



# Canada

## Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector)

The oil and gas sector is the largest industrial emitter of methane in Canada, releasing almost half of total methane emissions from industrial sources.

Beginning in spring 2018, new federal regulations restricted methane emissions from upstream activities such as exploration, drilling, production, processing and transmission of oil and gas from facilities that handle significant volumes of gas. They cover specific methane emissions sources including fugitive emissions and venting from specific equipment and from facilities generally. Stakeholders for this effort include indigenous peoples; provincial, territorial and municipal governments; industry; and non-governmental organizations.



### ***How Canada is Measuring Effectiveness***

Reductions of methane emissions from the oil and gas sector are tracked in the national greenhouse gas (GHG) inventory. Industry actions will also be reviewed through ongoing reporting requirements in the regulations.

### ***Expected Outcomes***

Reducing methane is recognized as one of the lowest cost opportunities to make significant GHG reductions from the energy sector. The federal methane regulations for the oil and gas sector have been designed to achieve Canada's target of reducing emissions of methane from oil and gas operations by 40 – 45 percent from 2012 levels by 2025. The regulations will result in tangible reductions of 20 megatonnes of carbon dioxide equivalent between 2018 and 2035, which is equal to taking about 5 million passenger vehicles off the road each year.

# Initiatives to Prevent GHG Emissions through Diversion and Prevention of Organic Waste

The anaerobic decomposition of organics in landfills is a major source of methane in Canada. When organics are buried in a landfill they can emit methane for up to 50 years. These emissions can be avoided by diverting organics to other waste management activities (such as composting) and by preventing the generation of unnecessary organic waste. Environment and Climate Change Canada is doing extensive work to provide information to provincial and municipal organization on the waste disposal options available for organics. ECCC is also raising awareness of food waste as a contributor to methane generation, and it is developing strategies to encourage reductions in food waste across the food distribution network. Collaboration among the provinces, municipalities, and the public will be key components of this effort.



## ***How Canada is Measuring Effectiveness***

- GHG calculator for waste diversion scenario planning
- Canadian Forum on Food Waste and Loss
- "Taking Stock Report" that will identify current actions and opportunities
- National Framework to measure and report food waste and Loss

## ***Expected Outcomes***

Greater awareness among Canadians on the issue of food waste and loss. Informed decision making by jurisdictions when planning waste diversion infrastructure.

# Landfill Gas Capture and Utilization Feasibility

Landfills are a major source of methane nationally. While diverting organics from landfills will help mitigate future methane emissions, organics that have already been disposed of in landfills will continue to emit large amounts of methane over the next 20-50 years. Current landfill gas (LFG) capture practices mitigate up to 50% of generated methane in landfills, however opportunity exists to reduce emissions by increasing the amount of LFG capture.

Environment and Climate Change Canada is working to encourage greater LFG collection across provinces and municipalities through feasibility studies of LFG capture in small, medium and large landfills. This work includes

developing a comprehensive landfill database, LFG modelling, assessment of existing technologies, and cost-per-tonne assessments.



## ***How Canada is Measuring Effectiveness***

Canada will be completing a report on GHG Emission Mitigation in Small Canadian MSW Landfills, as well as an inventory of large and medium-size landfills.

## ***Expected Outcomes***

LFG capture and utilization information will be made available to provinces and municipalities such in order for them to make informed decisions about greenhouse gas (GHG)-mitigation options for landfills in their jurisdictions.

# International Collaboration to Address Methane Emissions

Environment and Climate Change Canada is working to establish collaborative relationships with several international partners in this effort anticipated to take place between 2017 to 2022.

## ***Vietnam***



Canada is providing \$1M over the next three years to mitigate short-lived climate pollutant (SLCP) emissions from Vietnam's municipal solid waste sector as a means of supporting the implementation of Vietnam's nationally determined contribution (NDC) and ultimately helping the country achieve its commitments under the Paris Agreement.

*Partners:* ECCC, Federation of Canadian Municipalities (FCM), Association of Cities of Vietnam (ACVN), and Government of Vietnam (MONRE and MOC).

### **How Canada is Measuring Effectiveness**

The project's effectiveness will be reflected in capacity building and technical assistance related to supporting NDC implementation in each countries' respective waste sectors.

### **Expected Outcomes**

This project is expected to help Vietnam realize their objectives and targets articulated in NDCs, as it relates to the waste sector, thereby helping each country achieve their goals under the Paris Agreement.

## ***Senegal and Côte d'Ivoire***

Canada recently launched a \$2.12 million bilateral NDC project with Côte d'Ivoire and Senegal, over three years, that aims to support methane emission reductions in the solid waste sector.



*Partners:* ECCC, UNEP, and Governments of Senegal and Côte d'Ivoire.

### **How Canada is Measuring Effectiveness**

The project's effectiveness will be reflected in capacity building and technical assistance related to supporting NDC implementation in each countries' respective waste sectors.

### **Expected Outcomes**

This project is expected to help Senegal and Cote d'Ivoire realize their objectives and targets articulated in NDCs, as it relates to the waste sector, thereby helping each country achieve their goals under the Paris Agreement.

## Chile



Canada is providing \$7 million over four years to support the implementation of Chile's Nationally Determined Contribution (NDC) under the Paris Agreement. The Canada-Chile Program, deployed between 2017 and 2021, focuses on providing capacity building and technical assistance to support clean innovation and reduce emissions from landfills, while exploring opportunities to divert organic matter from landfilling hence avoiding the generation

of methane in landfills.

*Partners:* ECCC, Arcadis Canada, Government of Chile (MMA), Chilean municipal governments, public and private financial intermediaries, and other industry stakeholders.

### How Canada is Measuring Effectiveness

The project's effectiveness will be reflected in capacity building and technical assistance related to supporting NDC implementation in each countries' respective waste sectors.

### Expected Outcomes

This project is expected to help Chile realize their objectives and targets articulated in NDCs, as it relates to the waste sector, thereby helping each country achieve their goals under the Paris Agreement.

## China

Canada provides strategic support to China to accurately baseline, measure, report, verify and reduce their methane, black carbon and volatile organic compound (VOCs) emissions from oil and gas production.



*Partners:* Carleton University, University of Alberta, Canadian clean tech firms, National Development and Reform Commission, Ministry of Ecology and Environment and their science academies (China Academy of Environmental Planning (CAEP), and National Center for Climate Change Strategy and International Cooperation), Ministry of Science and Technology (MOST), China Petroleum and Chemical Corporation (SINOPEC).

### How Canada is Measuring Effectiveness

Emissions factors, calculation tools, guidance documents, monitoring programs and/or emission assessments that are developed through the course of the project will all promote success. Training programs, workshops and/or study tours may also be key components of project effectiveness, along with best practices are developed and/or transferred for potential application to other jurisdictions and introductions facilitated between Canadian technology vendors and Chinese industrial, commercial, and institutional end-users or Chinese marketing representatives.

### Expected Outcomes

This project is expected to help China advance activities in achieving its environmental performance targets to reduce black carbon and VOC emissions, and improve air quality, as identified in its 13th 5-Year Plan, and creating market opportunities for Canadian clean technologies and methodologies.

## Mexico



Environment and Climate Change Canada is providing \$7 million over four years to support the implementation of Mexico's nationally determined contributions (NDC) under the Paris Agreement. The Canada-Mexico Bilateral Initiative's (CMBI) primary objective is to develop a comprehensive package of measures for the sector supporting NDC implementation with the aim of leveraging climate investments from public and private sources. More recently, the CMBI received additional funding from Natural Resources Canada (\$2 million) to support black carbon measurement elements, bringing the total contribution to \$9 million.

*Partners:* Government of Mexico (National Institute for Ecology and Climate Change (INECC), Secretariat of Energy (SENER), Secretariat of Environment and Natural Resources (SEMARNAT); Mexican Petroleum (PEMEX), Secretariat of Finance), Clearstone Engineering Ltd. (implementing partner), Carleton University, public and private financial intermediaries and other industry partners.

### **How Canada is Measuring Effectiveness**

Mitigation actions and/or identified opportunities will relate to supporting NDC implementation in Mexico's oil and gas sector.

### **Expected Outcomes**

Realizing objectives and targets articulated in Mexico's NDC, thereby helping Mexico achieve their goals under the Paris Agreement.

# Natural Sciences and Engineering Research Council of Canada (NSERC) FlareNet Strategic Network: Global Research Initiative to Address Flare Generated Pollutant Emissions from Unconventional Oil and Gas Processing

FlareNet is an NSERC Strategic Network with an objective to provide a quantitative understanding of flare generated pollutant emissions critical to enabling science-based policy, accurate pollutant inventories, understanding of climate forcing and health implications, and engineering design and assessment of mitigation strategies to minimize environmental impacts in the energy sector.



Flaring is the most commonly deployed approach to reduce methane emissions from gaseous waste streams. Recently published work in FlareNet (Tyner & Johnson, EST, 2018), has also shown that flaring and incineration are likely to increase significantly as new methane regulations are implemented. Since the start of serious discussion of methane regulations from 2016-2018, reported flaring is trending up at (oil/bitumen/gas batteries, gas gathering systems and gas plants) with a year over year increase of 8 percent.

Quantitative understanding of flare generated pollutant emissions are thus critical for informing appropriate mitigation actions and understanding implications, including impacts of policy and regulatory decisions. This is a key goal of FlareNet.



The FlareNet Network is a 5-year \$6.9M project funded by NSERC (\$5.5M over 5 years) with contributions from government agencies, industry and Canadian universities (NRCan contribution includes \$835,000 and in-kind support). The Network integrates a diverse group of researchers working on research challenges through collaborative

large-scale experiments backed by field measurements.

Experiments occur at two main research facilities — the Carleton University Intermediate-Scale Flare Facility and the Boundary Layer Wind Tunnel Facility at the University of Western Ontario — as well as at selected measurement sites in the field. Research is organized to tackle key knowledge gaps under five highly integrated themes:

1. Flare Emissions during Flowback Operations at Hydrofractured Gas Wells
2. Refinery and Upgrading Flares: Effects of Air- and Steam-Assist on Emissions Control
3. Effects of Turbulent Crosswinds on Flare Emissions
4. Properties of Black Carbon (BC) and Other Particulate-Phase Species Emitted During Flowback and Routine Flaring Operations
5. Development and Application of Novel Technologies for Field Measurements

## ***How Canada is Measuring Effectiveness***

FlareNet has over a 130 specific research milestone metrics that span over the 5 integrated themes. Embedded within those research milestones are specific mitigation strategies for reductions in methane emissions and black carbon – the two most critical short-lived climate pollutants (SLCPs).

Key indicators of progress include increasing publication outputs, national and international conference presentations, invited consultations, and collaborative contributions to technical standards, policy decisions, and regulatory development.

- FlareNet is working closely with the World Bank Zero Routine Flaring team and Petroamazonas (Ecuador) to implement a large, demonstration flare mitigation project in Ecuador, intended to achieve directly quantified black carbon emissions reductions.
- Large-scale collaborative experiments, combining resources and expertise from a range of institutions are also underway, with the key goal of producing new peer-review emissions data and models necessary to backstop more aggressive policy and regulatory actions.
- FlareNet has also committed to continued technical contributions to standards development for flares through the Canadian Standards Association (CSA).
- Internationally, FlareNet is participating in ongoing discussions of EU black carbon action committee, where flares are understood to have important effects on Arctic environments.
- FlareNet is developing and deploying field-measurement technology that can be used to baseline emissions and build stronger business cases for specific mitigation actions.

## ***Expected Outcomes***

Key outcomes will include improved emissions inventories, quantitative emissions data and models to assess cost-benefits of specific mitigation actions, technologies to predict and measure emissions in the field, and technical support and analysis to enable emissions reduction projects.

*Partners:* Matthew Johnson, FlareNet Director and Canada Research Professor, Mechanical and Aerospace Engineering, Energy and Emissions Research Laboratory and Flaring Research Laboratory, Carleton University



# Research Efforts to Control Greenhouse Gases Emissions from Livestock

Since 2013 Canada has four ongoing efforts to deal with Greenhouse Gas emissions from livestock. Researchers associated with the University of Alberta are quantifying GHG emissions from 60 ranches in Manitoba, Saskatchewan and Alberta. They are investigating the use of 5 adaptive multi-paddock grazing approaches on GHG emissions.



Researchers associated with the University of Manitoba are investigating the impact of stacking BMPs as opposed to using them in isolation on GHG emissions on whole farm GHG emissions.

The University of Saskatchewan research team is investigating how to improve the nutritional value of grazed forages and the impact of non-bloat legume pastures on enteric methane production.

The University of Lethbridge is investigating the impact of adding biochar to feedlot beef cattle diets on GHG emissions from enteric fermentation and manure management.

## ***How Canada is Measuring Effectiveness***

Effectiveness is measured by how the results of the four research teams can be applied to promote sustainable agricultural production and mitigation information and technologies.

## ***Expected Outcomes***

Canada aims to promote sustainability of agricultural production in Canada and make Greenhouse Gas mitigation information and technologies available to farmers.

# Agricultural Greenhouse Gases Program

In 2016, Canada create the Agricultural Greenhouse Gases Program (AGGP). The goal of this five-year (2016-2021) program aims to enhance the understanding and accessibility of agricultural technologies, beneficial management practices (BMPs) and processes that can be adopted by farmers to mitigate agricultural greenhouse (GHGs) emissions in Canada.

The AGGP aims to support initiatives that have the potential to lead the way to broader adoption or application of BMPs on farm and by the sector more generally. The program also aims to support efforts to understand the potential impacts of GHGs as well as approaches to mitigate agricultural GHG emissions. The AGGP hopes this information will result in better strategies for climate change adaptation across the agricultural sector.

The AGGP ultimately contribute to the mitigation of GHG emissions and other positive longer-term environmental impacts for Canada, which in turn supports the Government of Canada's commitments to the environment and climate change.

## ***How Canada is Measuring Effectiveness***

Effectiveness is measured by GHG emission reductions that may be reflected in Canada's National Inventory Report (NIR) of greenhouse gases.

## ***Expected Outcomes***

Canada aims to promote sustainability of agricultural production in Canada and make Greenhouse Gas mitigation information and technologies available to farmers.