



Session 4: Evaluating Methane Emission Reductions and Other Benefits of Organic Waste Management Projects

Training on Best Practices for
Landfill and Organic Waste
Management

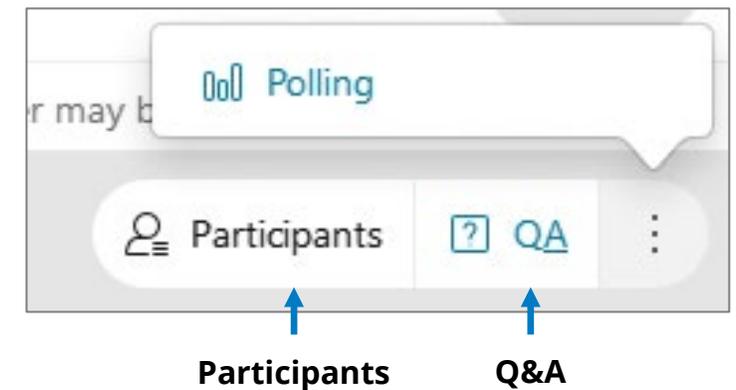
October 31, 2024



Webinar Panels

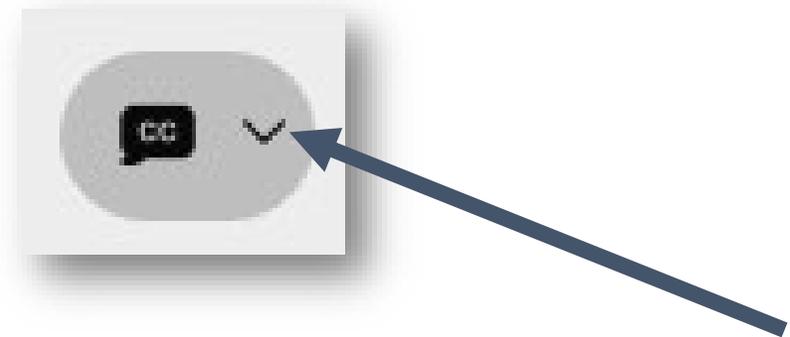
- We will use two panels
 - Participants and Question & Answer (Q&A)
 - Use the arrow to expand or collapse the panels

- Adding Panels
 - If some panels don't appear, select the desired panels in the lower right corner



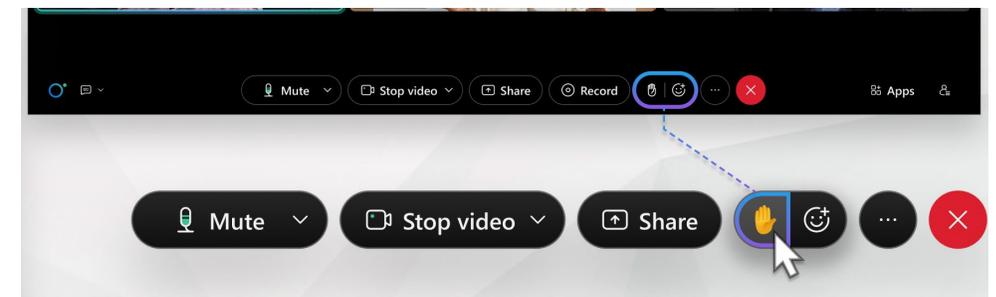
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Q&A

- Participants are muted while speakers are presenting
- Please enter your questions in the Q&A box at any time during the training. These questions will be answered during the open discussion
- To ask a question:
 - Select "All Panelists" from the drop-down menu
 - Enter your questions in the Q&A box
 - Hit "Send"
- If you'd like to unmute yourself in the open discussion, please use the hand raise function and we will call on you and unmute you



Speakers



Patrick CoatarPeter
Environmental Policy Analyst
U.S. Environmental Protection
Agency



Sandra Mazo-Nix (Moderator)
Solid Waste Management
Senior Associate
Abt Global



David Cooley
Senior Associate
Abt Global



Lucas Nachman
Senior Project Professional
SCS Engineers

Overview of Session

- Importance of Evaluating Methane Reductions
- Basics of Measurement, Reporting, and Verification (MRV)
- Example MRV System
- GMI Tools and Resources
- Example Analysis Using GMI Tools

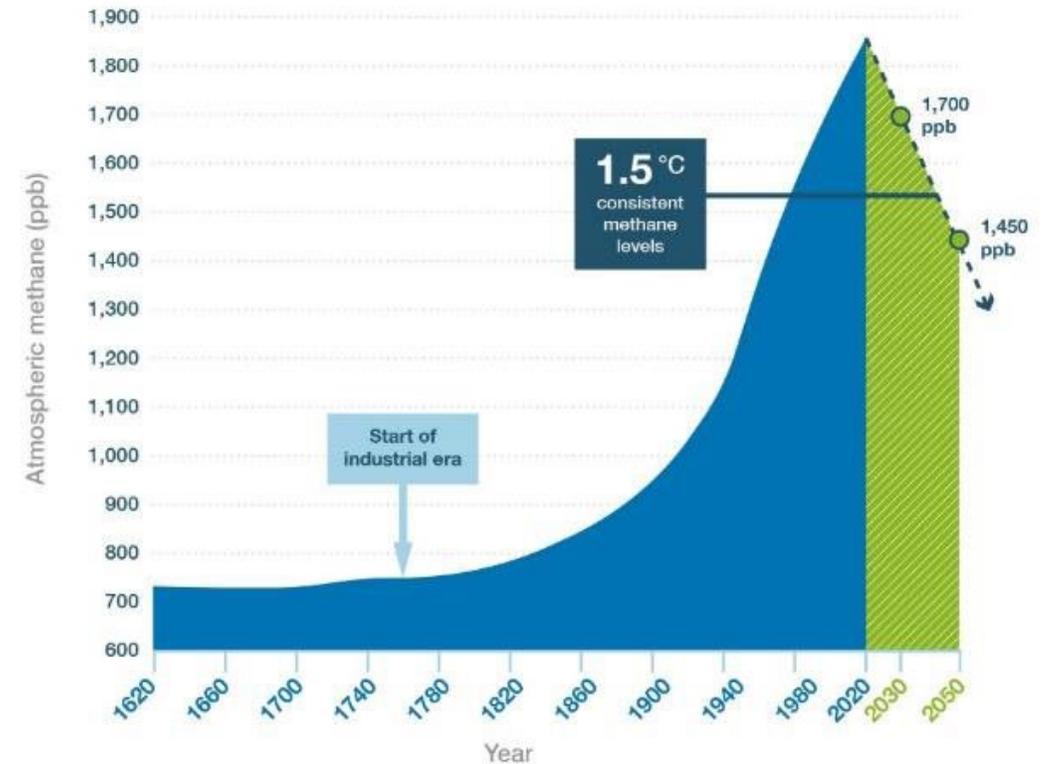
Importance of Evaluating Methane Reductions

Presenter: Lucas Nachman

Recap on Methane

- **Powerful greenhouse gas (GHG).** One ton of methane can trap more than 28 times the amount of heat as one ton of carbon dioxide over a 100-year period
- **Precursor to tropospheric ozone (smog),** an air pollutant and GHG
- **Short-lived climate pollutant** with an atmospheric lifetime of ~12 years
- **Opportunity for fast climate action**
 - Cutting methane now delivers substantial, immediate climate benefits
 - Capturing and converting methane into clean energy can enhance energy security

Global atmospheric methane

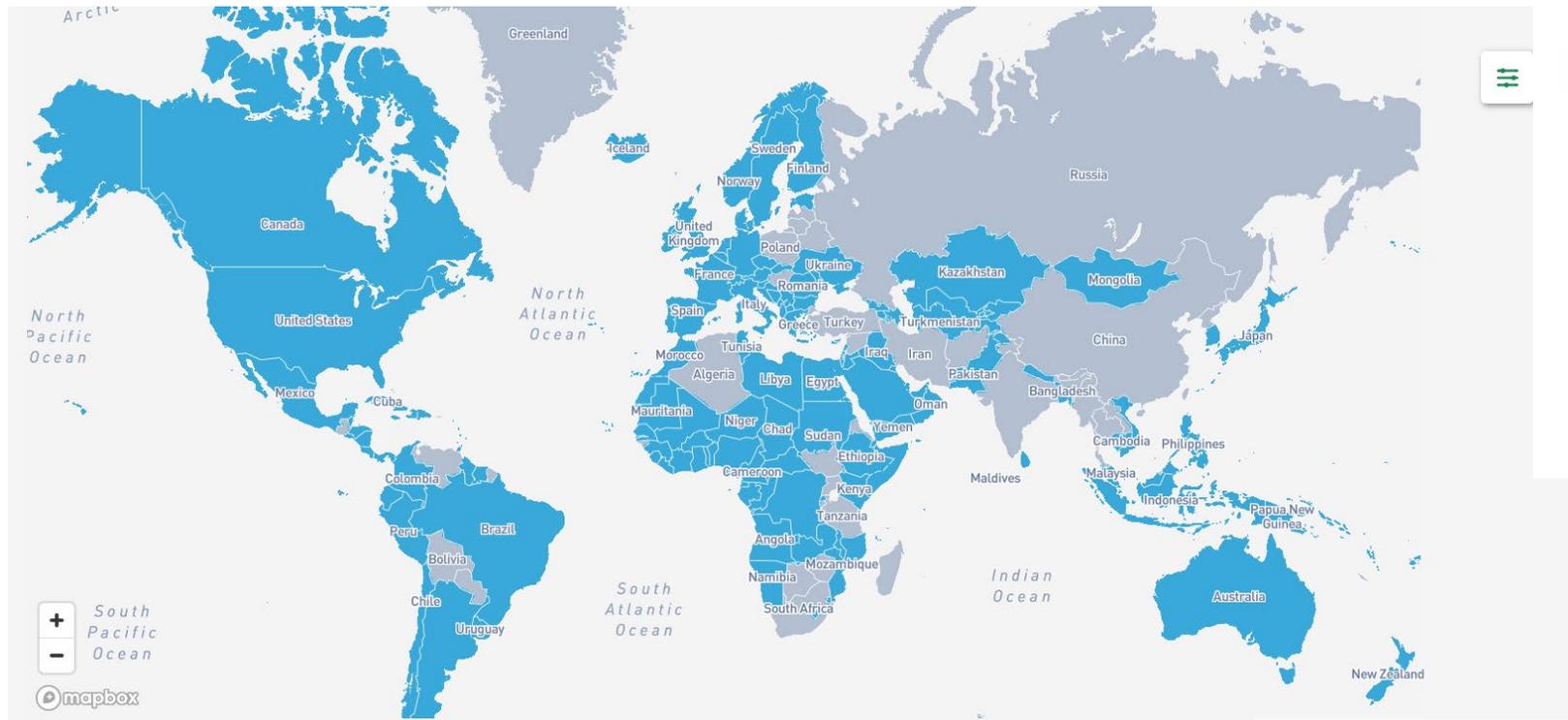


Source: Ed Dlugokencky, NOAA/ESRL

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Growing commitments by 150+ countries to reduce methane

- 30% reduction of methane emissions by 2030, compared to 2020 levels



Global Methane Pledge

Importance of Evaluating Methane Reductions

Basics of Measurement, Reporting, and Verification (MRV)

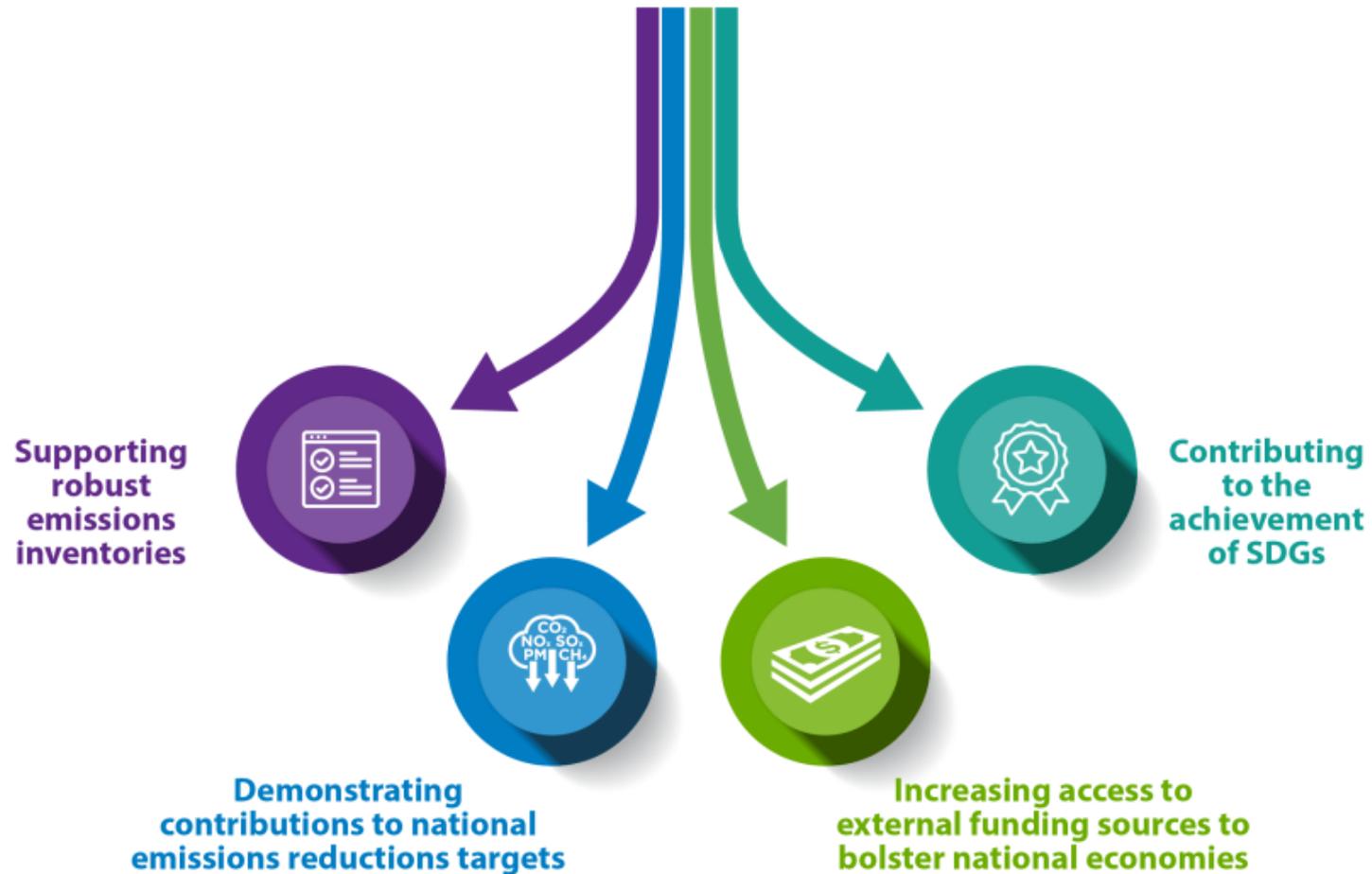
Example MRV system

GMI Tools and Resources

Example Analysis Using GMI Tools

The Benefits of Tracking Methane Reductions from Biogas Projects for National Governments

ROBUST MRV ACTIVITIES CONTRIBUTE TO NATIONAL-LEVEL PRIORITIES AND OBJECTIVES



Basics of Measurement, Reporting, and Verification (MRV)

Presenter: David Cooley

Measurement, Reporting and Verification (MRV) of Methane



MEASUREMENT

Tracking and documentation of data and information on GHG emissions and emissions reductions from a project. This can involve:

- Direct monitoring of emissions (e.g., using biogas flow meters)
- Modeling (e.g., using emissions factors and activity data to estimate emissions)
- Or a combination of both



REPORTING

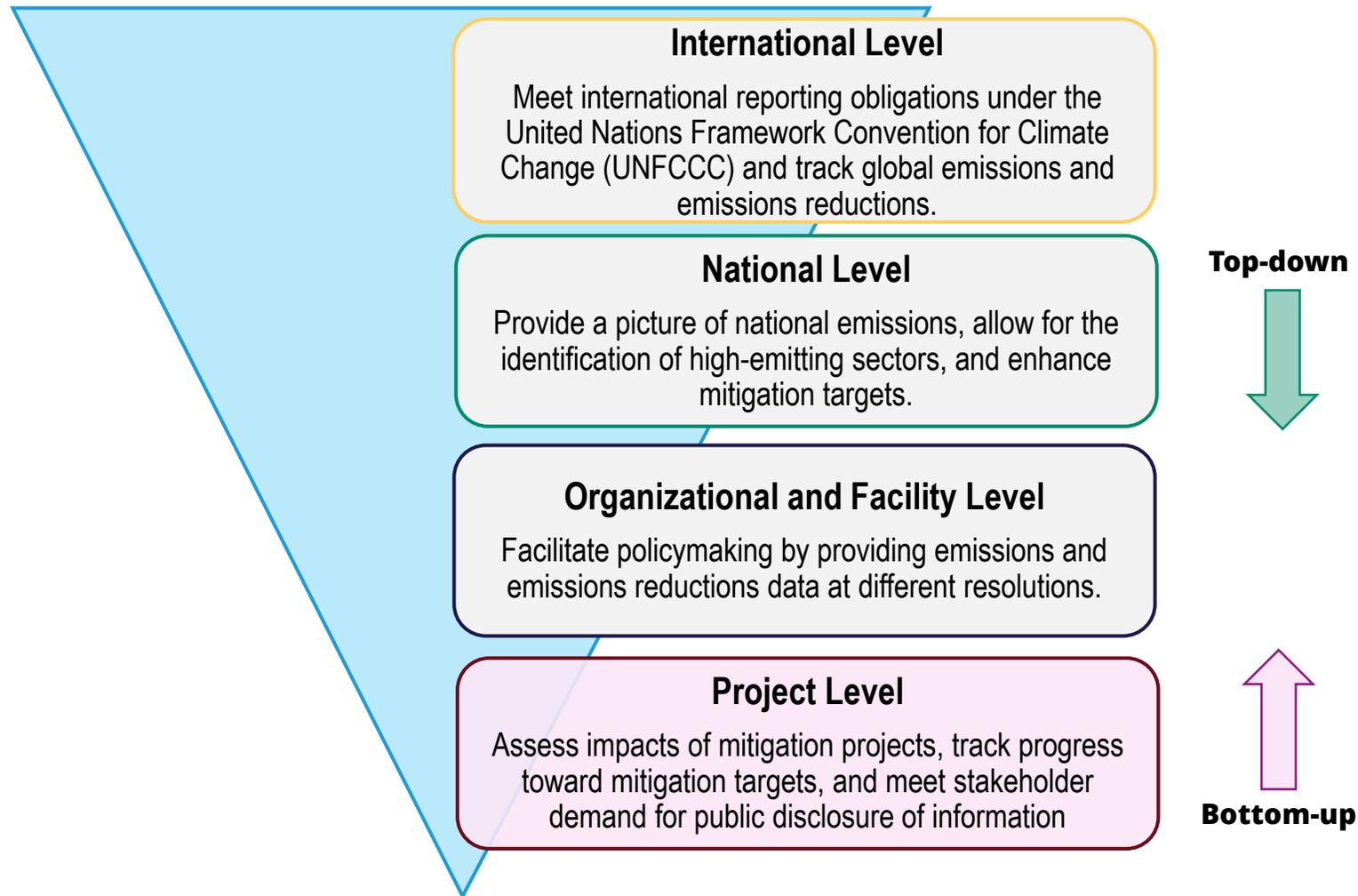
Disseminating measured GHG emissions and emissions reduction data and information using standardized methods and formats.



VERIFICATION

Independently assessing reported GHG emissions and emissions reductions, typically through an independent, third-party verification body.

Measurement, Reporting and Verification (MRV) of Methane



When to Use MRV Frameworks

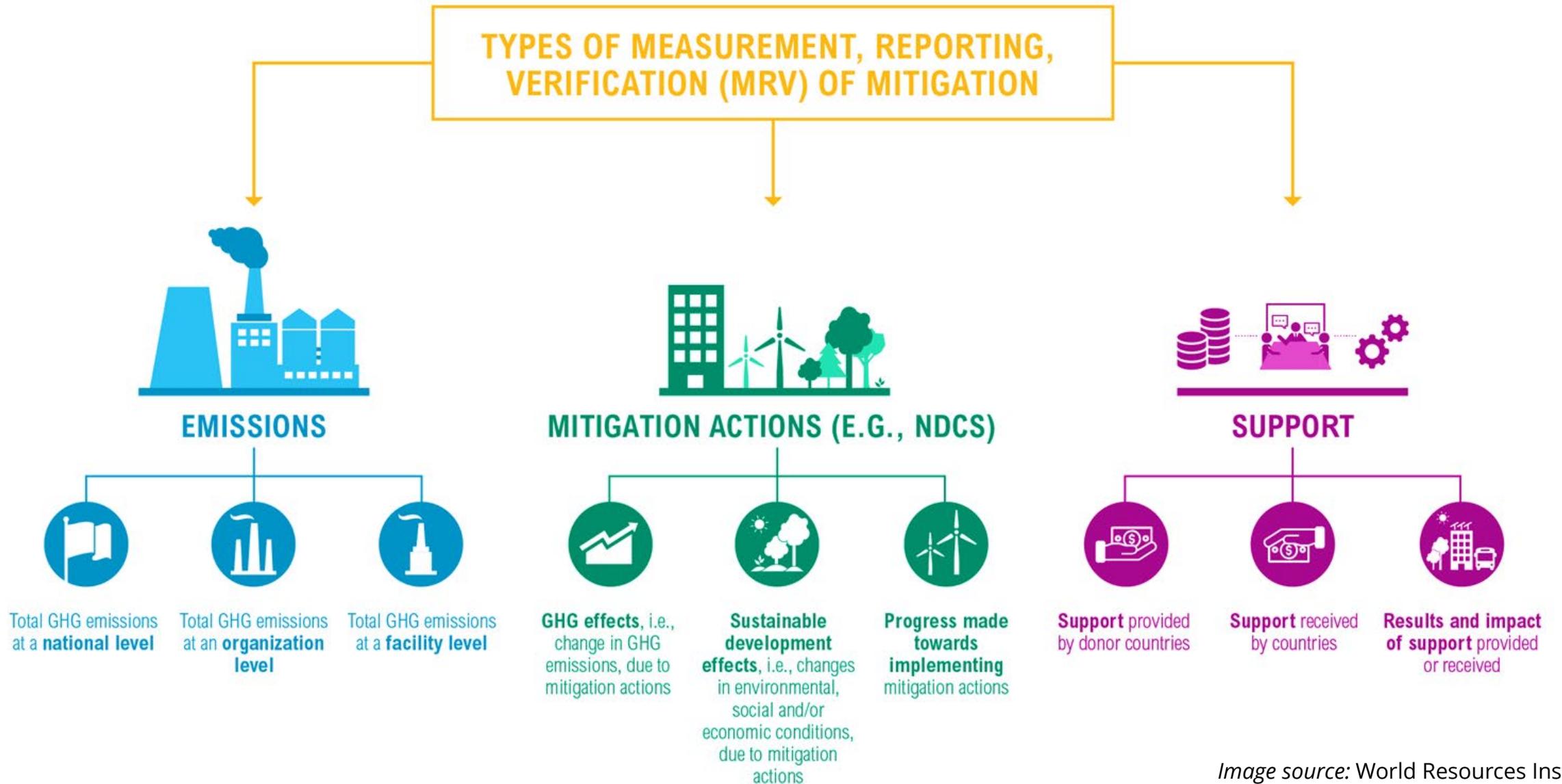


Image source: World Resources Institute

Uses of Project-Level MRV Data

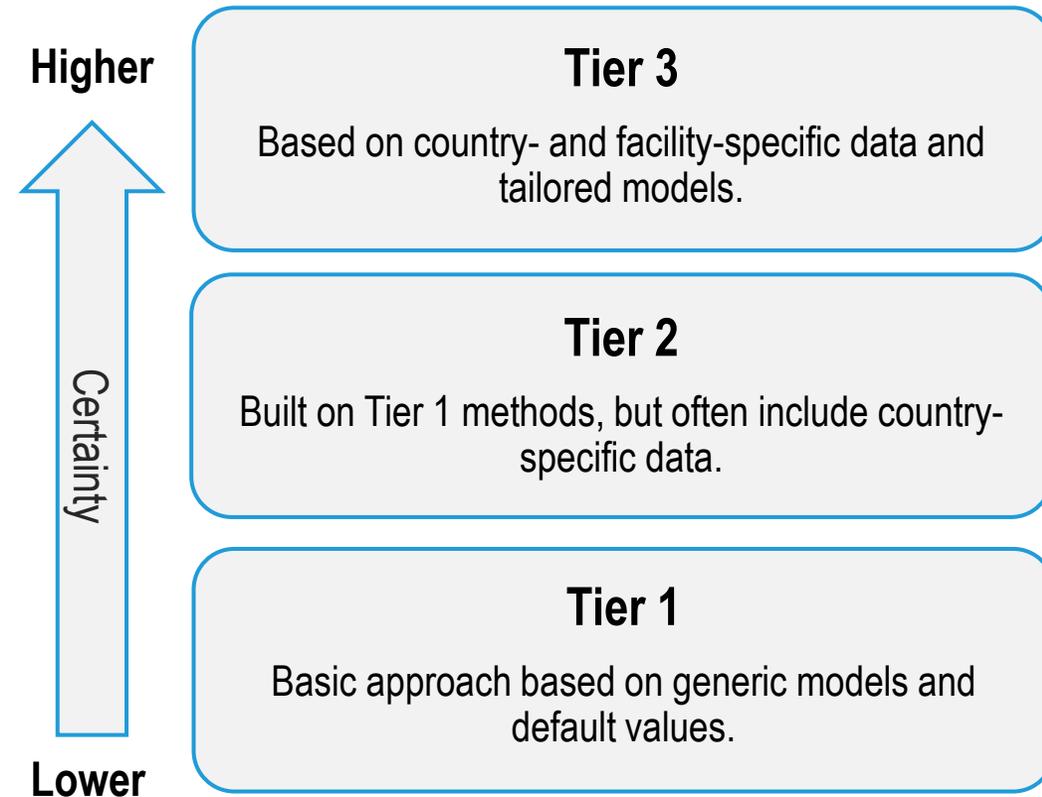
- **To develop national inventories to be submitted under the United Nations Framework Convention for Climate Change (UNFCCC):**

- The Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories provide three tiers of methods for estimating emissions from a particular source.
- Many governments use **Tier 1** methods in the biogas sector.
- Project-level MRV data can be used to advance from Tier 1 to Tiers 2 and 3 by:
 - Refining methane recovery estimates
 - Developing country-specific emissions factors
 - Improving activity data

- **To enhance mitigation targets in Nationally Determined Contributions (NDCs)**

- **Contribute to the achievement of Sustainable Development Goals**

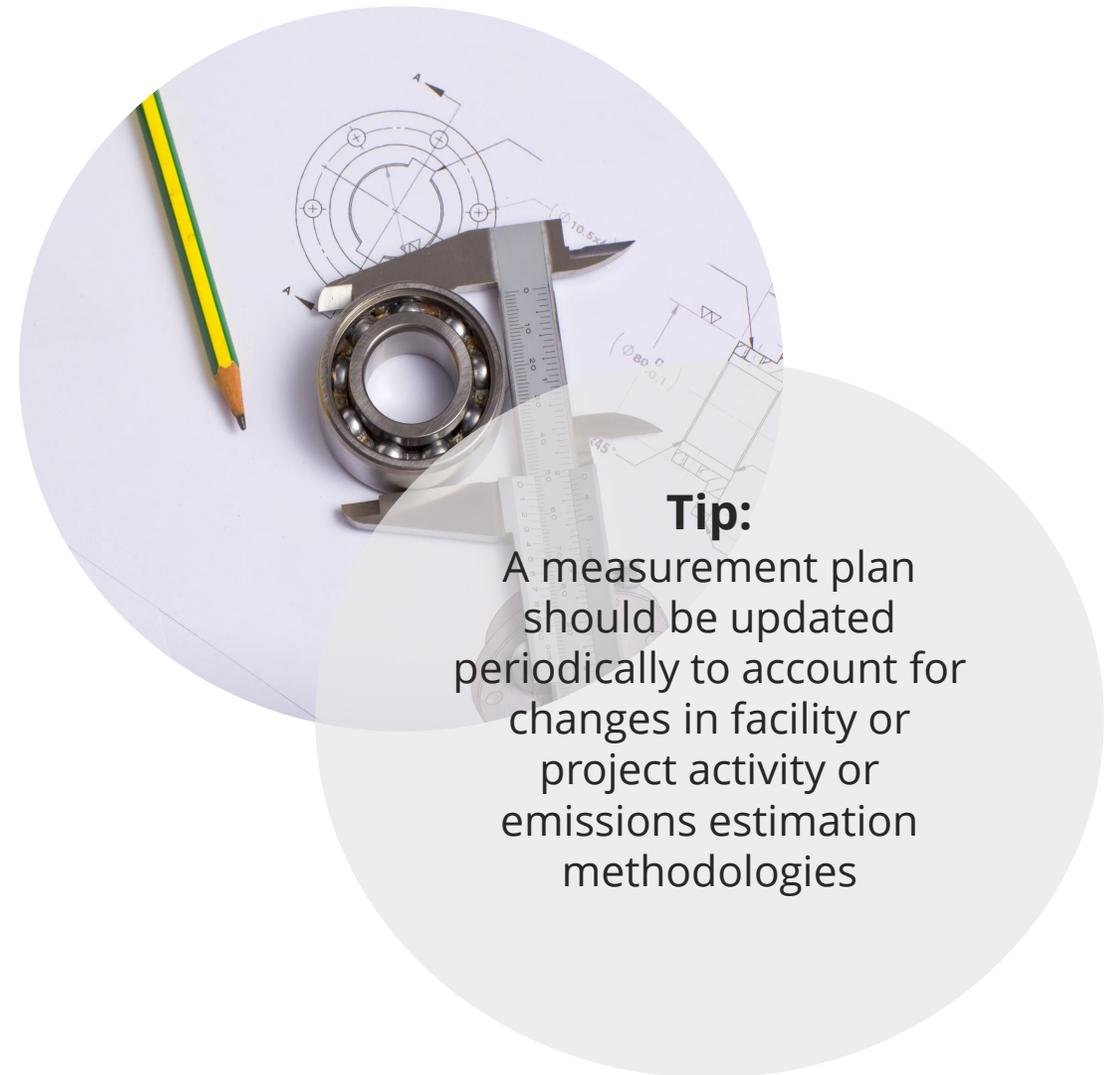
- **Increase access to external funding sources**



Best Practices for Measurement

Develop a measurement plan

- A measurement plan provides facility personnel with key steps to collect and manage greenhouse gas (GHG) reduction data.
- Key elements of a measurement plan include:
 - An overview of the facility and operations
 - Roles and responsibilities of facility personnel
 - A description of GHG mitigation project/activities
 - GHG mitigation project measurement, including data to be collected, onsite equipment used to collect data, data collection process, etc.
 - GHG emissions reduction quantification methods and equations



Tip:

A measurement plan should be updated periodically to account for changes in facility or project activity or emissions estimation methodologies

Best Practices for Measurement

Quantify Emissions Reductions

- **Establish a business-as-usual emissions baseline** as a reference for estimating emissions reductions.
- Emissions can be estimated:
 - **Before project implementation (ex-ante).** Estimates based on modeling assumptions can be used in feasibility assessments or project proposals.
 - **After project implementation (ex-post).** Estimates based on real measurements from the project site tracks mitigation progress.
- Quantify GHG emissions **annually**.
- Use established methodologies and tools: Methodologies based on IPCC GHG inventory guidelines should be used (e.g., Solid Waste Emissions Estimation)
- See **Exhibit C.1.** of the Handbook for a full list cost-free of biogas project emissions quantification tools

Tip 1:
Monitoring equipment (e.g., gas flow meters) should be maintained and calibrated to increase data accuracy and reduce uncertainties.



GMI's Solid Waste Emissions Estimation Tool is a cost-free tool that estimates emissions and emission reductions in the municipal solid waste sector. Download at www.globalmethane.org/SWEET

Best Practices for Reporting

Report emissions and emissions reductions data

- **Project operators can report emissions and emissions reductions data to:**
 - National government agencies, as required under national GHG emissions reporting programs
 - Local governments, as required for developing municipal emissions inventories
 - Voluntary programs (e.g., Carbon Disclosure Project)
 - Financial institutions or carbon offset program administrators
- The type of information to be reported, the level of detail, and the frequency of reporting will vary depending on the reporting program.



Tip:

Required information includes:

- Project name and contact information
- Project location
- Baseline emissions
- Time period of emissions reductions
- Proposed improvement plan

Best Practices for Verification

Verify emissions and emissions reductions

- GHG data and information should be verified by a third-party, accredited verification body to increase reliability.
- Verification should be conducted to a verification standard and criteria.
 - Verification standards for biogas projects are listed in **Exhibit A.3.** of [GMI's Policy Maker's Handbook for Measurement, Reporting, and Verification in the Biogas Sector](#)
 - Two common criteria when conducting verifications are materiality and level of assurance
- Verification may occur every other year, or every three years.



Verification process:

- Assessment of project boundaries, documentation checks, onsite inspections
- Review of measurement and metering methods and equipment
- Assessment of data collection and management systems
- Independent calculations of emissions reductions

For more information on MRV in the Biogas Sector

Policy Maker Handbook for Measurement, Reporting, and Verification (MRV) for Biogas Projects

Description: High-level handbook on guiding principles for conducting emissions MRV for the biogas sector

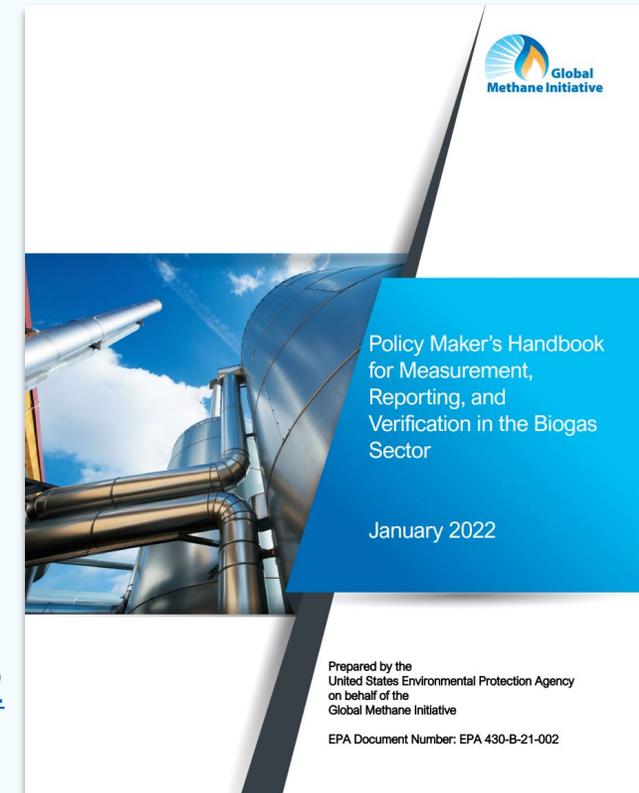
Applications: Understand how biogas project-level MRV best practices can be applied to support national-level objectives, including developing national GHG inventories and establishing national emissions mitigation goals

Audience: National governments

Download:

<https://globalmethane.org/resources/details.aspx?resourceid=5182>

Contact: Email biogastoolkit@epa.gov with any questions



Example of MRV System

Presenter: Lucas Nachman

Greenhouse Gas Reporting Program (GHGRP)

- **GHGRP:** Administered by the U.S. Environmental Protection Agency (EPA) under the Clean Air Act.
- **Purpose:** Requires certain facilities and suppliers to report their greenhouse gas (GHG) emissions annually.
- **Key Requirements:** Facilities like power plants, landfills etc., emitting 25,000 metric tons or more of CO₂ equivalent per year must report emissions.
- **Objectives:**
 - Track and report GHG emissions
 - Support climate change policies and regulations

GHGRP Homepage
<https://www.epa.gov/ghgreporting>

GHG Emissions from Direct-Emitting Facilities

- **Direct-Emitting Facilities:** Direct-emitting facilities report emissions from each source category
 - Fugitive emissions
 - Surface emissions from landfill
 - Process Emissions
 - Emissions from fuel combustion
 - Open flare, enclosed flare, LFG energy plants
 - Insignificant emissions
 - Diesel fuel, propane etc. used for space heaters

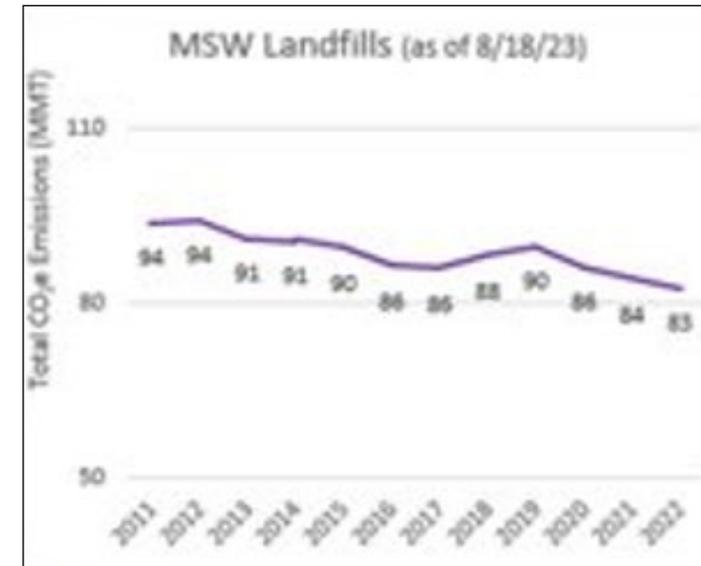
- **Examples: Landfill, Power plant, etc.**

More information: [GHGRP Emission Calculation Methodologies](https://www.epa.gov/sites/default/files/2017-12/documents/ghgrp_methodology_factsheet.pdf)
https://www.epa.gov/sites/default/files/2017-12/documents/ghgrp_methodology_factsheet.pdf

GHGRP: MSW Landfills (Subpart HH)

Panel I: Methane Emissions Reporting Requirements

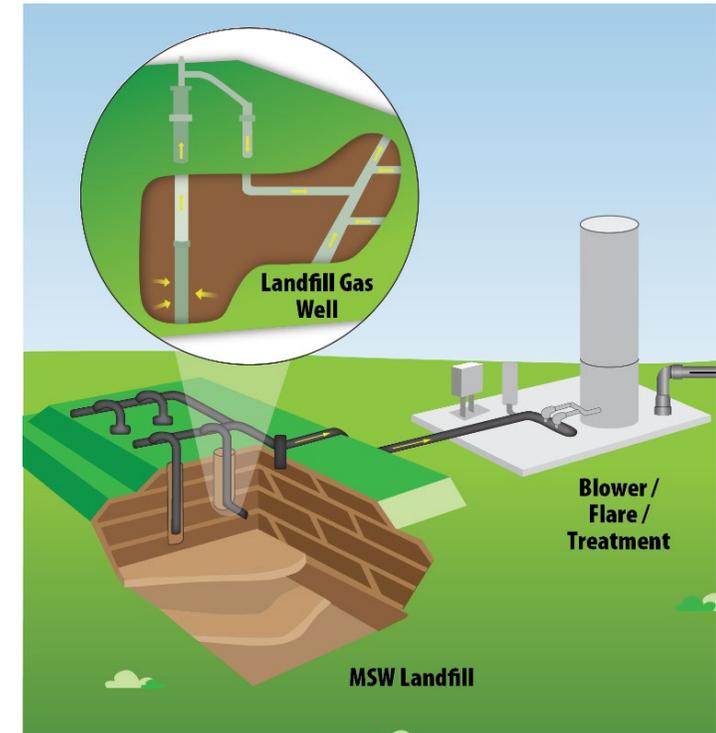
- Which landfills must report?
 - Subpart HH applies to both open and closed MSW landfills that have accepted waste since January 1, 1980.
 - Once a landfill's annual generation of CH₄ reaches 25,000 metric tons CO₂-e, subpart HH requires the landfill to report CH₄ emissions annually.
- Landfills must report:
 - CH₄ generation and CH₄ emissions from landfills
 - CH₄ destruction resulting from LFG collection and combustion systems
 - CO₂, CH₄, and N₂O emissions from stationary combustion units under subpart C (General Stationary Fuel Combustion)



GHGRP: MSW Landfills (Subpart HH)

Panel I: Methane Emissions Reporting Requirements (continued)

- The subpart includes landfills with and without a gas collection system.
- Facilities with a gas collection system must calculate and report CH₄ emissions using two methods:
 - Modeled generation, subtracting the amount of methane recovered and adjusted for destruction efficiency and soil oxidation.
 - Measured recovered methane considering a collection efficiency and adjusted for destruction efficiency and soil oxidation.

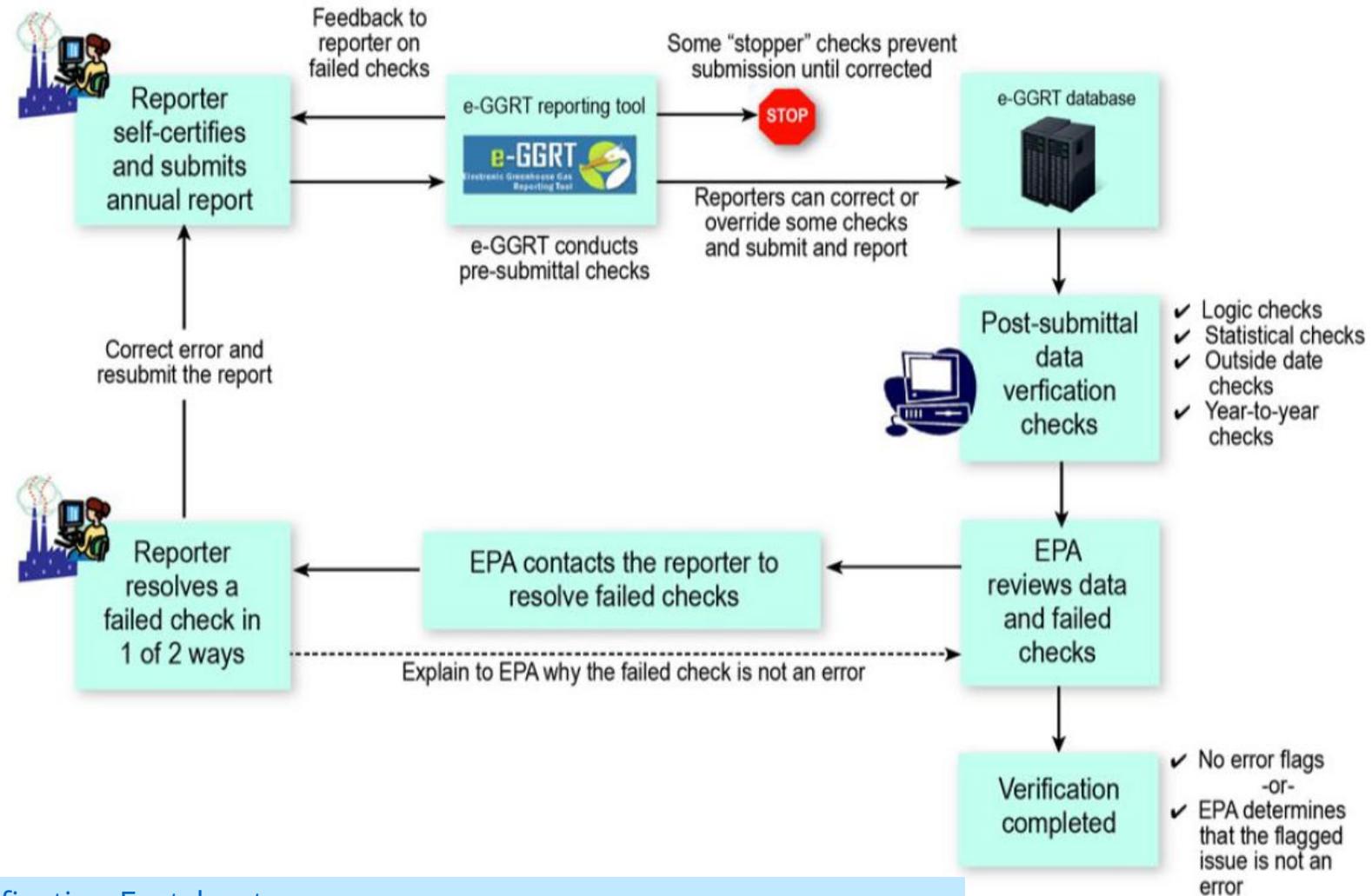


GHGRP Methodology to Calculate Emissions from Landfills

Methodology for CH₄

- Factors used for calculations are
 - Gather data
 - Amount of waste in place in landfill
 - LFG collection
 - Methane content of LFG
 - Beneficial use project (flared vs used for energy)
 - Using decay equation (HH-8)
 - Emission factors
 - Annual heat input
 - Conversion to CO₂ equivalent

Verification of Reported Data



More information: [GHGRP Verification Factsheet](https://www.epa.gov/sites/default/files/2017-12/documents/ghgrp_verification_factsheet.pdf)
https://www.epa.gov/sites/default/files/2017-12/documents/ghgrp_verification_factsheet.pdf

Questions?

GMI Tools and Resources for Methane Measurement

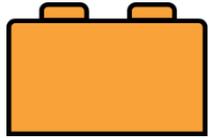
Presenter: David Cooley

GMI Biogas Tools



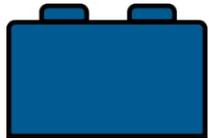
Waste Characterization Tool version 1.0

Streamlines data entry and provides instant analysis of waste composition



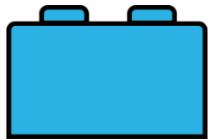
Solid Waste Emissions Estimation Tool (SWEET) version 4.0.5

Quantifies emissions of greenhouse gases and other air pollutants from the municipal solid waste sector



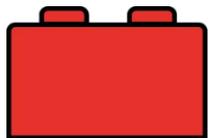
Landfill Gas (LFG) Screening Tool version 3.0

Estimates LFG recovery rate and provides potential project type and size



Anaerobic Digestion (AD) Screening Tool version 2.2

Estimates the quantity of biogas and digestate produced by AD systems and methane emissions reductions



Organics Economics (OrganEcs) version 3.1

Estimates costs, revenues, and profitability with composting and AD projects

What's in my waste stream?



Waste Characterization Handbook

Description: A guide and Excel-based tool to help decision-makers and solid waste professionals plan and conduct hand-sort waste characterization studies

Applications:

The Handbook includes recommended activities and resources to:

- Plan appropriate study for specific site conditions
- Conduct field activities to collect data
- Analyze data to make informed solid waste planning decisions

The Excel-based tool can be used to:

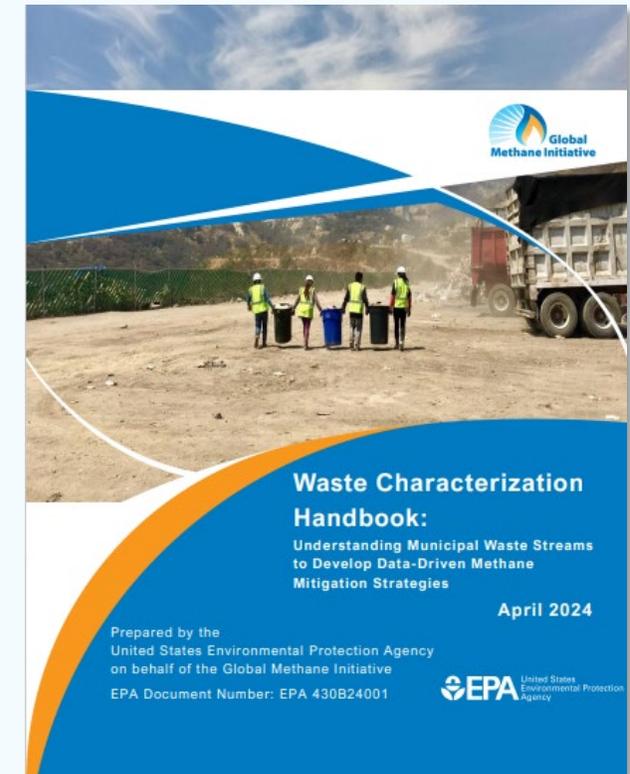
- Streamline data entry
- Visualize data entered during study

Audience: Decision-makers and solid waste professionals

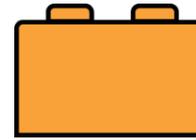
Link:

<https://globalmethane.org/resources/details.aspx?resourceid=5399>

Contact: Email biogastoolkit@epa.gov with any questions



How can I reduce my emissions?



Solid Waste Emissions Estimation Tool (SWEET)

Description: Excel-based tool for quantifying greenhouse gases (GHG) and other pollutants from sources across the waste sector at the project and municipal level

Applications:

- Create municipal GHG inventories
- Establish emissions baselines
- Compare policy and project choices for handling municipal waste
- Justify waste management projects for grant funding or financing
- Support quantification of public health impacts of waste management choices
- Measure, report, and verify emissions reductions

Audience: Local governments, waste professionals, policymakers

Download: <https://globalmethane.org/SWEET>

Contact: Email biogastoolkit@epa.gov with any questions



Outputs

- Carbon dioxide equivalent
- Black carbon
- Methane
- Sulfur oxides
- Particulate matter
- Sulfur oxides
- Emissions changes from the alternative versus business-as-usual scenario

Is gas capture feasible at my site?



Landfill Gas Screening Tool

Description: Excel based screening tool to assess potential feasibility of landfill gas (LFG) to energy projects

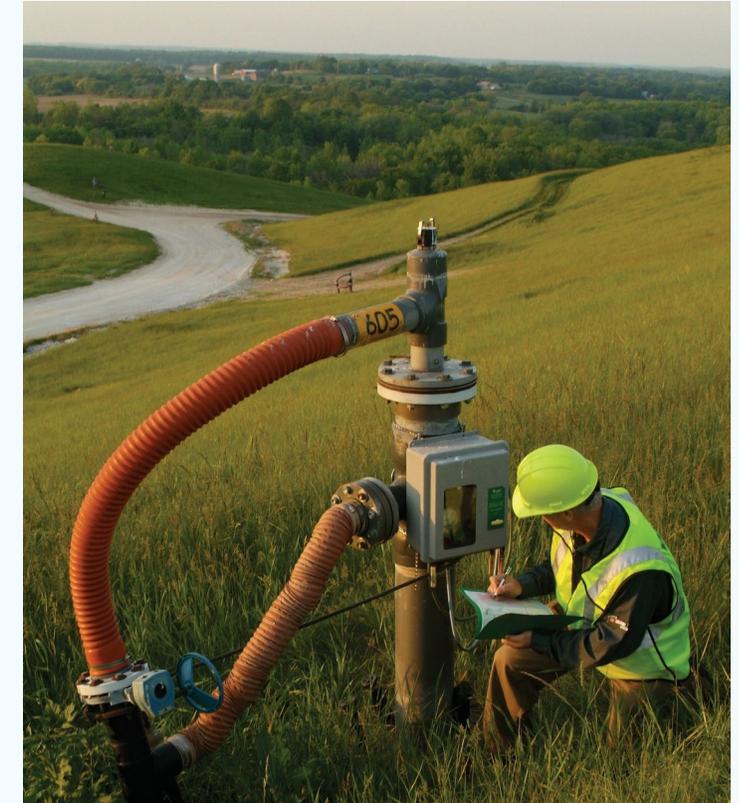
Applications:

- Estimate of how much LFG a site could collect
- Determine whether biogas production is sufficient to support LFG to energy project
- Determine potential project type and size

Audience: Landfill and/or dumpsite operators and project developers

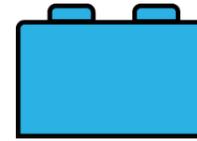
Download: <https://globalmethane.org/LFGST>

Contact: Email biogastoolkit@epa.gov with any questions



Source: Waste Management

Could my organic waste stream support an anaerobic digester?



Anaerobic Digestion Screening Tool

Description: Excel-based screening tool to assess potential feasibility of an anaerobic digestion project

Applications:

- Estimate biogas production potential
- Estimate digestate
- Estimate energy production
- Estimate GHG reductions from project

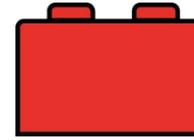
Audience: Project proponents and lending institutions/banks

Download: <https://globalmethane.org/ADST>

Contact: Email biogastoolkit@epa.gov with any questions



How can I make a compost project economically sustainable?



Organics Economics (OrganEcs)

Description: Two Excel-based tools to estimate the financials of composting and anaerobic digestion projects

Applications:

- Evaluate economic feasibility of project
- Evaluate the effect of tipping fees of project profitability
- Evaluate project net present value or internal rate of return
- Evaluate financial management and financial sustainability

Audience: Local governments, waste professionals, policymakers, facility operators, and project developers

Download: <https://globalmethane.org/OrganEcs>

Contact: Email biogastoolkit@epa.gov with any questions



EPA Biogas Toolkit for Project Developers

- **Description:** EPA's Biogas Toolkit includes 47 tools and resources to facilitate biogas project development.
- **Application:** Roadmap for planning and implementing biogas and composting projects and quantifying economic and environmental impacts.
 - Organized into project phases:
 - Getting Started
 - Pre-Feasibility
 - Feasibility
 - Development & Construction
 - Operations & Maintenance
- **Audience:** Project implementers, developers, financiers, and policymakers
- **Contact:** Email biogastoolkit@epa.gov with any questions



Where do I start?

[Guided Search](#)

Using the Biogas Toolkit: Use the filter panel to customize the list of biogas resources. Alternatively, click the "Guided Search" button to answer three questions and retrieve your results. Have questions? Please [contact us](#).

Filters

Project Phase

- Getting Started
- Pre-Feasibility
- Feasibility Assessment
- Development and Construction
- Operations and Management

Biogas Sector

- Agriculture
- Solid Waste
- Wastewater

Topic

- Engineering and

Displaying 47 of 47 resources.

- 

10 Keys to Digester Success

Many factors are required to successfully implement and operate an anaerobic digestion/biogas system. This resource lists 10 key factors essential for a successful farm-based digester project.

CHECKLIST
- 

Anaerobic Digestion Operator Guidebook

This guidebook helps operators increase operational performance and efficiency of AD systems, and avoid common challenges.

DOCUMENT
- 

Is An Anaerobic Digestion Project Appropriate?

Anaerobic Digester Project Development Handbook, Chapter 1

DOCUMENT

This chapter of the AgSTAR Project Development Handbook outlines the factors to consider to successfully implement and operate an AD/biogas system, provides characteristics for farms that might indicate an AD/biogas system is appropriate, and provides limitations and conditions that would determine that AD/biogas is not applicable.

Example Analysis Using GMI Tools

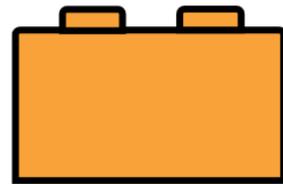
Presenter: David Cooley

Example: Meeting city organics diversion and methane reduction goals

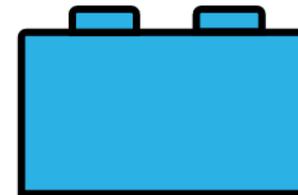
- **Challenge:** City leaders recently conducted a city-wide household and commercial waste assessment and determined that of the 370,000 metric tons of waste generated annually, 244,570 is food waste (66% of total waste generated). Based on the results of the assessment, the city pledged to:
 - Divert at least 20% of organic waste (50,000 metric tons per year)
 - Reduce methane emissions from the waste sector by 10% by 2050

Example: Meeting city organics diversion and methane reduction goals

- **SWEET inputs:** Leaders deciding between a city-wide composting plant, AD facility, or improved landfill management.
- **Analysis:** GMI tools provide decision makers with data on emissions by scenario.

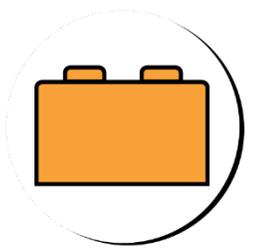


SWEET evaluated emissions reduction potential from three management scenarios

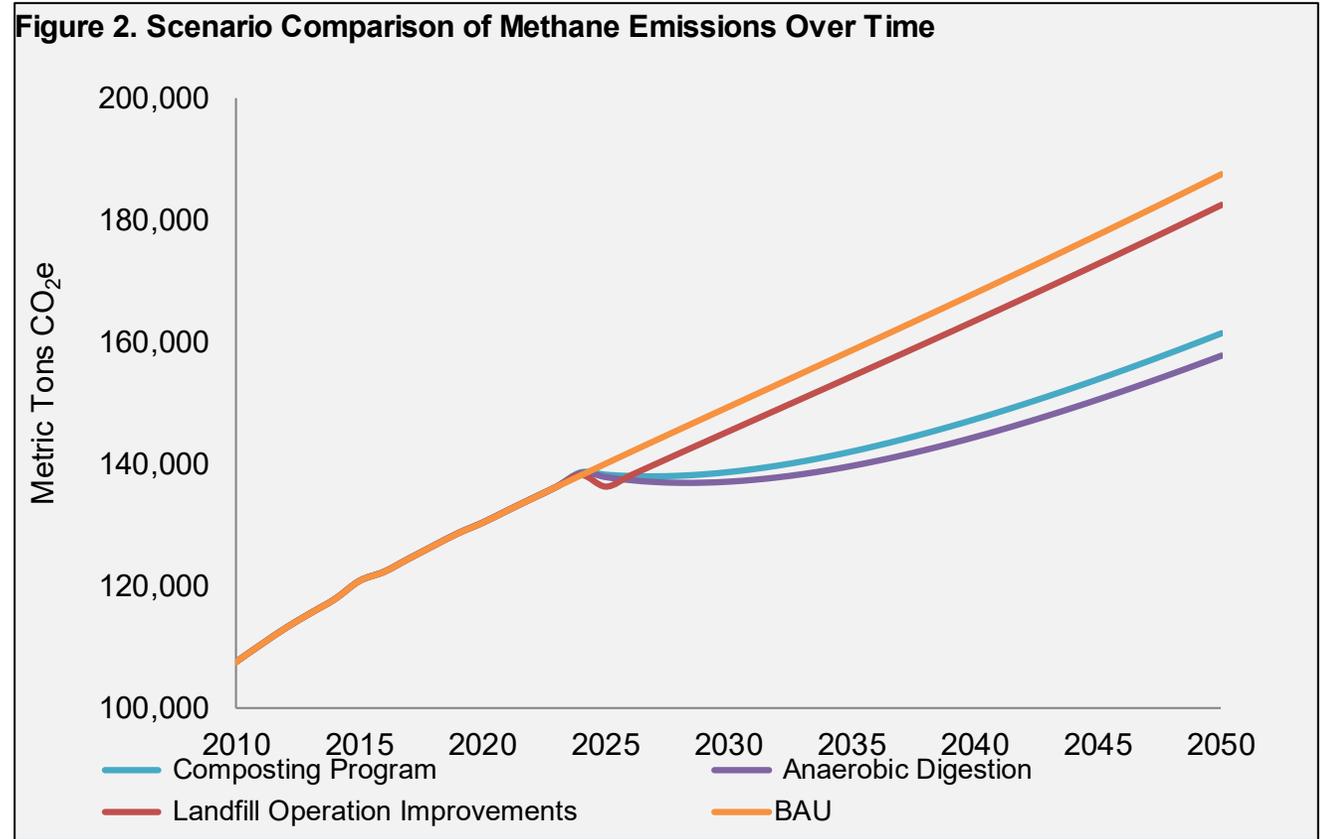


AD Screening Tool estimated potential biogas production from the chosen AD scenario

Example: Meeting city organics diversion and methane reduction goals

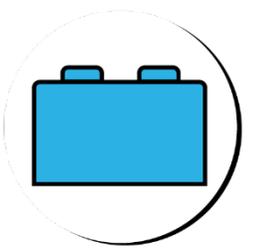


- **SWEET inputs:** Three scenarios
 - Implement city-wide composting program to divert 50,000 metric tons of food waste per year
 - Implement city-wide anaerobic digestion facility to divert 50,000 metric tons of food waste per year
 - Improve LFG capture efficiency at existing landfill by 2% per year
- **SWEET output:** Emissions per scenario
- **Decision:** City decides to pursue AD system



Anaerobic digestion (purple) produces the fewest methane emissions over time

Example: Meeting city organics diversion and methane reduction goals

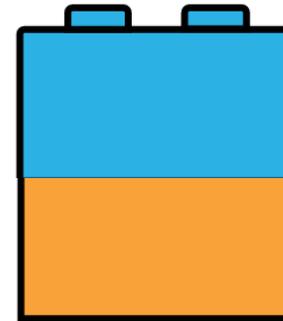
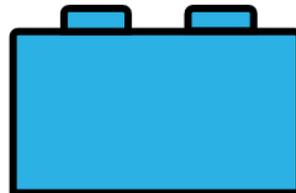
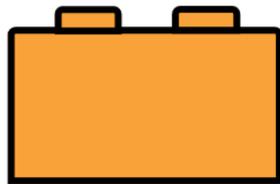


- AD Screening Tool inputs:
 - Feedstock type (food waste)
 - Feedstock amount (68.5 kg/day)
- AD Screening Tool outputs:
 - Biogas production: 38,963 m³/day
 - Digestate production: 26,461 kg/day

Biogas Production - The estimated low and high production values use calibration factors from actual observations that represent the 25th and 75th percentile values of the ratio between measured and modeled data. These values are used to adjust the maximum potential biogas generation values to estimate the likely biogas generation potential values.				
	Estimated Value (low)	Estimated Value (high)	Theoretical Maximum Potential	Unit
Annual Biogas Production	5,700,634	10,387,561	14,221,389	m ³ /year
Annual Methane Production	2,844,616	5,183,393	7,096,473	m ³ /year
Digestate Production		Value	Unit	
Total Non- Biodegradable Solids		964,250	kg/year	
Remaining Volatile Solids		8,661,912	kg/year	
Digester Solids		9,658,162	kg/year	
Dry Sludge		8,692,346	kg/year	
Liquid Effluent		965,816	kg/year	
Energy Recovery Options - Each energy recovery option is an "or" estimate (i.e., the plant will not be capable of producing both X kWh of electricity and Y m ³ /year natural gas, but is capable of producing either X kWh of electricity hours or Y m ³ /year of natural gas).				
	Value			Unit
Electricity Production (cleaned biogas to natural gas quality)	27,340			MWh
Electricity Production (biogas only)	18,490			MWh
Renewable Natural Gas (RNG) Production	2,844,616			m ³ /year
Cooking Gas Potential	52,061			homes/year
Home Heating Potential	39,045			homes/year

Example: Summary

Result: Demonstrated a scenario that could help the city achieve its emissions reduction and diversion goals in a technically feasible manner



SWEET evaluated emissions reduction potential from three management scenarios

AD Screening Tool estimated potential biogas production from the chosen AD scenario

Combined Analysis provides scenario comparison and detailed AD outputs.

SWEET and AD-ST- Broader Application and Links

- Linkage to EPA's Organic Economics (OrganEcs) Tool
 - Estimate costs, revenues, and profitability associated with anaerobic digestion and composting projects.
- Biogas Toolkit:
 - A web-based toolkit with **36 tools and resources** to facilitate biogas project development.
 - **Roadmap for planning and implementing biogas projects** and quantifying economic and environmental impacts.

Questions?

Tools and Resources List

- [MRV 101: Understanding Measurement, Reporting, and Verification of Climate Change Mitigation.](#)
- [Handbook on Measurement, Reporting and Verification for Developing Country Parties.](#)
- [GHG MRV Harmonization Framework.](#)
- ["MRV In Practice" – Connecting Bottom-Up and Top-Down Approaches for Developing National MRV Systems for NDCs.](#)
- [MRV Webinar Series: The Role and Importance of MRV for Biogas Projects:](#)
- [EPA's Biogas Toolkit](#)
- [Policy Maker's Handbook for Measurement, Reporting, and Verification in the Biogas Sector.](#)
- [GMI Solid Waste Emissions Estimation Tool](#)
- [GMI Anaerobic Digestion Screening Tool](#)
- [GMI Organics Economics Tool](#)
- [GMI Landfill Gas Screening Tool](#)
- [GMI Waste Characterization Handbook and Tool](#)

Thank You!

Please reach out with any questions to: biogastoolkit@epa.gov



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