

Improved Collection and Verification of Methane Emissions Data for Effective Mitigation

Oil & Gas Subcommittee Webinar

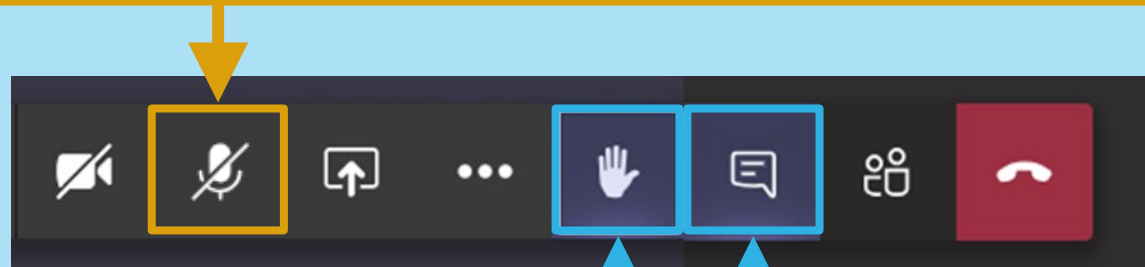
30 March 2021



Housekeeping – Tips for using Teams

Mute your microphone.

- Everyone should set the microphone to mute unless actively speaking.
- If participating by phone, press *6 to mute your phone.



If available, use the “Raise your hand” button to be called upon to speak.

Or, enter questions using the “Chat” pane. Type “Raise My Hand” to be called upon to speak.

Help!

Need Help?

If you need help, please send an email to asg@globalmethane.org

Agenda

- **Welcome**
 - James Diamond, GMI O&G Subcommittee Co-Chair, Environment and Climate Change Canada (ECCC)
- **Introduction to Webinar and Speakers**
 - Mark Taylor, Taylor Energy Advisors
- **Presentation: Improved Collection and Verification of Methane Emissions Data for Effective Mitigation**
 - Dora Luz Llanes Herrera, Agencia de Seguridad, Energía y Ambiente (ASEA)
- **Presentation: Methane: Data Collection and Mitigation**
 - Robyn Wille, Air Pollution Control Division, Colorado Department of Public Health and Environment
- **Presentation: Beyond compliance: Integrated Models for Emissions Reporting and Mitigation Strategy Development**
 - Alberto Alva, Process Ecology
- **Presentation: Moving Beyond Compliance and Changing Perspectives on Data Collection**
 - Brenna Barlow, Radicle
- **Presentation: Data = Decisions**
 - Darcy Spady, Carbon Connect International
- **Facilitated Discussion**
 - Mark Taylor
- **Wrap up and Adjourn**

Global Methane Initiative (GMI)

GMI is an international public-private partnership focused on reducing barriers to the recovery and use of methane as a clean energy source.

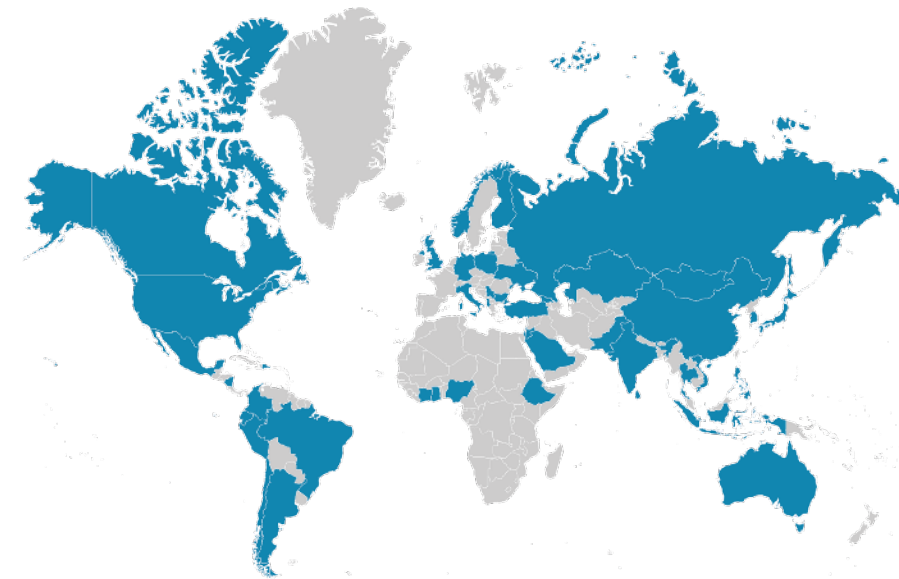
- 45 Partner Countries
- 700+ Project Network members
- Strategic partnerships with international organizations focused on methane recovery and use



UNECE



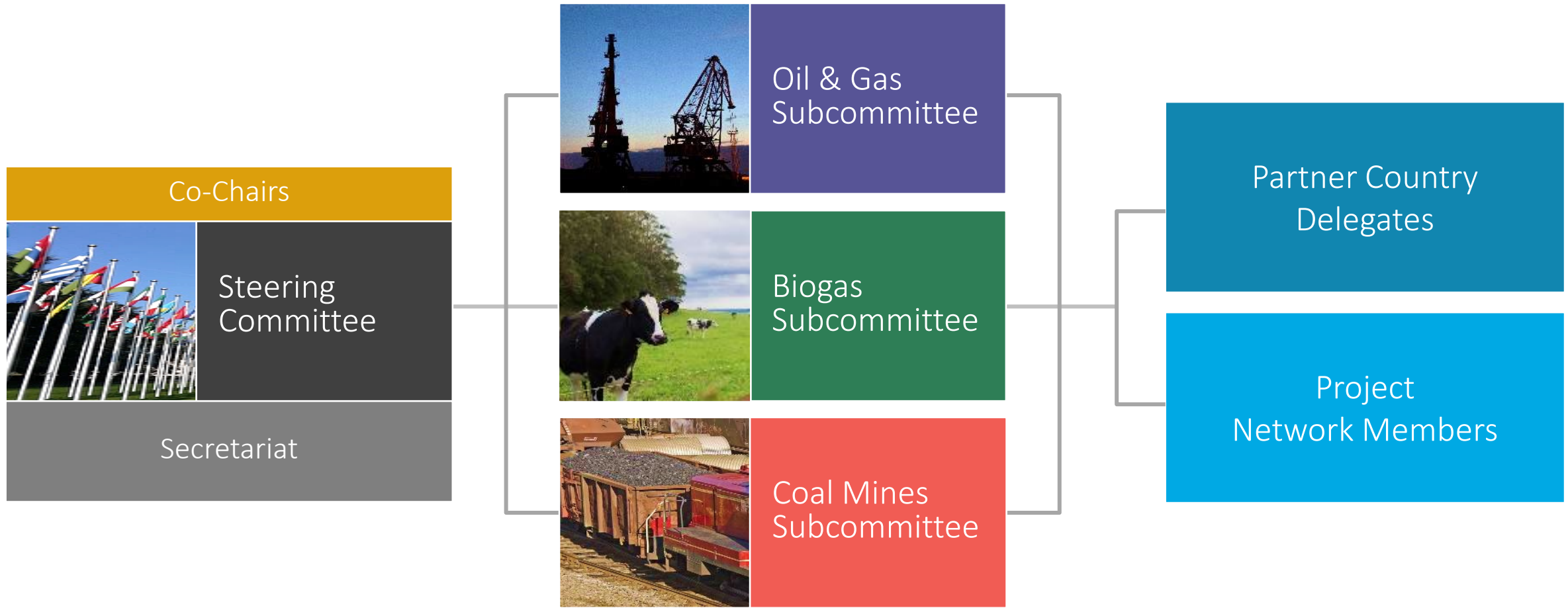
Since 2004



GMI Partner Countries represent approximately 75% of the world's man-made methane emissions.



Organizational Structure



Recovering and Using Methane in Sectors Targeted by GMI

Estimated Global Man-made Methane Emissions by Source¹



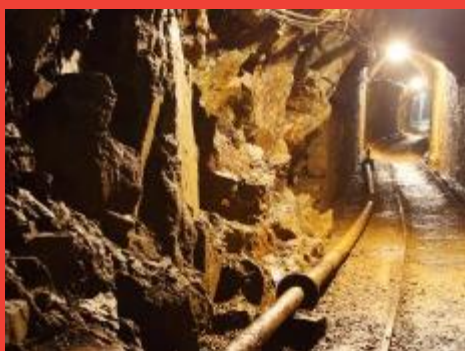
Oil & Gas Sector

Methane emissions from oil and natural gas systems result from both normal operations and system disruptions. These emissions can be cost-effectively reduced by upgrading technologies or equipment, and by improving operations.



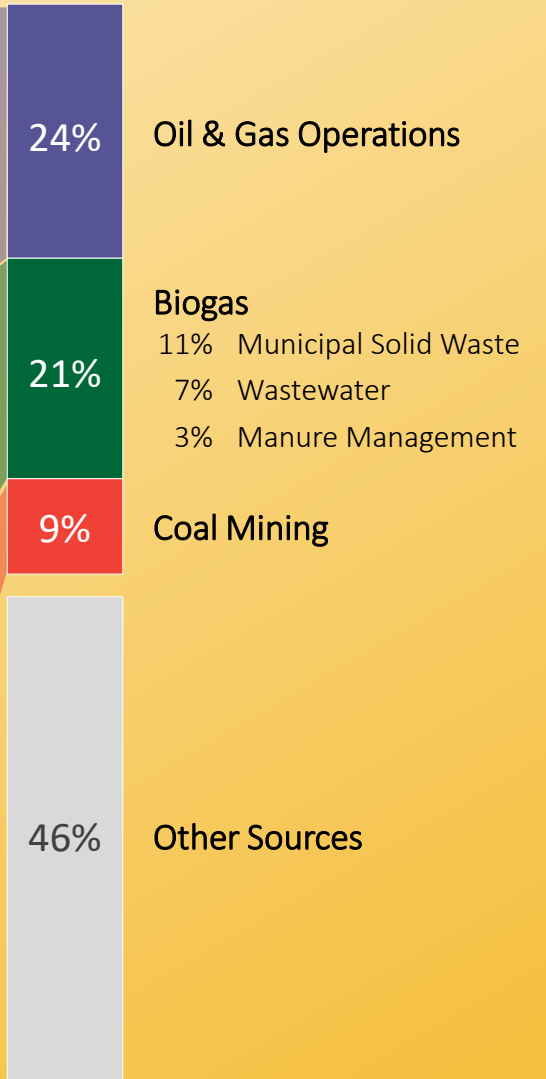
Biogas Sector

Biogas produced from the anaerobic digestion of organic material or emitted directly from landfills can be treated to create pipeline-quality natural gas, used as a cooking fuel, used to generate electricity, and captured on-site to provide heat and power.



Coal Mines Sector

Removing fugitive methane gas from underground coal mines and using it in profitable and practical ways can improve worker safety, enhance mine productivity, increase revenues, and reduce greenhouse gas emissions.

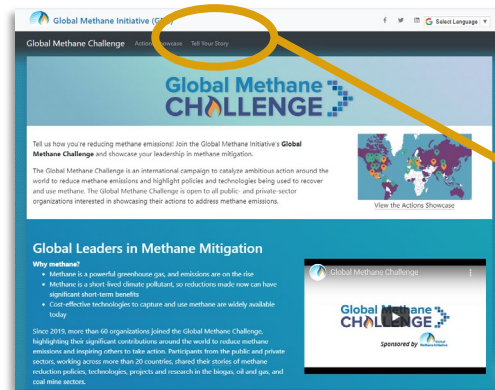


¹ U.S. EPA, *Global Anthropogenic Emissions of Non-CO₂ Greenhouse Gases: 1990–2030*

Global Methane Challenge



- The Global Methane Challenge is still open!
- Launched in 2019 to raise awareness and catalyze ambitious action to reduce methane emissions

A screenshot of the "Global Methane Challenge Submission Form". The form is titled "Global Methane Challenge Submission Form" and includes a progress indicator with five steps. Step 1 is highlighted, with the instruction "Tell us about your organization." Below this, there are input fields for "Organization Name", "Location (Country)", "Organization Website", "Point of Contact Name", "Phone Number", and "Email address".

Submit your story at
globalmethane.org/challenge/

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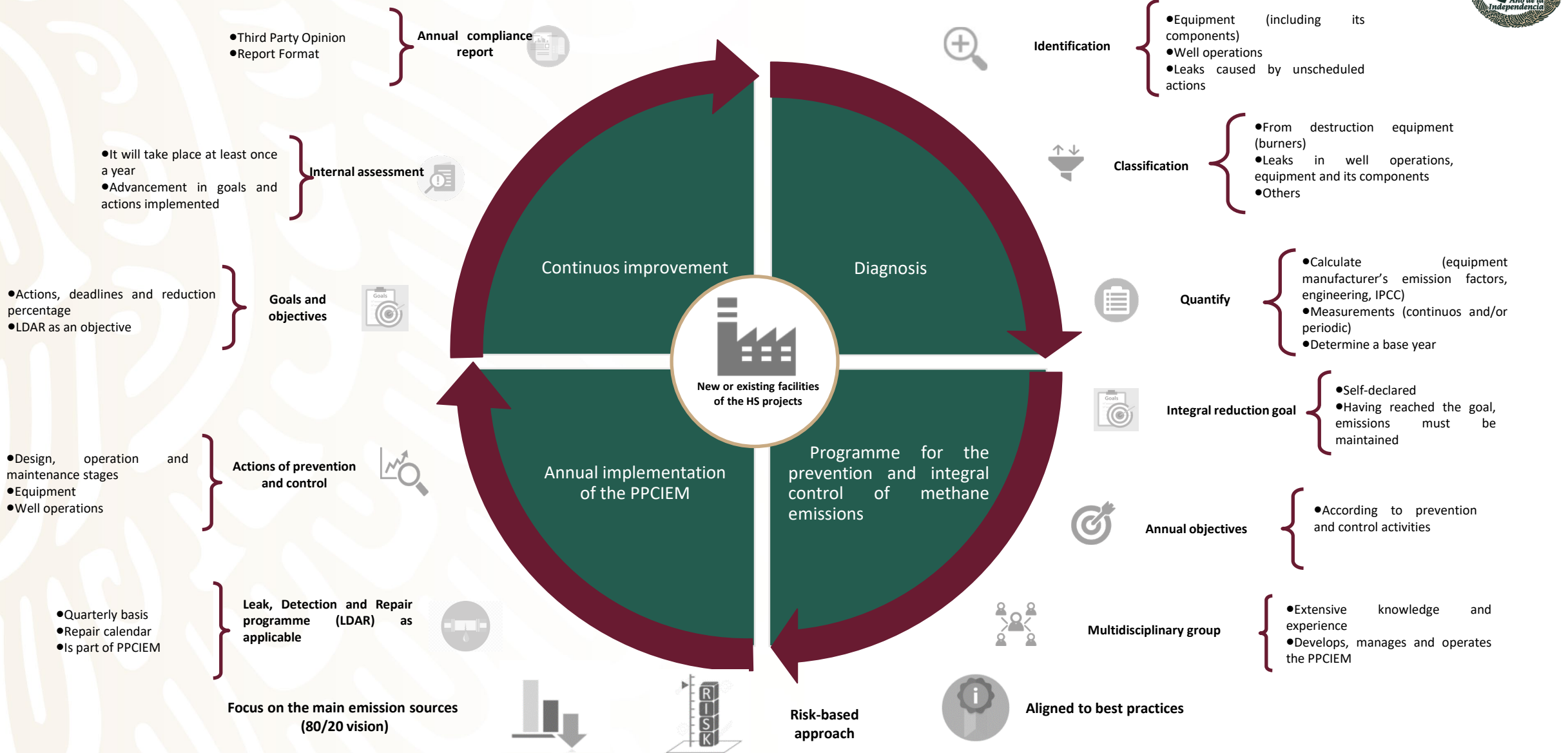


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ENERGÍA Y AMBIENTE



Methane Emission Control and Prevention Cycle



Implementation Phase of Mexico's Methane Regulation for Existing Facilities



MEDIO AMBIENTE
SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES

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Deadline for the industry to submit PPCIEM

Starting date for the leak detection and repair Programme (LDAR)

2nd Technical Inspection Report

1st Annual Compliance Report Deadline

Entry into force

November 6th
2018

November 7th
2018

June 2021

September 2021

December 2021

March 2022

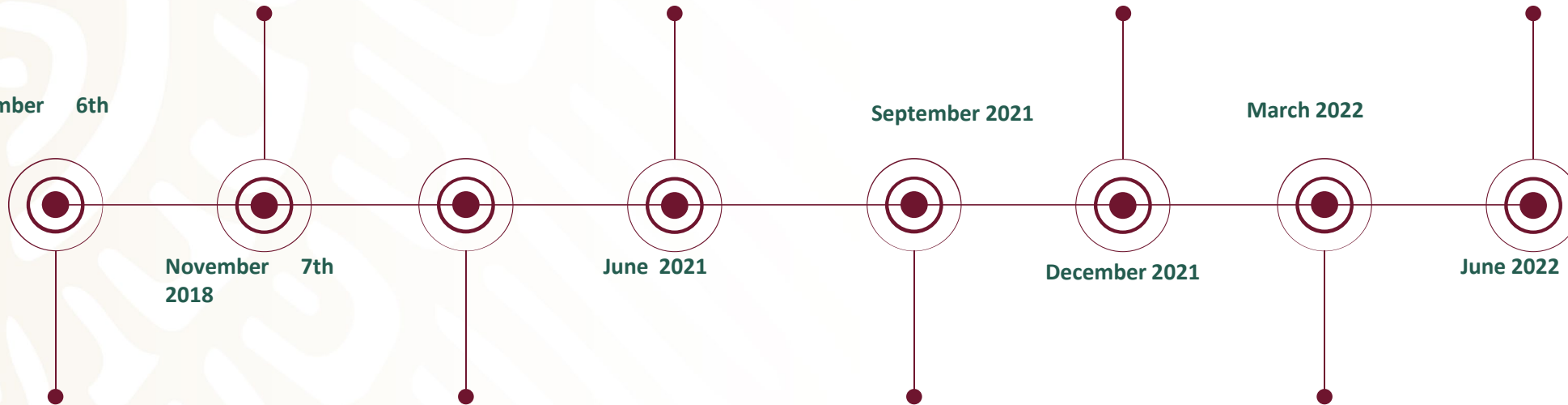
June 2022

Publication in the Federal Official Gazette

19 month period emission assesment and prevention and control Programme of the regulated industry (PPCIEM) modified deadline (29 june 2020)

1st Technical Inspection Report

3rd Technical Inspection Report



Implementation Phase of Mexico's Methane Regulation



MEDIO AMBIENTE
SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES



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Reception of data

- New and existing facilities of projects within the hydrocarbon sector activities



Data analysis

- Targets, methodology used, actions to be implemented, in the facilities of the hydrocarbon sector.



Systematization of information

- Databases (to be defined)



Create information repositories

- Per facilities of projects (to be defined)



Progress report

Increasing the value of methane emissions data to policy makers, regulators, oil and gas producers and contractors



MEDIO AMBIENTE
SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES

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1

What was the situation in 2017?

- MRV of methane not mandatory for all regulated
- Data came from the national inventory of GHG and compounds as well as from the Annual Operating Card
- Data based on IPCC methodologies, most of them Tier 1
- Not all sources (facilities) included
- Some measurements made with commercial but not environmental purposes

2

What did we want to obtain?

- Mitigation target (integral reduction goal)
- Data from each facility and equipment
- Establishing the “initial picture”
- Not a *Base Line* but a *Base Year*
- *MRV* from each facility
- The use a single methodology to keep the track of mitigation
- Encourage Tier 3 as much as posible



Collection, verification, and sharing of methane emissions data from the oil and gas industry



- Diagnosis
- PPCIEM
- RAC (with LDAR)
- Set of formats

Collection



- Third Parties
- ASEA

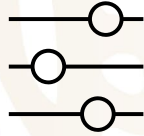
Verification



- Mexican Federal government
- Transparency (Progress Report)

Sharing

Collection, verification, and sharing of methane emissions data from the oil and gas industry



Challenges

- Diagnosis
 - ✓ Use of suitable methodologies
 - ✓ Appropriate classification (venting or leaking)
- PPCIEM and RAC
 - ✓ Measurement (well done?)
 - ✓ Track of measurement in every equipment and compound within the facility?
 - ✓ Real participation of the multidisciplinary team
 - ✓ Lack of equipment to verify LDAR/ conduct an audit

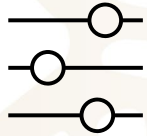


Opportunities

- Modification of formats (digital)
- Feedback from Third Parties
- Improve data of the National GHG Inventory
- Learning from regulated (best practices equivalent or superior)
- Transparency



Single platform storage of methane emissions data to improve data integrity/User interfaces to reduce the challenges and cost of collecting emissions data while improving the quality



Challenges

- Storage size
- Costs vs Budget restrictions
- Is feasible to develop?
- Who develops it?



Opportunities

- Reduce management risks
- Skills development
- Create or strengthen networks

Learning from the data, trusting the data, and value-added analysis of the data for methane mitigation



ASEA foresees:

Trusting the data:

- * **Third Party audits**
- * **Since information will be provided by the Regulated, TRUSTING in data is critical**



ASEA

AGENCIA DE SEGURIDAD,
ENERGÍA Y AMBIENTE

¡THANK YOU!

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Methane: Data Collection and Mitigation

Robyn Wille

Chief Strategy Officer

Colorado Air Pollution Control Division

March 30, 2021



COLORADO

Air Pollution Control Division

Department of Public Health & Environment

Colorado Legislative Directives

- ▶ House Bill 19-1261 and Senate Bill 19-096
 - ▶ Greenhouse Gas Reduction Goals
 - ▶ 26% by 2025; 50% by 2030; 90% by 2050
 - ▶ Greenhouse Gas Pollution Reduction Roadmap
 - ▶ Big Three GHG Sectors: Transportation, Electricity Generation, Oil and Gas
 - ▶ Oil and Gas is largest source category for methane emissions
- ▶ Senate Bill 19-181
 - ▶ Targets the oil and gas industry for methane, VOC and NOx reductions
 - ▶ More leak detection; “continuous methane emissions” monitoring



Regulatory Actions: Data Collection for Oil and Gas

- ▶ Regulation 7
 - ▶ Long history of regulation to address ozone
 - ▶ 2014: First U.S. state to address methane from oil and gas industry; first reporting for leak detection and repair
 - ▶ 2019: Inventories including VOC, NO_x, and Methane
 - ▶ 2020: Preproduction/Early Production Air Quality Monitoring
 - ▶ 2021: Oil and Gas GHG Program (under development)
- ▶ Colorado Oil and Gas Conservation Commission
 - ▶ Cumulative Impacts Analysis



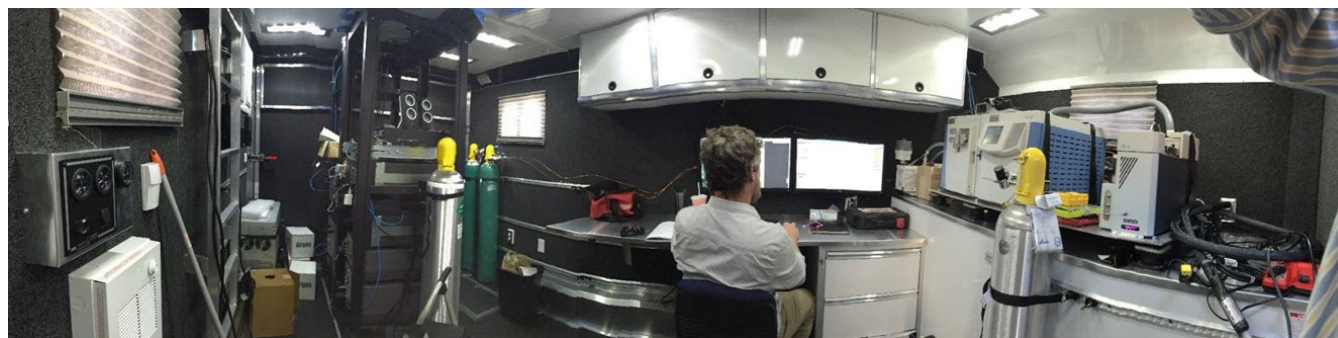
Oil and Gas Monitoring Programs

- ▶ IR camera program
- ▶ CAMML
- ▶ Martinez/Irwin Memorial Fund: Monitoring Van, Aerial Surveys, Satellite/Remote Sensing



Colorado Air Monitoring Mobile Lab (CAMML)

- ▶ CAMML typically deployed for 2-4 weeks at a location
- ▶ Ideal goal is to collect measurements during all phases of oil and gas development
 - ▶ Baseline, drilling, hydraulic fracturing, millout, flowback, early production
- ▶ Ideal location:
 - ▶ Within 1000' of oil and gas development
 - ▶ Down-drainage and in predominant wind direction
 - ▶ Toward residential areas/complainants
 - ▶ Connected to line power



3/18/2021

23



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Air Pollution Control Division
Department of Public Health & Environment

Mark Martinez and Joey Irwin Memorial Public Projects Fund

- ▶ 3a. **Aerial Survey Project**
- ▶ 3b. **Mobile Air Monitoring Van** (the van, plus 2 years of operational expenses)
- ▶ 3c. **Intrinsically Safe Optical Gas Imaging Cameras** (9 cameras and related, necessary equipment)
- ▶ 3d. **Satellite and Remote Sensing Technology** (two years of E&E Lab work)
- ▶ 3e. **Methane Emissions Technology Evaluation Center** (to help develop and characterize leak detection technologies for flowlines)
- ▶ 3f. **Gas Detection and Metering Equipment**
- ▶ 3g. **Remote Methane Leak Detectors**

3b. Mobile Air Monitoring Van

- ▶ “Acquire a mobile air monitoring van to measure pollutants, and help determine and locate leaks. The van would be a supplement not only to CDPHE’s CAMML, but also to APCD inspectors. This mobile air monitoring van would be driven past oil and gas facilities and operations, as well as near flowlines/pipelines. As the van detects leaks, measures are taken to specifically locate the leak and promptly notify the responsible operator.”
- ▶ Vendor selected: FluxSense
- ▶ Delivery expected early/mid-July
- ▶ Can determine emission rates from individual sources with wind lidar
- ▶ Can be used on-road in plume sniffer mode
- ▶ Technology has been proven, South Coast Air Quality Management District has a few vans and it’s been widely used in Europe and now, Asia



3a. Aerial Survey Project

- ▶ “Perform aerial surveys at least once per year for two years in the D-J Basin, which is part of the North Front Range ozone non-attainment area. Aerial surveys have the potential to identify and significantly reduce leaks from pipelines/flowlines, production pads, tanks, central gathering facilities, compressor stations. Identifying and resolving these leaks not only results in reduced exposure to organic compounds that can affect public health and emissions of ozone precursors, it prevents the economic waste of the product.”
- ▶ Phase 1: Aerial survey - Sees point source plumes > 10 kg/hour or 90 tons/year continuous
- ▶ Phase 2: Colorado State University - mobile lab ground teams will follow up on Phase 1 surveys to confirm and validate Methane Emissions Evaluation Tool model inputs
- ▶ Phase 3: Scientific Aviation - flights (aircraft and drones) over 4+ years to develop mass balance estimates

3d. Satellite and Remote Sensing Technology

- ➔ For the past three years, the University of Chicago's Energy & Environment Lab (E&E Lab) has worked with CDPHE to investigate how advances in remote sensing technology can be applied to find and reduce methane emissions from the oil and gas sector
- ➔ E&E Lab will:
 - ➔ Use machine learning techniques on facility-level data from CDPHE and public sources to predict oil and gas facilities most likely to emit methane (applying predictive analytics)
 - ▶ Partner with remote sensing data provider to conduct airborne methane emissions monitoring of oil and gas facilities and assess study feasibility
 - ▶ Evaluate remote sensing technologies and develop a report summarizing findings
- ➔ The proposed studies aim to generate data that could be used to inform regulatory strategies going forward


Questions?





Beyond compliance: Integrated models for emissions reporting and mitigation strategy development

March, 2021

#engineering4sustainability

 /process-ecology-inc

 @processecology

 Processecology.com

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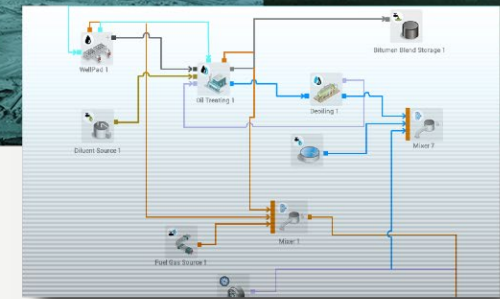
PROCESS ECOLOGY INC

Founded in 2003, Calgary, AB

We help oil & gas clients **identify solutions** that improve environmental and economic performance of operations.

The management team represents over **80 years** of experience in process engineering, simulation and plant optimization.

We have substantial experience in **air emissions management** for the oil & gas industry as well as in the development of decision-support software.



Emissions estimation and management

Process Ecology has been supporting the oil & gas industry in Western Canada with air emissions regulatory compliance for over **15 years**

- Approximately **45-50** operating companies rely on us to deliver quality reports to various Government agencies and other stakeholders
 - Greenhouse gas emissions
 - Methane emissions
 - Criteria air contaminants
 - Benzene (BTEX)
- Recent **regulations** in Alberta require very detailed and rigorous estimation/ measurement and reporting of methane emissions (AER Directive 060)



Context

The problem/ opportunity:



Investors are demanding demonstrated environmental performance - all while operators try to stay profitable in a depressed market.



Energy companies are under increasingly strict **GHG emissions regulations**. Mandatory reductions are common.



A **key challenge** is emissions data/ information/ knowledge that can be used and trusted by all stakeholders.

Data silos

Every **oil & gas operator** has different organizational structures and systems imposing data silos

- **Production accounting:** High quality data for main product receipts/dispositions. Highly regulated for royalty payments.
- **Regulatory/ Corporate Sustainability Reporting:** GHG emissions and production accounting data are intimately related. Regulatory compliance may have better data than production accounting for fuel, flaring and venting
- **Engineering:** The same data should provide input for engineering studies to identify emissions reductions projects or other improvements to facilities (optimization)



Integrated models



Detailed bottom-up inventories of emissions sources

- Fluid compositions
- Operating conditions
- Operating hours
- Non-routine events
- Emissions controls

Measurements vs estimation

Engineering models

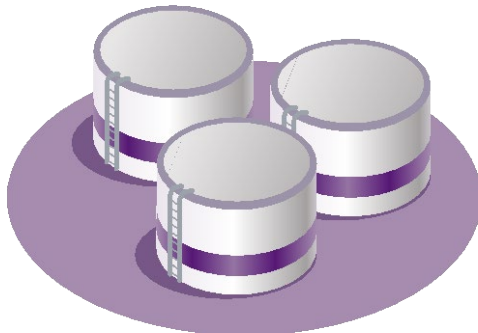
- Simulation
- Thermodynamics
- Fluid flow
- Mass/ Energy balances
- QA/QC

Consistent unique source of data = digital twin

Missing data?



- Minimum required information:
 - List of facilities by type and location.
 - Production accounting data.
- Supplemental data for improved accuracy:
 - Site-specific equipment & emission control data as well as process operating conditions.

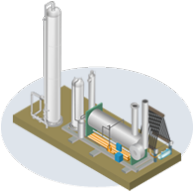


System auto-configuration functions:

- Default supplemental data values established based on type of facility and activity levels, coupled with typical engineering design practices and probability distributions.
- User may update data over time to manage uncertainties and achieve progressive improvement.

Emissions mitigation in Oil & Gas

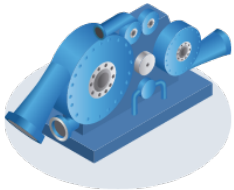
Which sources?



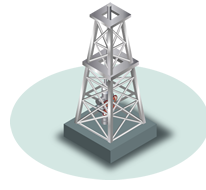
Glycol Dehydrators?



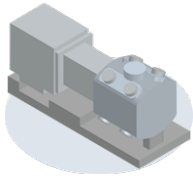
Tanks?



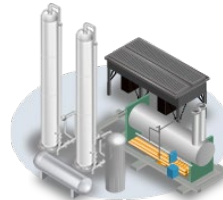
Centrifugal Compressors?



Wells?



Reciprocating Compressors?



Fugitives?

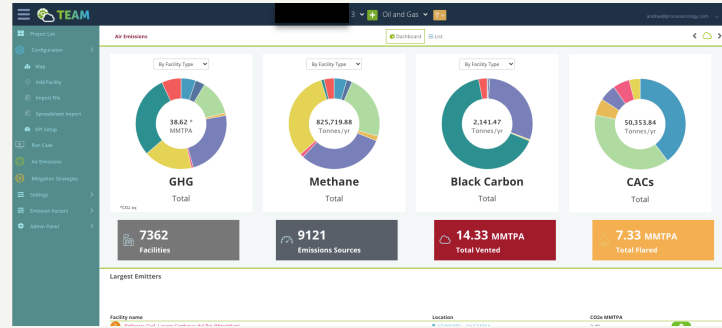
OTHERS?

Which technologies?

- Vapor recovery units?
- Seal replacements?
- LDAR?
- Combustors?
- Flares?
- Tie to gathering systems?
- Etc...

Emissions profiles

System-wide summary

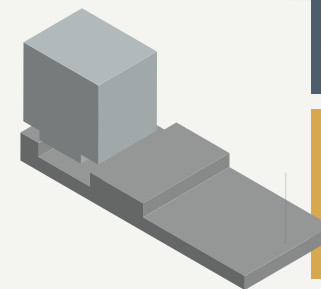
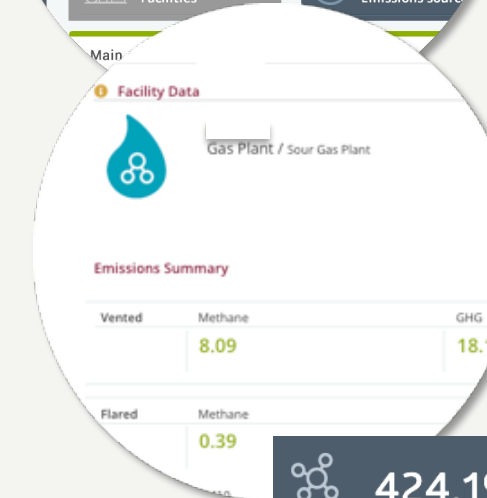
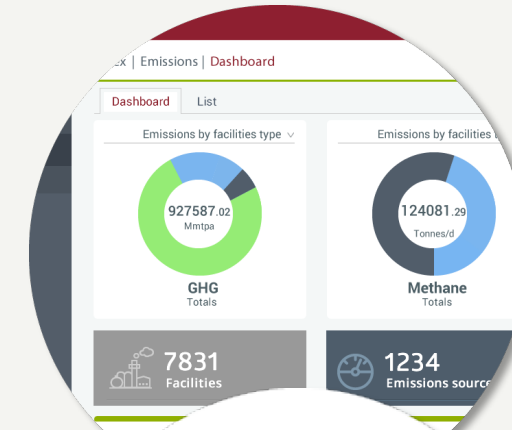


Facility summary

| Category | Methane | GHG | Black Carbon | NOx | CO | PM2.5 |
|------------|---------|------------|--------------|-------|-------|-------|
| Vented | 8.09 | 18.13 | | 0 | 0 | 0 |
| Flared | 0.39 | 0 | 0 | 0 | 0 | 0 |
| Combustion | 1.43 | 787,865.34 | 0.11 | 47.25 | 12.03 | 0.28 |
| | PM10 | TPM | VOC | | | |
| | 0.28 | 0.28 | 0.32 | | | |

Equipment summary

| Category | Methane | GHG | Black carbon | Nox | CO |
|----------|---------|------|--------------|--------|--------|
| Vented | 9.84 | 0 | | | |
| Flared | 2.3 | 0 | 0 | 124.54 | 124.54 |
| | PM2.5 | PM10 | TPM | VOC | |
| | | | | | |



424.19
Kg/h
Total methane

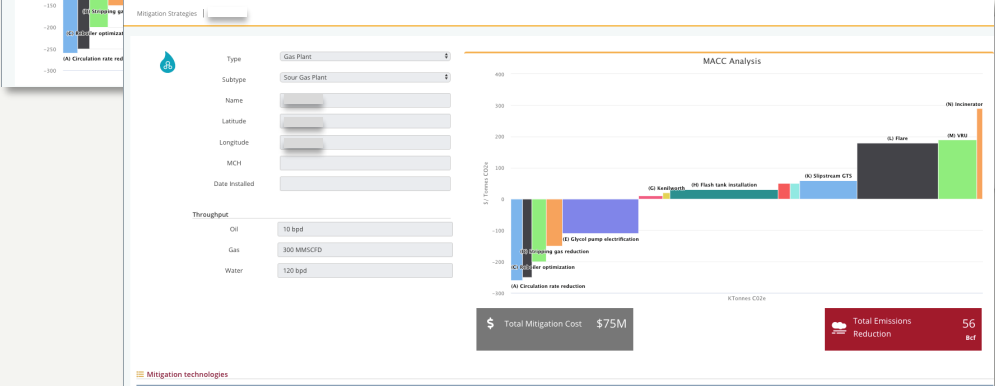
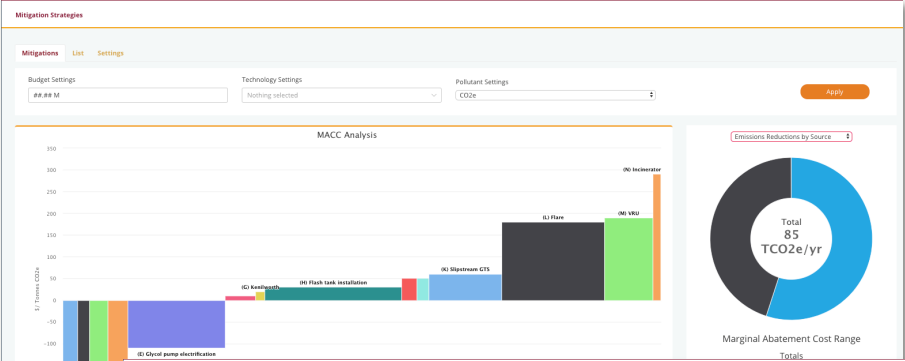
32,828,757.03
Kg/h
Total GHG

Mitigation strategies

System-wide summary

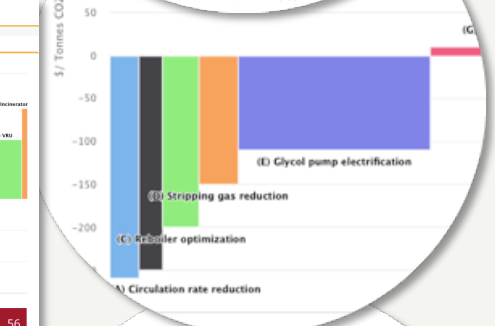
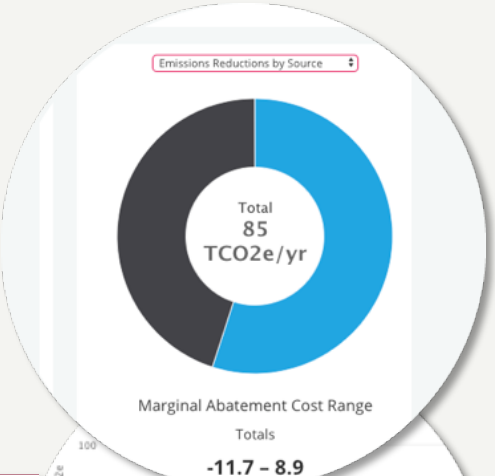
Facility summary

Technology summary



Mitigation Technology Details

| Economic Results | | CAPEX | | OPEX | |
|----------------------------|--------------------|-------------------------|-------------------|------------------|------------------|
| NPV | 8,948,685.93 USD\$ | Equipment Cost | 131,397.55 USD \$ | Electricity Cost | 36000 USD \$/yr |
| Payback Period | 0 days | Installed Cost | 0 USD \$ | Fuel Gas Cost | 0 USD \$/yr |
| Marginal Abatement Cost | 3.21 CAD\$/tonnes | Marginal Abatement Cost | 131,397.55 USD\$ | O&M | 0 USD \$/yr |
| Emissions Reduction | | | | Total OPEX | 3.26 MM USD\$/yr |
| Emissions Before Controls | Tonne CO2 e / y | | | | |
| Emissions After Controls | Tonne CO2 e / y | | | | |
| Total Reduction | 31,837.87 kg/h | | | | |



Mitigation Technology Details

| Economic Results | |
|----------------------------|--------------------|
| NPV | 8,948,685.93 USD\$ |
| Payback Period | 0 days |
| Marginal Abatement Cost | 3.21 CAD\$/tonnes |
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Thank you

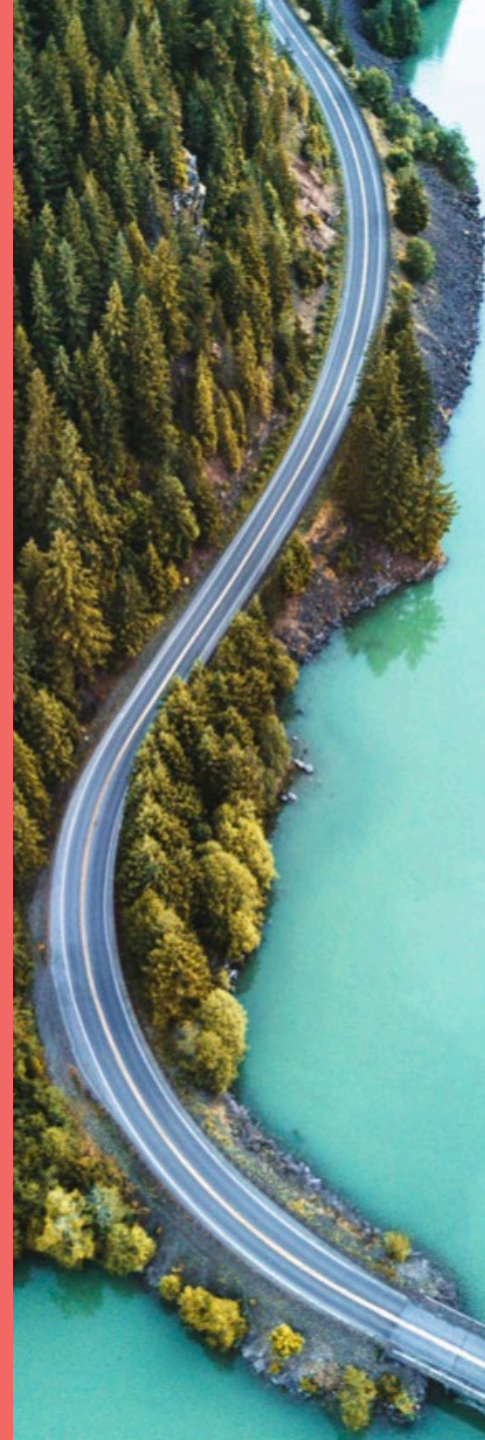
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Moving Beyond Compliance and Changing Perspectives on Emissions Data

GMI Oil & Gas Subcommittee
March 30, 2021

Brenna Barlow
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RADICLE



What can data do?

\$100M+ CAD
in value generated for our clients by creating and selling emissions offsets



Over 3,000 Clients
we do great work with around the world



6.5 Million Tonnes
of carbon dioxide emissions reduced by working together



More than \$350M CAD
traded in environmental commodities



12 Years
of experience as thought leaders in the sustainability industry



15M Tonnes
of offset credits transacted to date supporting agriculture, oil & gas and forestry sectors



Advisor with the World Bank Group to help operationalize markets under the Paris Agreement



Largest developer of compliance-grade credits in Canada



Advisor to enable international markets



1,000+ businesses trained through Climate Smart



24% average GHG reduction & \$4.7 million in aggregate cost savings from Climate Smart⁴¹ businesses

How much do we rely on emissions data?

Verification

Operating Data

Fugitive
Surveys

Reporting

Evidence

Equipment
Inventory

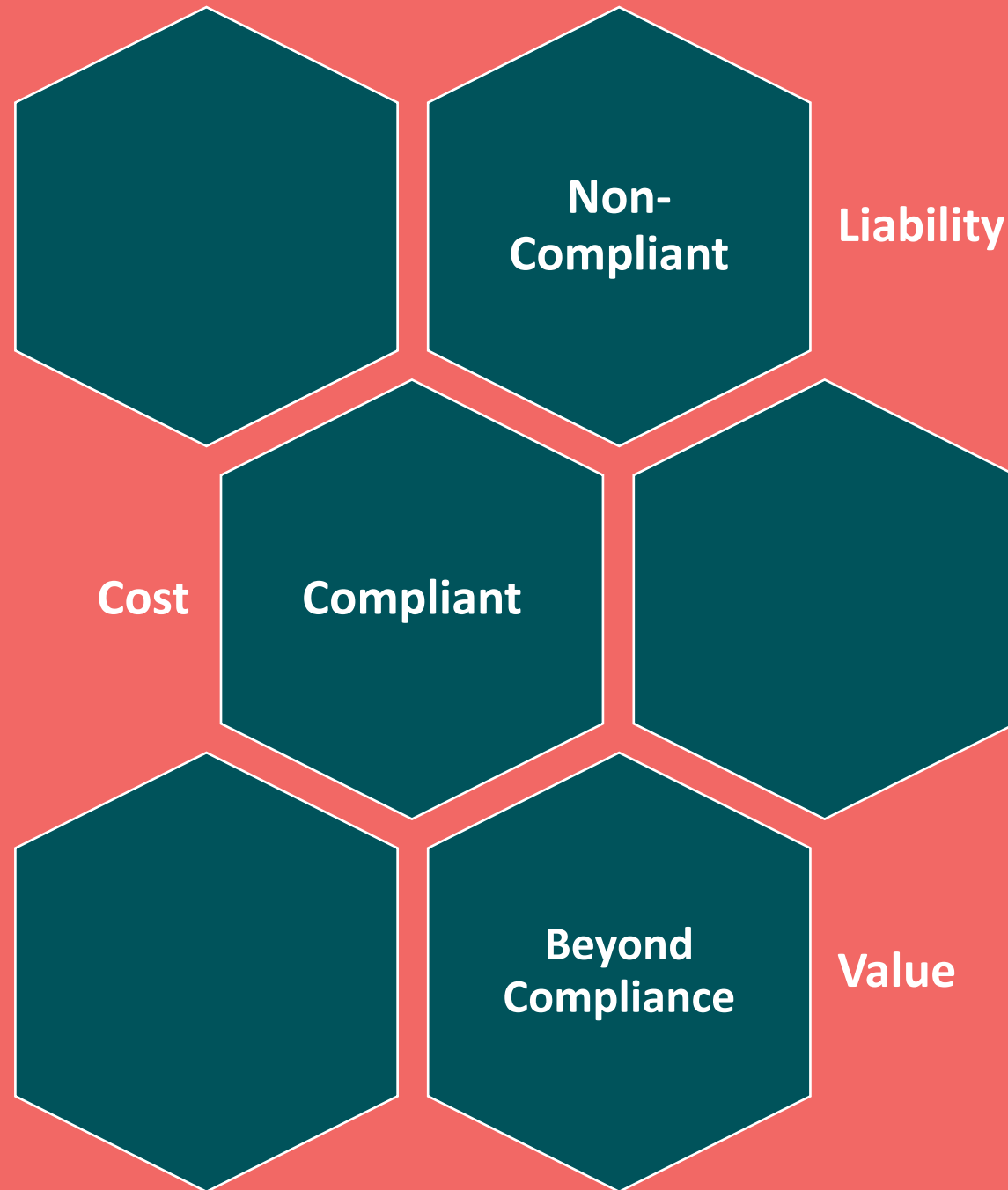
Testing

Measurement

Site
Information

What opportunities can we uncover with this detailed information?

How do our perspectives on emissions performance change our attitudes about cost, efficiency and value?



Emissions Data for Compliance

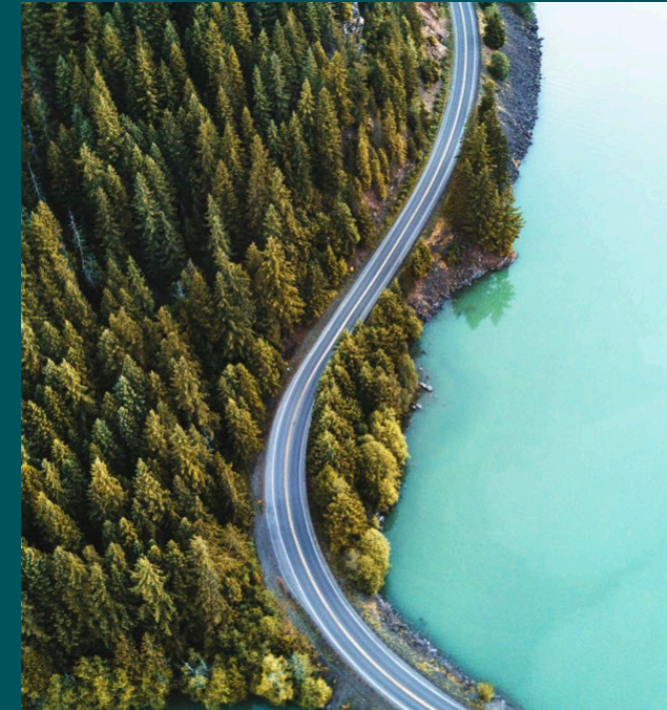
Drivers are cost and efficiency

Reduces liability

Emissions Data Beyond Compliance

Drivers are value

Increases revenue



Shifting Perspectives on the Emissions Data Supply Chain



Consider the Field



Intervene Early



Sooner is Better



Move
Data

Thank you

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RADICLE

Global Methane Initiative
Oil & Gas Subcommittee Webinar
30 March 2021



DATA = DECISIONS

Goals



Paris Accord Targets

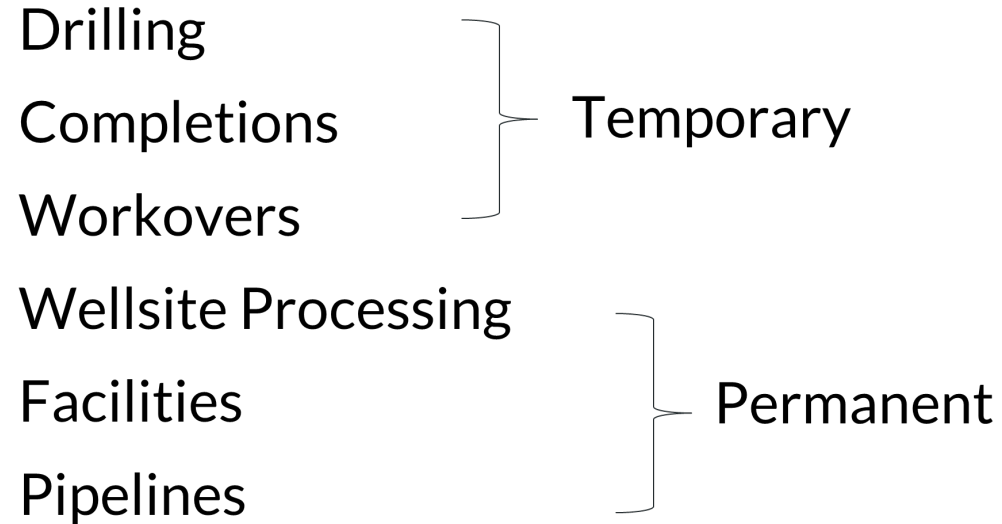
Energy Efficiency

Responsible Development of Energy

Mitigation of GHGs

Starting Point

Emissions: Across the Industry



Consistent Methodologies

-collection

- Simple data library
- Example: .csv file format

-quantification



User Interface

- should accept input from multiple systems
- lowest common denominator
- user friendly



Learnings

Leads to decisions by

- industry
- regulators
- government
- investors



Example of Solutions

Pneumatic Devices

Hydrocarbon Storage Tanks

Compressors

Casing Gas

Good data = Informed decisions

Data

- Facility / Source Inventory
- Vent volumes (and leak rates)
- Emissions

Decisions

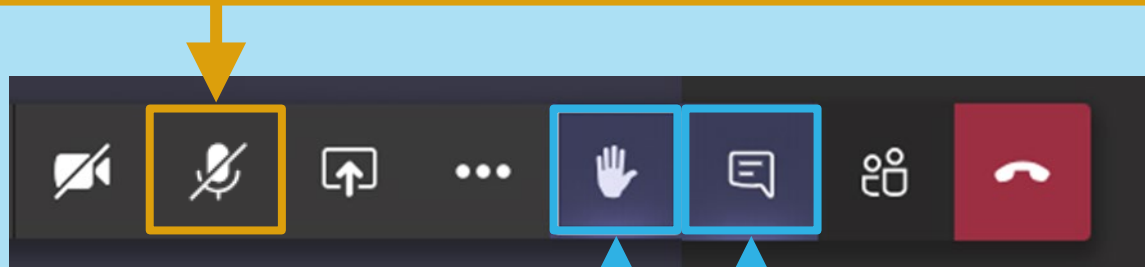
- Project recommendations (meet / exceed compliance)
- Project abatement costs
- Review of available funding opportunities



Question and Answer

Mute your microphone.

- Everyone should set the microphone to mute unless actively speaking.
- If participating by phone, press *6 to mute your phone.



If available, use the “Raise your hand” button to be called upon to speak.

Or, enter questions using the “Chat” pane. Type “Raise My Hand” to be called upon to speak.

Help!

Need Help?

If you need help, please send an email to asg@globalmethane.org

Wrap Up

GMI Oil & Gas Subcommittee Webinar: Improved Collection and Verification of Methane Emissions Data for Effective Mitigation



30 March 2021

- A recording of today's Subcommittee webinar and this presentation will be posted on the GMI website soon

Reminder



We welcome your feedback!
We encourage you to share suggestions by email to asg@globalmethane.org.

Thank you for participating today

