.

GHG emissions from transportation are primarily from the combustion of fossil fuels (e. g. gasoline, diesel). The transportation sector is Ontario's largest source of greenhouse gases, and the agricultural and food sectors are a significant user of transportation services. According to the NIR, transportation makes up 35% of Ontario's GHG emissions, and the transportation sector's emissions continue to grow. Emissions from diesel fuelled freight road transportation in Ontario emitted 14 Mt of CO<sub>2</sub>e in 2012, up from 6.2 Mt of CO<sub>2</sub>e in 1990<sup>1</sup>. Trucking is the primary GHG emission source of getting goods to market, and make up approximately 17% of food processors' cost.

Some of these emissions can be reduced as a result of RNG transportation projects. Agricultural materials could be harvested to produce RNG, and other GHG emissions could be avoided by using purpose grown crops. Food-based organic materials that may have been destined for the landfill could be reutilized to capture their energy. The final by-products of anaerobic digestion (called 'digestate') could be used as a nutrient source on agricultural fields, increasing soil carbon and reducing the use of chemical fertilizers. And emissions from fossil fuel-based transportation fuels can be replaced with RNG that is close to being carbon neutral. Together, these are the GHG emissions sources that are targeted through the proposed program.

---

<sup>1</sup> <http://www.ec.gc.ca/ges-ghg/> National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada, Part 3.

## 2.4 What Types of Transportation Are Suited to RNG Fuelling?

Generally, RNG is similar to conventional fossil natural gas and can be used in commercially available natural gas vehicle engines. Currently, the primary market in Canada for natural gas engines has been in transport trucks, garbage trucks, and buses. Figure 2 shows a natural gas refuelling site in Mississauga, Ontario. There are also Original Equipment Manufacturer (OEM) natural gas passenger cars and light duty trucks. After-market conversions can be installed in many diesel or gasoline engines, including off-road vehicles like agricultural or construction tractors.



**Figure 2.** An Emterra compressed natural gas refuelling facility in Mississauga with many overnight slow-fill stations.

When RNG is injected into the natural gas grid its characteristics are essentially the same as fossil natural gas. Renewable natural gas can therefore be produced at one location and natural gas fuelling might occur in another location. RNG may be transported in specialized high pressure cylinders with tractor trailers. RNG fuelling may also occur at the site of RNG production. Vehicles operating in towns and cities, along the 400 series highways, or in rural areas could be fuelling up at new or existing natural gas fuelling stations or using their own dedicated natural gas fuelling equipment.

## 3 Rationale for the Agrifood RNG for Transportation Program

Ontario's Climate Change Action Plan will help the province transition toward a lower-carbon economy. Agricultural biomass, by-products from the bioprocessing facilities, and waste food materials could become a significant source of low-carbon fuel. Currently, these agricultural and waste food materials are under-utilized. Some agricultural and food wastes are land-applied as a nutrient and some organic wastes are sent to landfills. In most cases, these wastes are a significant source of GHG emissions. Anaerobically digesting these materials would reduce emissions by putting the wastes to a productive use while at the same time displacing the use

of fossil fuels. Promoting the switch to vehicles that use RNG and natural gas is an objective in the Climate Change Action Plan.

### 3.1 Reducing Transportation GHG Emissions

Greenhouse gases are emitted through the extraction, processing, movement, and utilization of fossil fuels. As mentioned above, transportation fuel use makes up about 35% of Ontario's GHG emissions. The transportation sector operates with tight economic margins and must remain economically competitive. The sector continues to develop and adopt new technologies and systems to reduce fuel consumption and improve fuel efficiency. The reason for the focus on transportation fuels is that this is one of the largest opportunities to reduce GHG emissions with RNG (see section 4 for complementary CCAP initiatives dealing with transportation).

Greenhouse gas emissions can be significantly reduced by replacing diesel fuel with RNG fuel. To use RNG, a vehicle or fleet must first convert from diesel fuelling to natural gas fuelling by either switching to natural gas engines, or through engine modifications. Using compressed natural gas (CNG) or liquefied natural gas (LNG) instead of diesel has a significant cost savings because of the comparatively low cost of natural gas in North America at present. Simply switching from diesel fuel to CNG or LNG could achieve a life cycle GHG emission reduction of 15-20%. The final step to maximize emission reductions is to use RNG blended with fossil natural gas. The Canadian National Inventory Report on greenhouse gas emissions<sup>2</sup> determined that diesel fuel has a carbon intensity of 76.8 g CO<sub>2</sub>e/MJ, while California Air Emissions Board<sup>3</sup> has calculated agricultural RNG (as CNG fuel) to have one of the lowest carbon intensities of different fuel sources at approximately 13 g CO<sub>2</sub>e/MJ.

In Canada, several transportation fleets, waste haulers, transit fleets, and even some individual citizens are already converting their vehicles over to natural gas fuelling. In addition to lower exhaust emissions, other advantages of natural gas engines include less noise and cost savings from reduced maintenance. All of these advantages apply when RNG is used in natural gas engines.

Businesses that reduce GHG emissions through RNG may find other economic opportunities in the market place. The RNG production and utilization may generate environmental attributes that can be sold (e.g. "carbon credits"). Some businesses are also looking for ways to reduce the carbon footprint of their products through the supply chain, and to report these reductions to their clients and customers. Fuelling with RNG or RNG blended with natural gas can be one way to achieve these marketing goals. Replacing imported diesel fuel with locally produced RNG also results in fuel dollars being spent and kept within the Ontario economy.

---

<sup>2</sup> [http://unfccc.int/national\\_reports/annex\\_i\\_ghg\\_inventories/national\\_inventories\\_submissions/items/9492.php](http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php)

<sup>3</sup> [https://www.arb.ca.gov/fuels/lcfs/121409lcfs\\_lutables.pdf](https://www.arb.ca.gov/fuels/lcfs/121409lcfs_lutables.pdf)



## 3.2 Creating Low-Carbon Fuel by Anaerobically Digesting Agrifood Materials and Diverting Food Wastes from Landfills

Agricultural materials, bioprocessing, and food wastes represent a significant volume of material that may cause GHG emissions. But when used to produce energy, these materials can become a source of low-carbon fuel.

As RNG anaerobic digesters are built in Ontario, the feedstock sources will likely vary, depending on local availability and individual project design. Anaerobic digesters have been commercially deployed in Ontario primarily to produce electricity. Farm-based anaerobic digesters are generally using manure and food waste as feedstocks. Existing farm-based digesters get most of their revenue from renewable electricity generation. A few larger ‘merchant’ digesters built in industrial areas focus on providing waste management solutions for municipal and food wastes. They get a large portion of their revenue from waste management ‘tipping fees’ for receiving waste rather than primarily energy sales. Food wastes received at digesters alternately might have gone to landfill or other destinations and produced GHG emissions that were not captured. There are thousands of anaerobic digesters in Europe. In Germany, the primary model for agricultural anaerobic digestion is to use manure and purpose-grown energy crops such as corn silage as the digester feedstock. However, across Europe, food processing wastes, municipal organic wastes, and other organic materials are mainly treated by anaerobic digestion.

There is proven capacity in Ontario to successfully build and operate anaerobic digesters. The Canadian Biogas Association was originally established in Ontario, and Ontario houses several biogas design and equipment companies. Generally, the lessons learned from the deployment of existing digesters in Ontario will be applicable to new RNG digesters.

RNG digesters produce biogas that is ‘upgraded’ to eliminate most carbon dioxide and other impurities. In most cases, road vehicles will operate on high concentrations of methane in the RNG. For projects connected to the natural gas pipeline, the pipeline gas quality standard will dictate the quality of gas produced. While RNG production has been commercially deployed around the world, there are only a few examples of it in North America.

## 3.3 Demonstrating RNG Business Models for Transportation Fuelling

A key goal of the proposed program is to demonstrate the business models needed to deliver RNG to the transportation sector. There are potentially several participants needed in a successful business model to deploy RNG for transportation fuelling. Different businesses may be involved in the generation of the energy feedstocks and the operation of the RNG production facility. Gas utilities may be involved in the movement of the gas. The fuel station may be operated by an individual trucking fleet, or could sell fuel for public sale and provide fuelling for several fleets. Separate companies may be engaged to measure and track the fuel utilization and to quantify the GHG emissions. For RNG production to grow to meet future

renewable targets, many companies will need to learn from the early innovators to help grow the sector.

There are models to build upon from other jurisdictions. Fuelling with pure RNG, and blending with CNG has been growing in many countries around the world. Sweden has been using CNG and RNG blended fuels for over a decade. In Sweden, personal vehicles represent the largest number of vehicles using these fuels, and many buses and heavy transport vehicles are also using RNG. There is even a proposal to operate a ferry on RNG and CNG. Germany, Switzerland, the Netherlands, and several other countries are strong adopters of RNG and CNG vehicle fuels.

In the USA, dairy farms are leading the way in producing and using RNG. Likely the best known and largest adopter is Fair Oaks Farms near Fair Oaks, Indiana. They operate several large dairy farms and transport milk across a large region with their fleet of natural gas fuelled tractor trailer trucks. They are using anaerobic digestion, renewable fuels, and GHG emission reductions as an important part of their overall business environmental sustainability plan. Hilarides Dairy in California is another large dairy farm that produces RNG for their trucks.

In Canada, two farms are involved in RNG production. Fraser Valley Biogas operates an RNG system at a farm that sells its RNG to FortisBC, the local gas utility. Soon, Seabreeze Dairy Farm in B.C. will be doing the same. FortisBC markets their fuel to homeowners and businesses through a voluntary RNG buying program.

In Ontario, the City of Hamilton produces RNG from their wastewater treatment system and injects it into the natural gas grid. The City also operates over 50 city transit buses on compressed natural gas.

The intention of the proposed agrifood RNG for transportation demonstration program is to help the initial Ontario projects get established and for these developers to share their knowledge for the benefit of future RNG developers. Lessons will be learned as digester and transportation companies and others work together to find mutual benefits through differing priorities, project timeframes, and financial motivators. Projects will navigate business planning, financing and approvals to construct and deploy the different components of the project. If constructed, lessons will be learned through facility operation, staff training, management, maintenance, and reporting. If established, the program's participants who receive funding will be expected to share information, both to demonstrate project performance, and to inform any future policy and programs, and enable subsequent projects to move forward with the experiences and lessons learned from these early demonstration projects.

### 3.4 Supporting Successful Demonstration Projects

It is anticipated that through the program that a variety of projects may be deployed and that the projects supported will achieve a variety of environmental and economic outcomes while contributing lessons learned that may be of benefit to future projects. Some of the features that could be valued in demonstrations could include project attributes such as:

1. **Viability:** Does the project have a good likelihood of reaching commercial operation, contributing emissions reductions, and producing fruitful lessons learned? Does each participant in the project have demonstrated economic benefit that will lead to long-term success of the project?
2. **Value:** Does the project result in cost effective greenhouse gas emissions reductions (e.g. \$/tonne CO<sub>2</sub>e)? Are there other environmental co-benefits that arise from the project?
3. **Variety:** Do the projects demonstrate different business models to enrich learning opportunities? As a result of each additional project will a new business sector “see themselves” in the business model demonstrated? Are there different sources of RNG, and different types of transportation systems fuelled with RNG? Are different types of businesses engaged in the project’s supply chain compared to other projects?

## 4 Complementary Initiatives

There are several initiatives identified in the Climate Change Action Plan that may be complimentary to the agrifood RNG for transportation demonstration program. Pending funding approval, these programs may be delivered by different ministries, but have complimentary outcomes and overlapping stakeholders. The summary of these programs as presented in the Climate Change Action Plan are provided here, for information purposes only:

### 4.1 Green Commercial Vehicle Program

A new Ontario Green Commercial Vehicle initiative may provide incentives to eligible businesses that want to buy low-carbon commercial vehicles and technologies to reduce emissions, including electric and natural gas-powered trucks, aerodynamic devices, anti-idling devices, and electric trailer refrigeration. The government is proposing to provide up to \$170 million in funding towards this initiative.

### 4.2 Build a Network of Low-Emission Fuelling Stations

The Province may work with the Ontario Trucking Association, Union Gas, Enbridge Gas and others to establish a network of natural gas and low- or zero carbon fuelling stations. It may work with utilities to ensure the recovered biogas content of the fuel provided is increased over time to further lower the carbon footprint of this alternative fuel. Natural gas has lower carbon content than diesel and also burns cleaner, producing less local air pollution. The government is proposing to provide up to \$100 million in funding towards this initiative.

### 4.3 Establish Renewable Content for Natural Gas

Ontario may introduce a renewable content requirement for natural gas and provide supports to encourage the use of cleaner, renewable natural gas in the industrial, transportation and buildings sectors. The goal is to reduce emissions economically from natural gas use in the

building and transportation sectors. The government is proposing to provide up to \$100 million in funding towards this initiative.

The Canadian Gas Association and natural gas utilities have announced an industry target for renewable natural gas of 5 per cent RNG-blended natural gas in the pipeline distribution system by 2025 and 10 per cent by 2030<sup>4</sup>. Producing this quantity of RNG-blended natural gas will require many businesses working together; it will require significant investments and new technologies will need to be implemented. Early developers will be at the forefront learning the technical and economic feasibilities of developing a sustainable and expanding RNG sector in Ontario. This agrifood RNG for transportation demonstration program could be one of the early drivers for technology adoption.

#### 4.4 Developing a Modern Renewable Fuel Standard for Gasoline in Ontario

Ontario posted a Discussion Paper on the Environmental Registry in January 2017 entitled 'Developing a Modern Renewable Fuel Standard for Gasoline in Ontario'. The discussion paper, found at EBR Registry Number 012-7923 is seeking comments on the design options under consideration for the proposed Renewable Fuel Standard for gasoline. Input is being sought on various elements of the program design including targets and blending requirements, flexibility mechanisms, assessing lifecycle emissions, and transparency. The discussion paper lists RNG as a low-carbon fuel, and includes a question regarding the eligibility of low-carbon transportation projects for compliance purposes in the Renewable Fuel Standard.

### 5 Some Helpful Questions

To support the design of the program, here are some questions that may help you respond to this document. Please provide answers to any questions that have specific interest to you.

1. What are the best opportunities for successful agrifood RNG for transportation projects? Which businesses or organizations are best prepared to successfully deploy RNG anaerobic digesters and natural gas fuelled fleets? What other business partners and business relationships will need to be in place for projects to succeed?
2. What are the key financial opportunities that will help projects to succeed?
3. At what scale would a project have to be deployed to be successful? How much RNG production? How many vehicles?
4. Are businesses and organizations ready to develop and deploy RNG for transportation projects? Are there gaps in the supply chain? What would improve companies' readiness?

---

<sup>4</sup> [http://www.cga.ca/news\\_item/canadas-natural-gas-utilities-propose-target-for-renewable-natural-gas-content/](http://www.cga.ca/news_item/canadas-natural-gas-utilities-propose-target-for-renewable-natural-gas-content/)

5. What barriers do you foresee to developing a successful project? How can these barriers be overcome?
6. How long would it take to deploy an RNG for transportation project from conception to successful operation?
7. Describe the types of government support needed to successfully deploy RNG for transportation projects.
8. What are some criteria or project attributes that should be considered or prioritized for a project to be supported through this program?
9. What should be included in the program to ensure broader uptake of RNG for transportation after the program is completed?
10. Please comment on any other requirements or considerations for the Agrifood RNG for Transportation Demonstration program.

Please submit your written comments online through the Environmental Registry, registry number 013-0316 by 19 June 2017, or to the Ontario Ministry of Agriculture, Food, and Rural Affairs by sending your comments by email to [RNG@ontario.ca](mailto:RNG@ontario.ca). Thank you for your interest in the proposed program!