



Government
of Canada

Gouvernement
du Canada

Update on Canadian Biogas Initiatives

GMI Biogas Subcommittee Meeting

Baltimore, USA

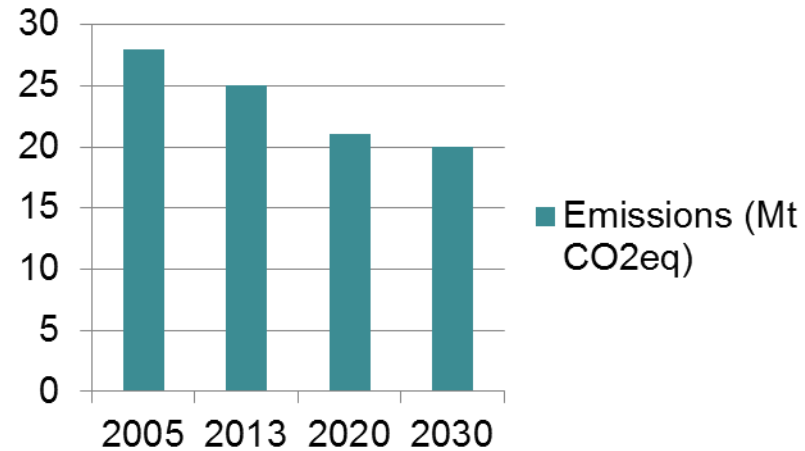
September 27, 2017

Canada 

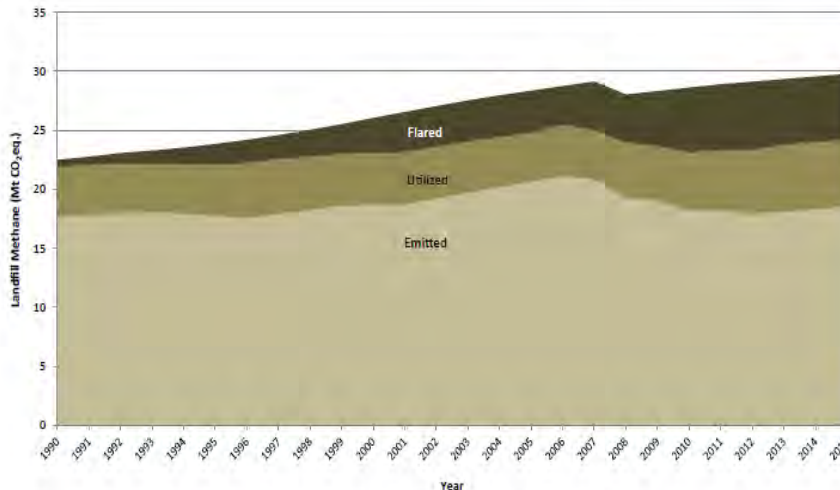
WASTE SECTOR

Trends in methane emissions from Canadian waste sector

- Emissions in 2030 expected to be 29% below 2005 level
- Largely due to increased MSW landfill gas capture



Source: Canada's Second Biennial Report on Climate Change, 2016



Source: Canada's National Inventory Report, 2017

- 36% of methane was captured in 2015, compared to 21% in 1990
- In 2015, Canadian landfills accounted for 22% of national methane emissions, or ~3% of Canada's total GHG inventory

New Canadian actions to reduce methane emissions from the waste sector

- Strategy on Short-Lived Climate Pollutants (July 2017)
 - Collaborate with provinces and territories to develop measures/actions to reduce methane from landfills, organic waste and food waste
- Supporting Chile's Nationally Determined Contributions (2017)
 - Supporting the deployment of technology and activities geared at reducing methane emissions at existing landfill sites
 - exploring opportunities and planning projects to divert organic matter from landfills
- Commission for Environmental Cooperation (CEC) (July 2016)
 - Canada, US and Mexico committed to developing and implementing national methane reduction strategies for key sectors and issues including waste management and food waste
- Pan-Canadian Framework (December 2016)
 - Carbon Pricing Regulations and Clean Fuel Standard initiatives anticipated to increase the demand and funding available for projects that will capture and control/utilize LFG

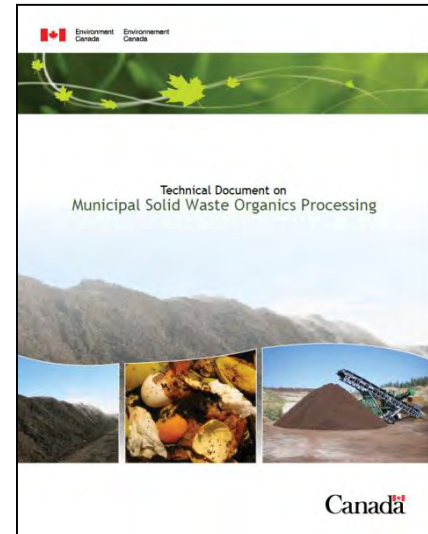
Landfill Gas

Two foundational studies underway by Environment and Climate Change Canada (ECCC) to identify methane mitigation opportunities and costs

- **Large landfills** (greater than 40K tonnes waste disposed/yr):
 - Approx. 100 large landfills, which represent 75% of total landfill gas in Canada
 - Technical and economical assessment of methane emission reductions achievable through installation or enhancement of LFG capture and control systems (Report expected Fall 2017)
- **Small landfills** (smaller than 40K tonnes waste disposed/yr):
 - Thousands of smaller landfills in Canada
 - Inventory of sites, analysis of potential methane generation and emissions, identification of mitigation options and costs (Report expected Winter 2018)
- ECCC has initiated discussions with provinces and territories to inform decisions on future measures to reduce LFG

Organics Diversion

- ECCC published [Technical Document on Municipal Solid Waste Organics Processing, 2013](#)
- Organic disposal bans in Quebec, Nova Scotia, Prince Edward island, New Brunswick, certain municipalities
- ECCC is collaborating with provinces and territories to identify opportunities for future ECCC activities to support increase organics diversion and processing
- CEC: North American Initiative on Organic Waste Diversion and Processing
 - Identify barriers, opportunities and solutions related to increasing organic waste diversion and processing capacity in North America
 - Final report expected Fall 2017



Food Loss and Waste

- ECCC is collaborating and engagement with OGDs, provinces, territories and key stakeholders to analyze options and develop recommendations for federal measures or activities to reduce food loss and waste
- ECCC is working with CEC (Governments of Canada, Mexico and the United States on issue of food waste:
 - Initial foundational work - [Characterization and Management of Food Waste in North America](#) (Final report expected Fall 2017)
 - Current work includes two projects (2017-2019):
 1. Measurement
 2. Youth Engagement/ Awareness

Other RNG Activities in Canada

National

- ECCC developing a Clean Fuel Standard to reduce Canada's greenhouse gas (GHG) emissions through the increased use of lower carbon fuels and alternative technologies.

Provincial

- Province of Ontario Ministry of Agriculture, Food and Rural Affairs has proposed an [Agrifood Renewable Natural Gas for Transportation Demonstration Program](#)
 - linking single or several companies (i.e. digesters) with transport companies to produce renewable natural gas fuel for vehicles
- Province of Quebec has developed the [2030 Energy Policy](#):
 - increase by 25% overall renewable energy output
 - increase by 50% bioenergy production

Supporting Chile's Nationally Determined Contributions (NDC)

Overall objective:

\$7M to support Chile's NDC implementation in the waste sector through:

- the reduction of methane emissions from existing landfill sites and measures to divert organic matter from landfilling; and,
- the development of robust sectoral MRV.

Program Priorities

1. Reduction of emissions through technology deployment in selected cities;
2. Tracking, monitoring and reporting emission reductions as well as explore opportunities for new and innovative cooperative arrangements;
3. Leverage co-financing from public and private sector partners for the planned projects as well as creating financial enabling conditions for scaled-up implementation through engagement international financial institutions and Multilateral Development banks; and,
4. Provide technical support for communications opportunities.

Supporting Chile's NDC

Activity 1: Technology Deployment

- Eight Chilean cities have been identified based on how well they represent Chile's climatic and geographic diversity.
- For each city, the goal is to capture methane emissions from the existing landfills and create clean energy.
- For the first four cities, methane capture will be complemented by the development of plans for a new facility in order to divert organic matter from landfilling.

RETROFIT OF EXISTING LANDFILL AND CH₄ CAPTURE

- Vina del Mar
- Puerto Varas
- Iquique
- Hanga Roa
- Rancagua
- Concepcion
- La Serena / Coquimbo
- Puerto Natales

ORGANIC DIVERSION

- Vina del Mar
- Puerto Varas
- Iquique
- Hanga Roa

Supporting Chile's NDC

Activity 2: Monitoring, Reporting and Verification

MRV is essential to unlock investment and support climate actions to implement the Paris Agreement. The Canada-Chile Program will include:

MRV IN THE WASTE SECTOR:

- Sharing/reviewing existing emission factors, tools and inventories
- Exploring/developing a new methodology/protocol for organic waste diversion
- Pitching the new methodology to make it accepted or at least building the case for acceptance
- Potential for south-south cooperation with additional countries

PROJECT LEVEL MRV

- Tracking emissions that result from the individual projects
- Reporting project results applied against NDC
- Scaling up project results to highlight sector potential
- Communicating results of the project and potential for the sector

COOPERATIVE APPROACHES

- Exploring bilateral arrangements to transfer ITMOS that satisfy key requirements including environmental integrity and robust accounting.
- Exploring private sector role and potential for ITMOs as part of a trading system

Supporting Chile's NDC

Activity 3: Leverage Financial Investments

PROJECTS CO-FINANCING

- Engaging Public Sector partners (national, regional and local) to secure co-financing.
- Engaging international and national Private Sector partners to secure co-financing.

SCALE UP BEYOND CANADA'S SUPPORT

- Engaging private and public sector partners (international, national, regional and local) to secure long term financing.
- Engaging national banks, IFIs and MDBs to scale up implementation.

Supporting Chile's NDC

Activity 4: Communications

SENIOR MANAGEMENT

- Providing Communications opportunities and support for both national governments (Senior management and Minister level)
 - Press Release
 - Communique
 - Specific events (i.e opening ceremony)

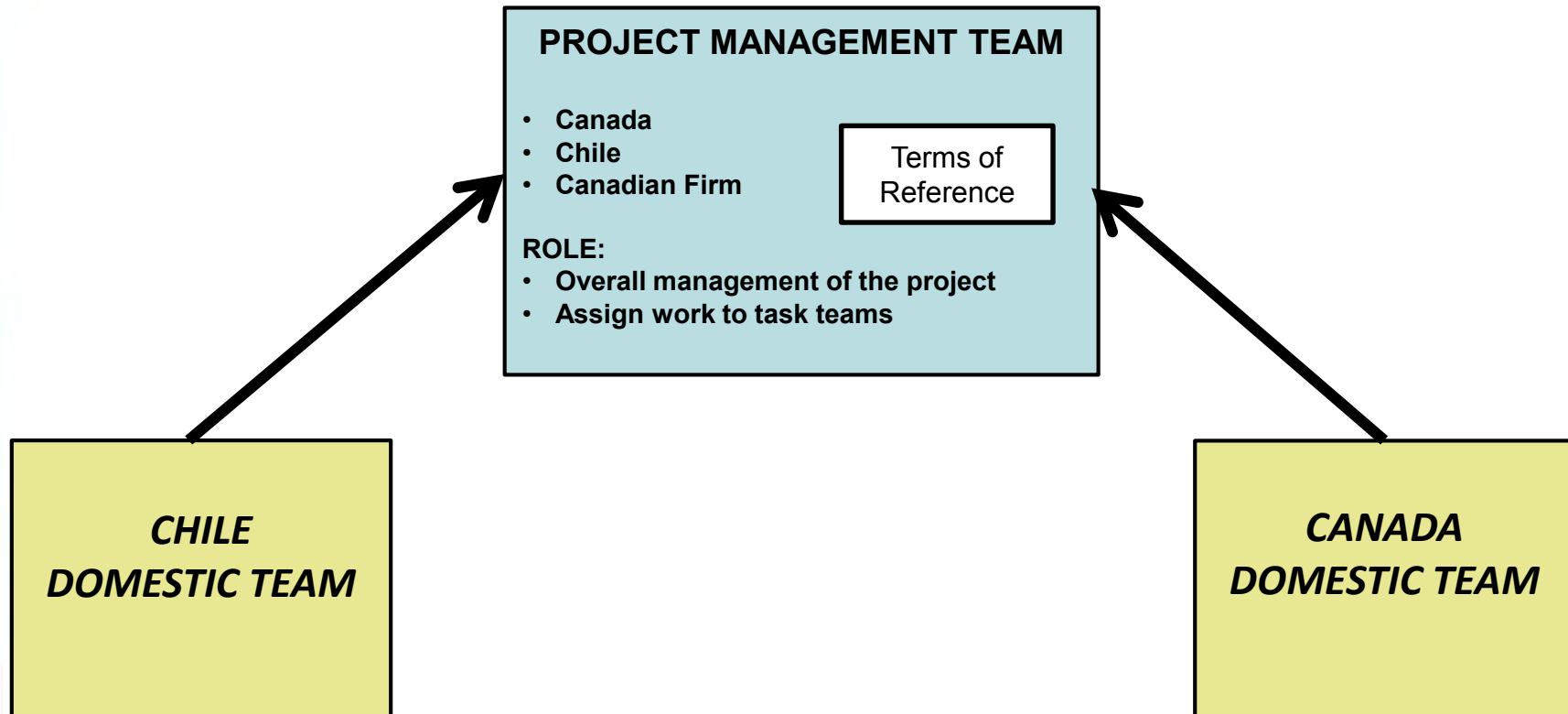
INTERNATIONAL SCENE

- Providing support for reporting and disseminating result internationally through various fora:
 - Partnerships (CCAC, GMI,..)
 - UNFCCC (COPs, intersessional, ...)

COMMUNITY LEVEL

- Providing support for potential public education and outreach campaigns at the local level to engage communities in adopting climate friendly practices.
 - Schools programs
 - Ad Campaigns

Supporting Chile's NDC Governance



Supporting Chile's NDC

Potential for Replication

- Based on its experience, Canada is committed to supporting the development of government-driven mitigation strategies that will ultimately:
 - Support the adoption and the implementation of technologies to significantly reduce Short-lived Climate Pollutants;
 - Support the implementation of NDCs;
 - Deliver direct environmental and health co-benefits; and,
 - Leverage significant public and private investments as well as financial institutions.
- An additional \$5.72M of bilateral funding to be allocated.

Supporting Chile's NDC

A New Context for Mitigation Transfers

- The Paris Agreement has created a new world – moving away from a top-down regime (Kyoto Protocol) to a bottom-up approach.
- Article 6 of the Paris Agreement sets a foundation for various cooperative market-based and non-market approaches to achieving targets.
- Under the Paris Agreement, international trades and transfers of emission reductions used towards targets are called **Internationally Transferred Mitigation Outcomes (ITMOs)**.

Supporting Chile's NDC

Piloting Approaches for ITMOs

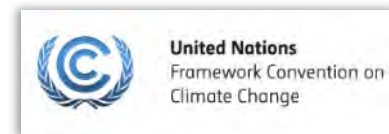
Through the implementation of both bilateral initiatives, Canada will work with Chile and Mexico to:

- Develop capacity-building for tracking, monitoring, and reporting emission reductions;
- Identify option to achieve NDC levels; and,
- Develop incentive for the participating actors to replicate the model in other communities/facilities.

AGRICULTURE SECTOR

A National Survey

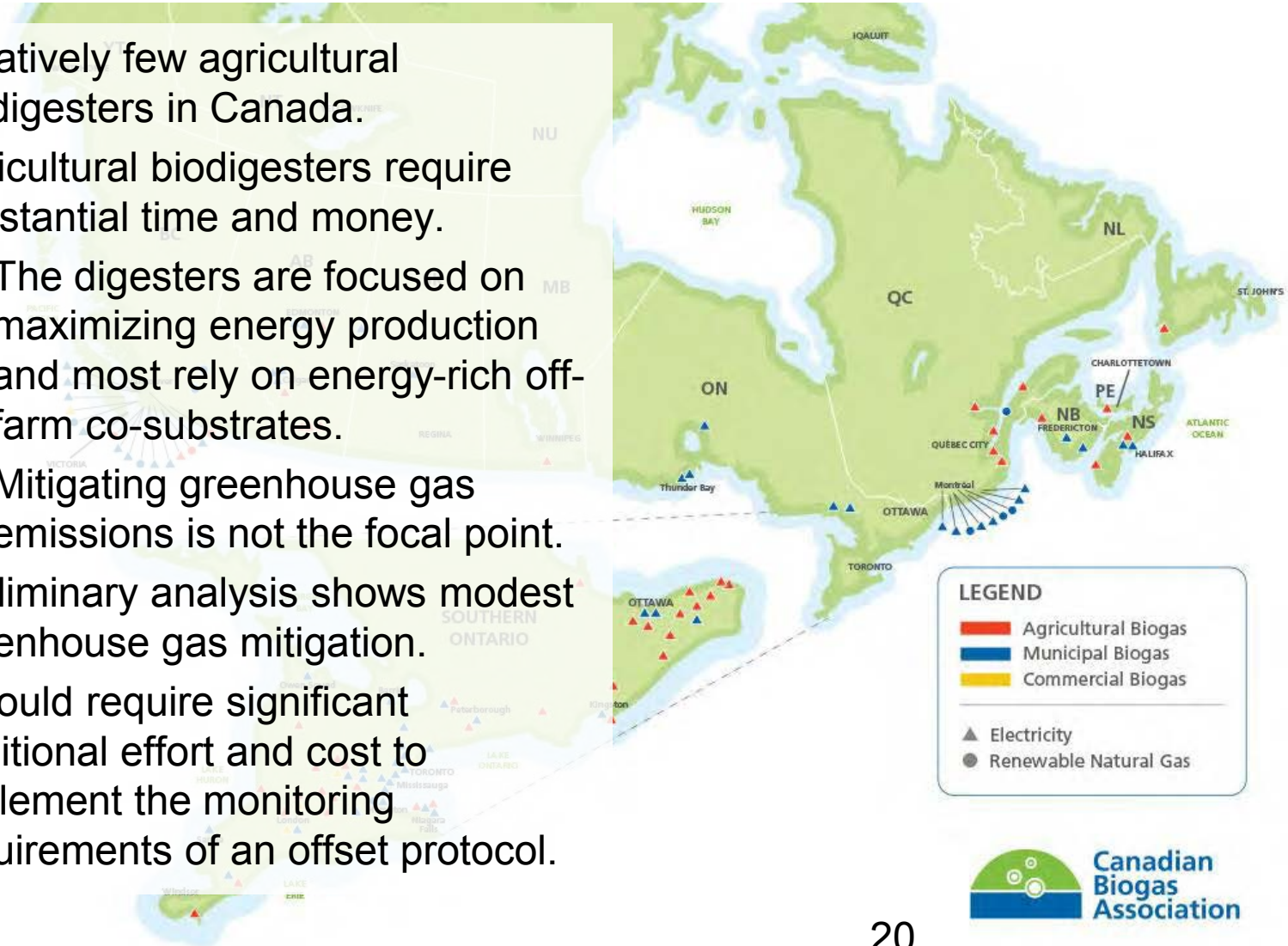
- Lack of a national dataset describing the number of Agricultural biogas projects
- 2014 Survey by IPSOS Reid
 - 300 page report
- Funds from: Environment and Climate Change Canada, Agriculture and Agri-food Canada, and Natural Resources Canada



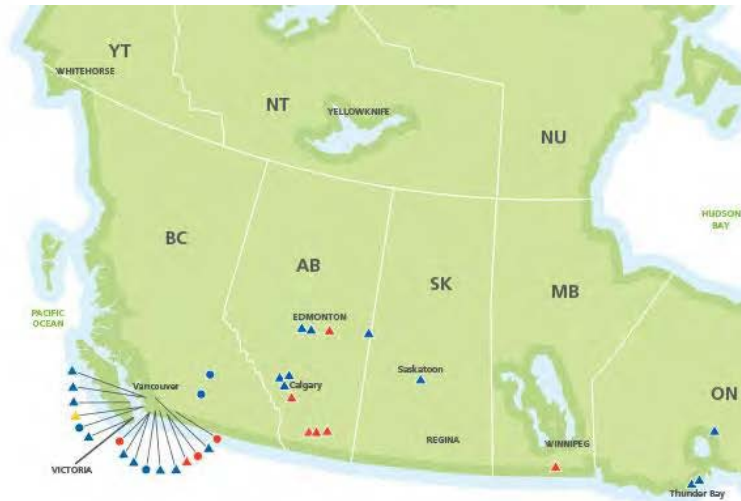
Value of Biogas Conference & Forum, March 23, 2018 | Woodbine Convention Centre, Toronto, ON

National Survey - Summary

- Relatively few agricultural biodigesters in Canada.
- Agricultural biodigesters require substantial time and money.
 - The digesters are focused on maximizing energy production and most rely on energy-rich off-farm co-substrates.
 - Mitigating greenhouse gas emissions is not the focal point.
- Preliminary analysis shows modest greenhouse gas mitigation.
- It would require significant additional effort and cost to implement the monitoring requirements of an offset protocol.



National Survey – Summary (cont'd)



- **Key to reducing emissions:**
 - management of digestate
 - reducing leakage and flaring
 - storage of digestate in a covered tank or ultra-efficient solid separation,
 - empty tank completely two to three times per year,
 - application by rapid incorporation of the digestate or shallow injection.
- **Avoided emissions vary**
 - Benefits of electricity production depends on regional electricity grid.
 - Benefits of waste diversion varies greatly depending on the waste.

National Survey - Respondents

Table 1 - Sample of Biogas Operators by Farm Type Compared to Known Data

* "Other" includes a mix of greenhouse, crop, veal, mink operations.

Farm Type	Estimated Distribution of Operators	Respondent Sample of Biogas Operators		
		Total Responding	Completed	Partially Complete
Dairy	31	29	13	16
Beef	4	5	3	2
Swine	6	0	0	0
Poultry	2	0	0	0
Other*	7	1	0	1
TOTAL	50	35	16	19

Table 2 - Biogas Operators Sample by Region

	BIOGAS		
	Complete	Partial	Total
AB	1	4	5
BC	2	2	4
MB/SK	1	0	1
ON	12	17	29
Total	16	11	35

Table 3 - Non-biogas Operators by Region

	NON-BIOGAS		
	Complete	Partial	Total
AB	9	371	380
BC	3	20	23
MB/SK	8	300	308
ON	28	749	867
QC	2	3	4
Don't Know	1	25	26
Total	51	1557	1608

Results of this study are not projectable to the larger population of agricultural operators or biogas operations and are to be considered directional in nature, due to low response rate among the small universe of biogas operators.

National Survey - Feedstocks

92% use additional organic material (besides manure), thus biogas plants process much larger quantities of biomass than farms without biogas plants.

Table 50- Amount of Manure Digested in Biogas System

Cubic Meters/day	Total	
	Liquid	Solid
Total Responding	19	21
Mean	20 m³	137 m³

Q12_19/Q12_24- Cubic metres/day In 2013, approximately how much liquid/solid manure from your farm operation was digested in your biogas system?

- Most farms primarily use liquid manure
- A few farms use a lot of solid manure
- About 1 in 5 digesters receive dilute feedstocks. These bring a very large quantity of material on-farm with increased handling and storage costs per unit of energy and nutrients supplied.

Table 51 - Organic Materials Used as Inputs for Anaerobic Digester

Organic Materials (beyond livestock manure) used for inputs for anaerobic digester in 2013	Percentage Responding	Average volume per month (metric tonnes)
Use organic materials beyond livestock manure in 2013 (NET)	92.6%	
Fats, Oils and Greases (FOG) or Dissolved air flotation fats	55.6%	754
Waste animal feeds	33.3%	15
Waste commercial food from grocery stores, distribution cent	29.6%	298
Food processing materials	29.6%	281
Beverage or dilute process water	22.2%	4,467
Spoiled crops	22.2%	10
Crops - residue harvested	11.1%	15
Crops - purpose grown	11.1%	205
Distillers grains	7.4%	20
Other (e.g. pet food, greenhouse vegetables, enzyme byproducts, separated organic solids, why permeate)	22.2%	253
Did not use organic materials beyond livestock manure in 2013	7.4%	
Total Number Responding		26

(Q12.28 Which of the following organic materials (beyond livestock manure), if any, did you use as inputs for your anaerobic digester in 2013? For each type of organic materials you used, in metric tonnes, imperial tons, or cubic metres please indicate the volume used per month.)

National Survey - Feedstock Supply Challenges

- Most have difficulty maintaining consistent feedstocks.
- Inconsistent feedstocks reduces system performance. Potentially higher fugitive methane losses during transitions.

Table 48 - Supply of Feedstocks to Run Biogas System

The supply of feedstocks to run biogas system (manure, off-farm material)	Count	Percent of responding
I have no trouble maintaining a consistent supply of the feedstocks I need for optimal production.	5	24%
I occasionally have trouble maintaining consistent feedstocks (e.g., 2x per year)	6	29%
I have trouble on a regular basis (e.g., monthly)	7	33%
I constantly have difficulty sourcing and maintaining feedstock supply.	3	14%
Total Responding	21	

(Q13.28 Regarding the supply of feedstocks to run your biogas system (manure, off-farm material), which of the following would be closest to your opinion? Please select one response.)

} **76%**

National Survey - Time & Money

Table 42 - Number of Hours Per Day Managing the Biogas System

Number of hours spent managing the biogas system	Percent of responding
1 to 2	70.8%
3 to 4	20.8%
8 or more	8.3%
Total Responding	
<i>(Q13.24 in 2013, how many hours per day did you spend managing the biogas system?)</i>	

A substantial time commitment:

- 1183 hours for development
- + 730 hours per year

Table 43 - Capital Investment

	Average Capital Investment Per Operator
Manure Management	\$76,317.10
Off-farm Feedstock Management	\$57,545.60
Digester tank and components	\$1,242,264.90
Biogas Collection, Conditioning and Delivery	\$220,874.40
Engine and generator and system controls	\$594,511.40
Grid interconnection (including power line upgrades)	\$124,577.00
Gas upgrading	\$10,045.60
Site Development	\$80,674.50
Soft Costs (PM, approvals, permits, design, engineering)	\$131,140.00
TOTAL CAPITAL INVESTMENT	\$2,537,950.50
Owner's development time (man hours)	1183.8 hours
<i>(Q13.23 How much was the capital investment of your biogas system? Enter costs in dollars per the following categories:)</i>	

National Survey – Potential for Growth

- 17% of non-biogas farms surveyed have an interest in installing a digester in the future.
- Some on-farm AD producing RNG are operating in British Columbia

32 additional plants were identified that could come online in the next two years.

Most planned digesters are in Ontario (53%)

Majority are on dairy farms (63%)

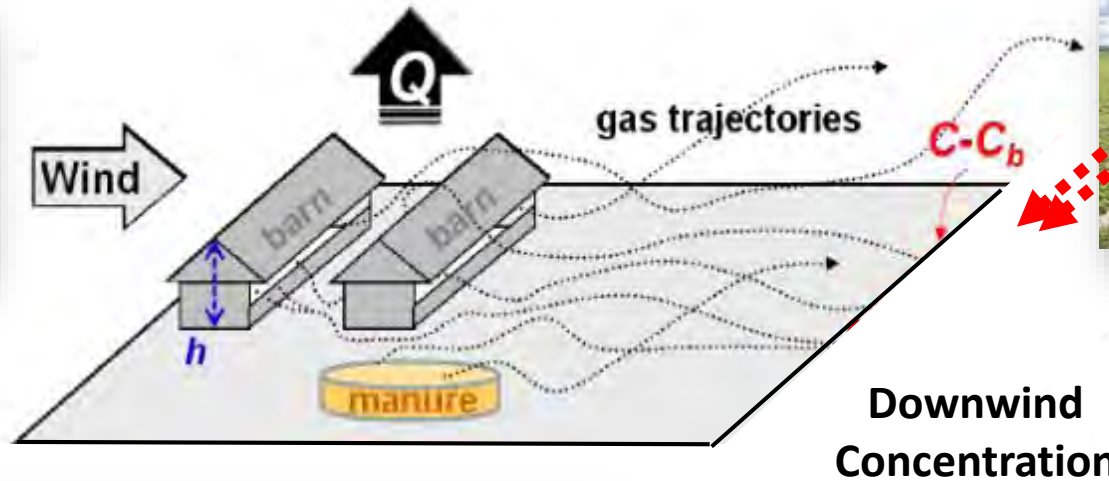
2nd highest interest was from the swine industry

Methane Emission Measurement

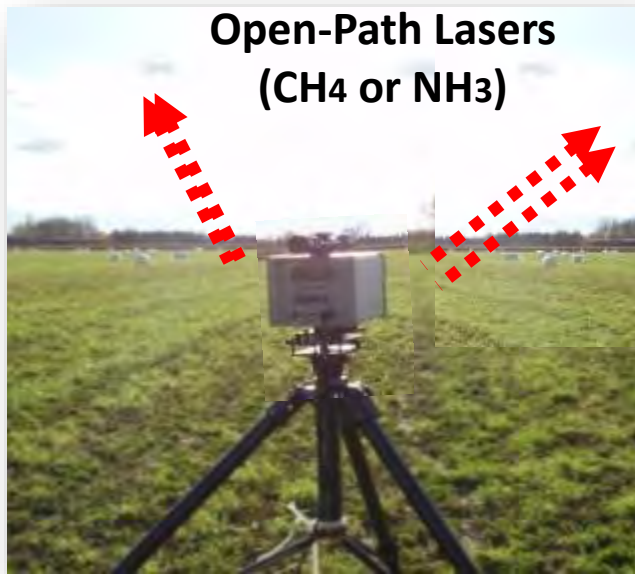
- Method developments highly transferable to other sectors (Oil & Gas)
- Collaborative with other departments (EC, NRCan) and Universities



Upwind
Concentration



Downwind
Concentration





Mitigating Emissions using Biogas

FUNDING: PERD (NRCan) co-led by MacDonald (EC) and VanderZaag (AAFC)
COLLABORATORS: AAFC (Smith, Desjardins), EC, OMAFRA, U of Guelph, Alfred College, Industry (Canadian Biogas Association)

- **Biogas: Mitigation Practice, but not counted in National Inventory**
- **On Farm Measurements:** GHG and ammonia emissions at biodigesters
- **National Survey:** all biodigester operators & comparable farms
- **Improve National Inventory:** GHG and NH₃ Inventories responsive to farm adoption of Biodigesters



Minimizing Methane Leakage

Emissions leaking from the biodigesters can be very large.

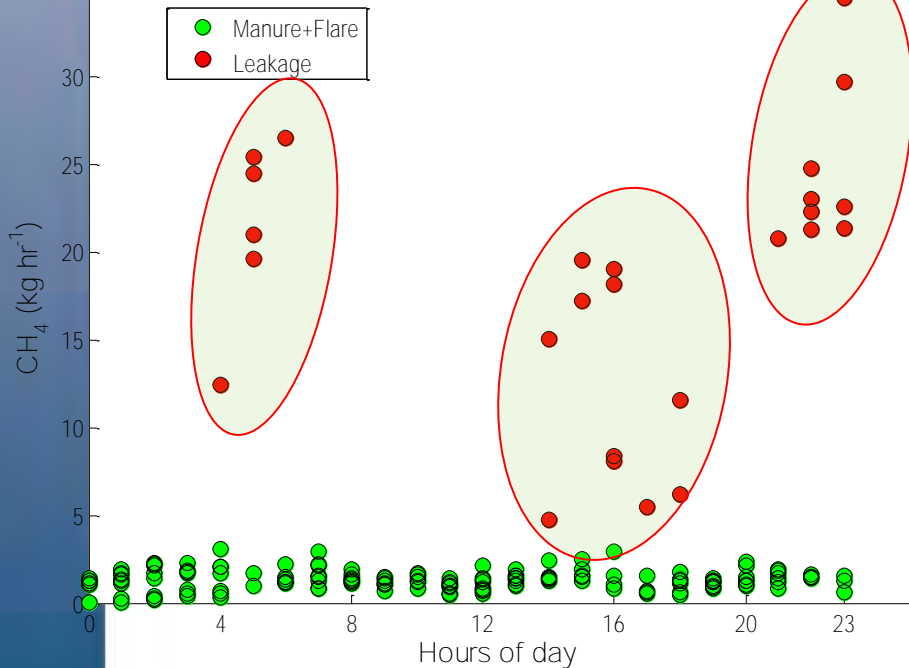
Important to minimize this. (stable operation, size of genset vs reactor)

2-Stage Biogas + Solid Separator



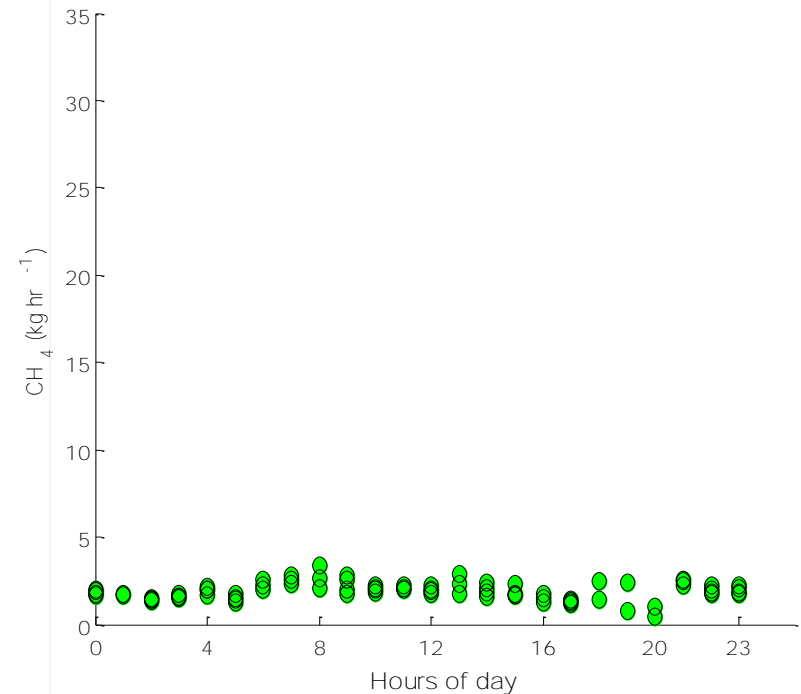
A Day with Leakage

CH₄ emissions with Leakage from the digesters



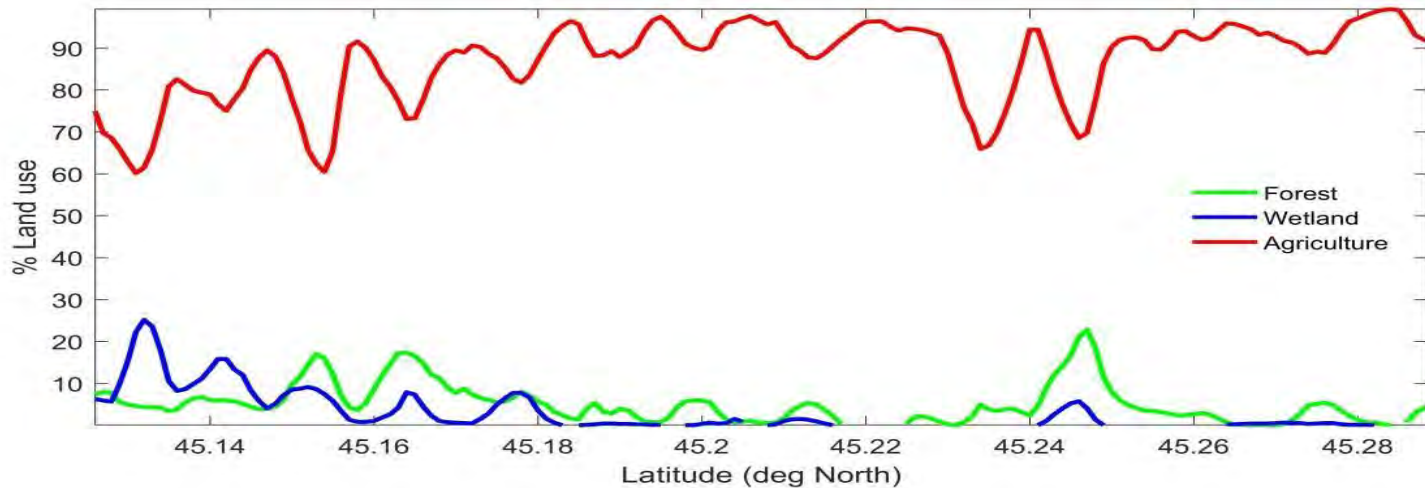
A Day without Leakage

CH₄ emissions from Manure + Flare, No leakage, OCT 25, 2014

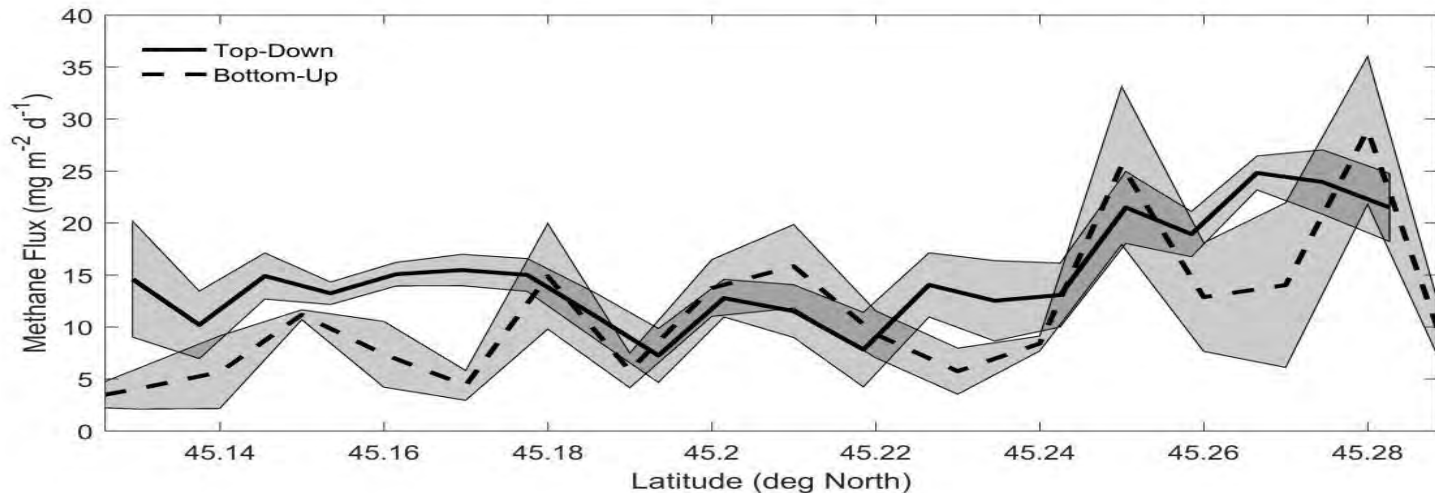


Verification of agricultural methane emissions inventory using aircraft-based flux measurements

Desjardins et al. 2017 Agr and Forest Meteorology J.



Land use contributions to the flux footprint (upper panel) and top-down 1 km aircraft-based CH_4 flux measurements 15 $\text{mg}/\text{m}^2/\text{d}$ and bottom-up inventory calculation 12 $\text{mg}/\text{m}^2/\text{d}$ (lower panel). Shaded grey area represents ± 1 SE.



Contacts

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GLOBAL METHANE FORUM

April 16-18,
2018
Toronto,
Canada

A stylized silhouette of the Toronto skyline in various shades of blue, featuring the CN Tower and several skyscrapers.

SAVE THE DATE