Methane Mitigation Project Phases, Practical Solutions, and Greenhouse Gas Emission Quantification

Global Methane Initiative

March 5, 2024

Call in Details: 1-415-655-0002, ID 2432 444 5941

Webinar Panels

We'll use three panels

- Participants, Slido, and question and answer (Q&A)
- Use the arrow to expand or collapse the panels

Adding Panels

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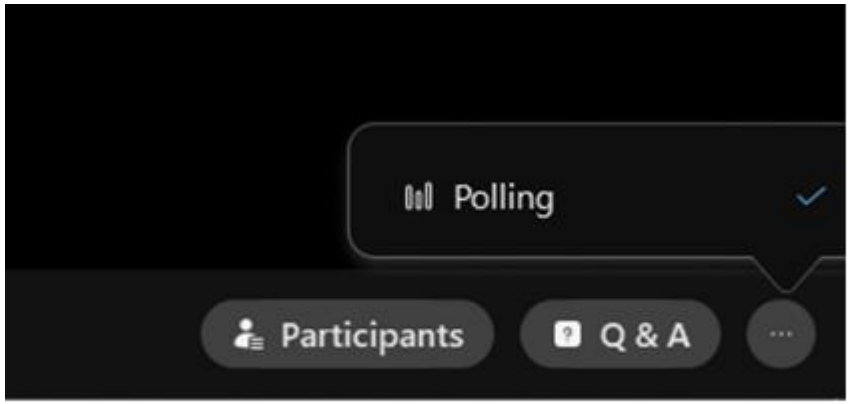

Participants **Q&A** **More polling options**

Polling and Feedback

Polling

- We’ll ask poll questions during the webinar
- The Slido panel will appear when we open the first poll
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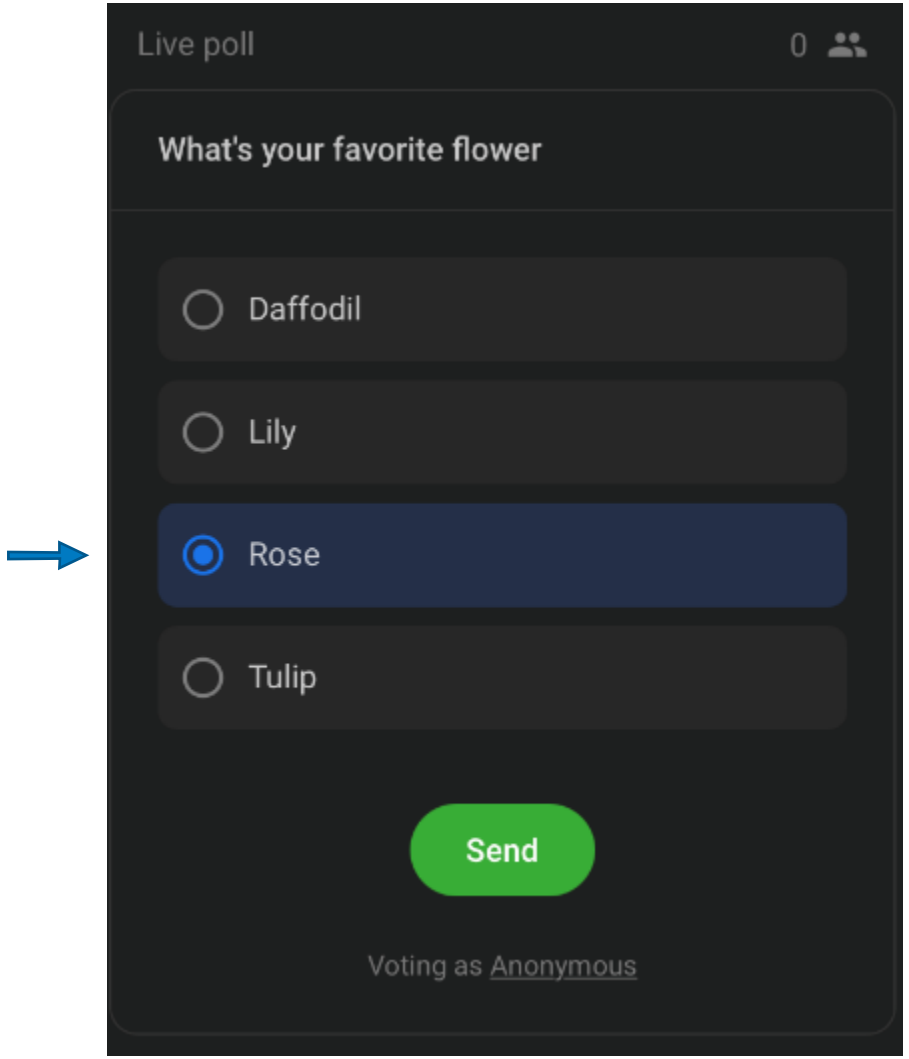


Webinar Feedback

- A feedback form will pop-up in the Slido panel near the end of today’s webinar with several questions
- Please make your selections and select “Send”

Q&A

- Participants are muted
- Questions will be moderated at the end of the webinar
- To ask a question:
  - Select “All Panelists” from the drop-down menu
  - Enter your questions in the Q&A box
  - Hit “Send”

- Final materials will be posted to the GMI website: www.globalmethane.org

Agenda

- Matt Hamilton – Environment and Climate Change Canada
- Mariel Vilella – Global Climate Program Director at GAIA
- Dr. Ali Abedini – President at Methane Expert Engineering
- Questions and Answers

March 2024

An Environmental Justice Perspective on Dumpsite Closures

Economic and Social Impacts, Barriers, and Benefits

Mariel Vilella
Climate Program Director, GAIA
mariel@no-burn.org

Who we are

GAIA is a global network of grassroots and national organizations from 92 countries around the world who are working together on **waste and justice**, and one of our main strategic priorities for the next several years is supporting **organizing and policy work for methane reduction.**

Our members have deep expertise in the field and are strongly rooted in their communities and countries. Many of them have been working for decades on **reducing pollution from organic waste and implementing composting, biogas, and other zero waste solutions.**

GAIA's regional teams

We are organized into **5 regional teams** that work in close collaboration with our members in **Asia, Africa, Latin America, Europe, and the US & Canada**, as well as a team that coordinates global policy and campaigns.

Overview

Dumpsites are a health and environmental hazard, polluting soil, air and water; fires, landslides, incidents, countless loss of lives.

However, closing dumpsites needs careful consideration for **social, economic and environmental reasons**. So far, transition to sanitary landfills has displaced thousands.

Cities need **an integrated sustainable solid waste framework** with an emphasis on waste reduction, reuse, recycling, redesign, and **an environmental justice (EJ) perspective.**

The key to addressing the methane emissions challenge lies in **waste diversion of organic waste** and **banning of untreated organic waste into landfills.**

The social and economic reality of dumpsites

Millions of waste pickers – mostly women-- make a living collecting, sorting, reusing and selling valuable recyclable materials. They work in unhealthy conditions without adequate compensation, health insurance, and proper training, facing strong social stigma. **Despite these challenges, high rates of recovery (50-80%) in some cities are due to informal recyclers** (UN Habitat, 2010).

The homes closest to dumpsites are often those of vulnerable populations who make a living by recovering recyclables with a monetary value. Recovering materials at the dumpsite is often more cost-effective than elsewhere.

Dumpsite upgrading or replacement can bring negative social impacts: physical displacement, direct effects to housing, land, property, economic activities and access to recyclables, broader effects on local economies, real stage values, the poverty-environmental nexus, and impact related to the negative social perception of disposal sites and other waste infrastructure. (UNEP, 2021)

The question:

How can we ensure a fair, just, and sustainable implementation of solutions?

Environmental justice principles are often neglected in waste management approaches, exacerbating social divisions and excluding critical stakeholders, especially in the informal sector.

Main barriers:

- Lack of alignment
- Failure to engage issues of justice
- Lack of strategy
- False solutions

The need:

The positive benefits related to the reduction of greenhouse gases (GHGs) are more important than ever

Effective climate action will not only reduce GHG emissions, but also improve many of the most fundamental ways in which society functions through associated environmental, economic, social, and political and institutional benefits.

The co-benefits:

- Air quality
- Food security
- Employment
- Political, institutional benefits

What we're doing

We developed **environmental justice principles for fast action on methane in the waste sector**, with leaders from 41 countries

We are inviting other organizations - including all of you - to join us in **putting these principles into action**

As GAIA we work with groups in **50+ countries** that are poised for action, and we aim to bring in **technical and financial support** for their efforts

How to use the EJ Principles for Fast Action on Waste and Methane

This set of EJ principles provide:

- guidance to policymakers in developing methane reduction policies, including dumpsite closures.
- checklists for nationally determined contributions (NDCs) key stakeholders

<u>Download in various languages</u> - up to 12

how to integrate community members and waste workers in the design and implementation of waste systems

The vision

The Framework includes a vision for systems change towards zero waste, climate justice, and quick action on methane reduction.

Successful implementation of organic waste diversion in line with EJ principles builds community, waste worker, and local government buy-in and demonstrates the practical effectiveness of these strategies, including important co-benefits in livelihoods and environmental health.

Five environmental justice principles for fast action the waste sector

Respect planetary boundaries to ensure intergenerational equity

Respect for all waste pickers and waste workers

Enhance inclusion and build from local knowledge

Respond to pollution and environmental harm with accountability

Support holistic solutions through systems change

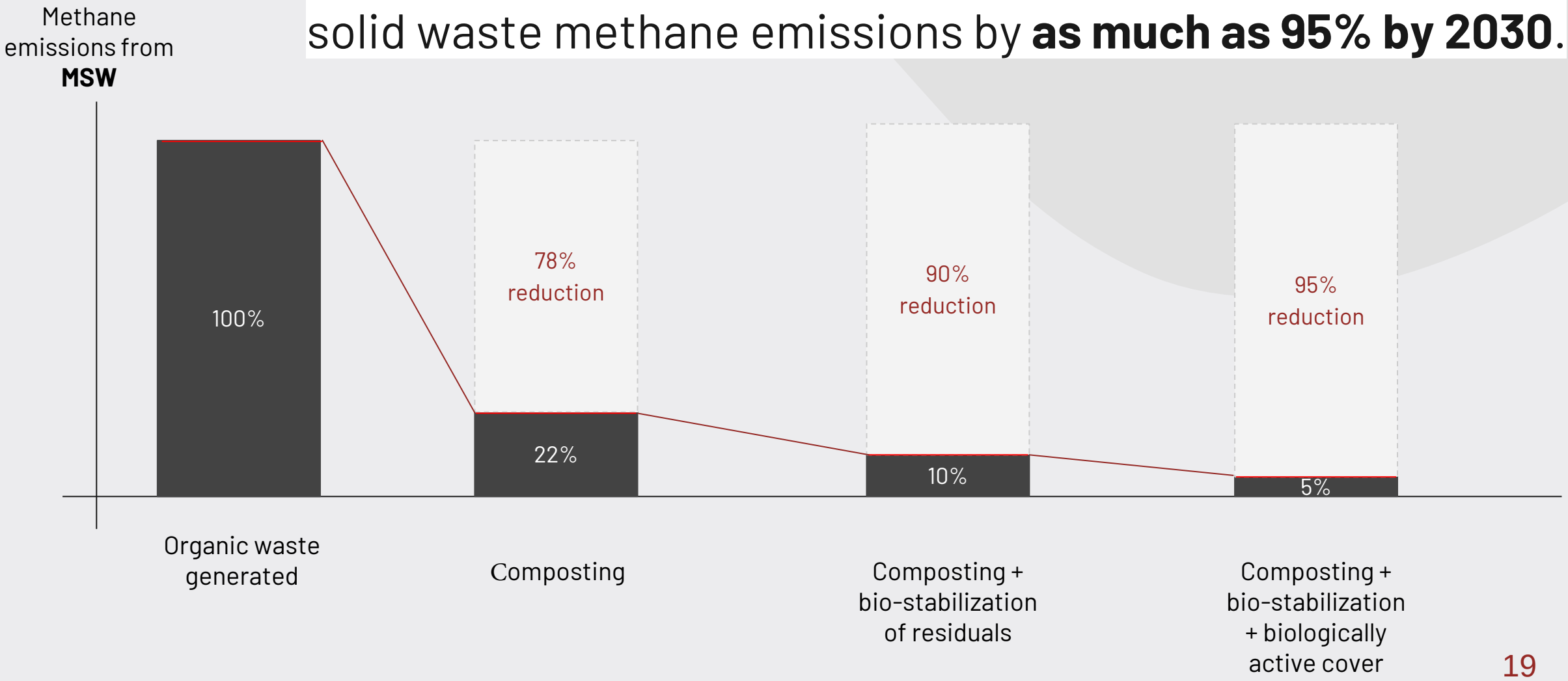
Five environmental justice principles for fast action the waste sector

1. Respect planetary boundaries to ensure intergenerational equity

Recognising ecological limits, the waste hierarchy must be applied to reverse climate change and drive a just transition that ensures intergenerational equity.

Organic waste prevention is the most powerful tool for reducing methane emissions, including preventing **upstream** emissions involved in its production, management, and transport.

Source separation of organic discards, coupled with composting, bio-stabilization of residual waste, and biologically active cover for landfills and dumps can reduce solid waste methane emissions by **as much as 95% by 2030**.



Five environmental justice principles for fast action the waste sector

2. Respect for all waste pickers and waste workers

Upholding and strengthening human rights, we must centre equity and justice in all our actions, protecting the livelihoods of waste pickers and waste workers and ensuring no harm in the first place.

Principle 2 – how does it apply to a dumpsite closure?

Just Transition: livelihood plans should be an integral component of any dump closure process

Engage with already existing wastepickers organisations ar global, regional, national, local level. International Alliance of WastePickers, REDLACRE, Asia Pacific Waste Pickers, national alliances, local associations/cooperatives, etc.

Embrace an specific approach to vulnerable communities: significant numbers of women, people from racial or ethnic minorities, low-income individuals and families, people with disabilities and mental health conditions, children, youth and young adults, seniors, immigrants and refugees.

Recognise and support waste pickers to join together in cooperatives or associations so that they can provide more efficient services and generate more income while their organisation can offer a pathway to formalisation (UNEP 2024).

Just one of many positive stories: SWACH in Pune, India

SWaCh is India's largest cooperative wholly owned by self-employed informal waste-pickers, providing sustainable livelihoods particularly for disadvantaged women, producing valuable compost that combats highly problematic soil degradation.

Image credit: SWaCH Coop, Pune

Door-to-door collection system for source-separated organic waste taken to composting site.

Currently, 71 waste-pickers are managing 7,000 kilograms (kg) organic waste daily composting site. Read GAIA's case study

How A Cooperative Owned By Garbage Pickers Is Solving Waste Management Crisis In Pune

English Español Português Français

INTERNATIONAL ALLIANCE OF
WASTE PICKERS

The International Alliance of Waste Pickers is a union of waste picker organizations representing more than 460,000 workers across 34 countries

Home | About | Where are we? | Global Meetings | Initiatives | Newsletters | News | Publications | Resources | Subscribe | Contact

Regional meeting

Asia Pacific Waste Pickers Organise: Historic Meeting in Kathmandu Addresses Threats, Elects Leaders, and Prepares for Global Congress

by International Alliance of Waste Pickers Region Asia-Pacific February 28, 2024

Instituto Polis

Crecer a Cielo Abierto, by several authors related to Zero Waste Alliance in Ecuador and Universidad Simón Bolívar

Dar es Salaam, Tanzania

NIPE FAGIO LEADS THE ZERO WASTE STRATEGY IN DAR AND BEYOND

This local organization has been building cooperative-led zero waste systems in Tanzania since 2019, and sees great potential in the formation and formalization of waste collection cooperatives in reducing the city's waste and carbon footprint.

Co- hosting the Global Zero Waste Conference in July 2024 - read more

Nipe Fagio
I am the change

Five environmental justice principles for fast action the waste sector

3. Enhance inclusion and build from local knowledge

In decision-making processes, enhancing inclusion and meaningful participation is a must, along with building from local knowledge and expertise.

Principle 3 - how does it apply to a dumpsite closure

A dumpsite closure requires **inclusive, participatory and representative decision-making** to avoid ill-informed or inappropriate measures applied to the local context which would ultimately increase the costs to society (UNEP 2024)

Local residents and civil society organizations (CSOs) often have significant expertise and contextual knowledge that can improve policies and infrastructure decisions. Yet input from technical teams may be given precedence over the views and experience of local communities and residents.

This will require **culture-sensitive and locally appropriate communications**, the need to **facilitate involvement** and to **engage in dialogue with all stakeholders** in the system, taking into account that in many countries, most urban waste collection and transportation are carried out by the informal recycling value chain.

Five environmental justice principles for fast action the waste sector

4. Respond to pollution and environmental harm with accountability

Any pollution or environmental harm caused must be addressed with accountability, putting means in place to compensate for damages and prevent further harm.

Principle 4: what should NOT happen/needs repair

Privatization for waste management (WM) system and restricted access to recyclable materials

Investment in thermal treatment eg waste-to-energy (WTE) incineration or similar

Mechanical Biological Treatment for Refuse-Derived Fuel production

Any end of pipe disposal infrastructure without upstream intervention

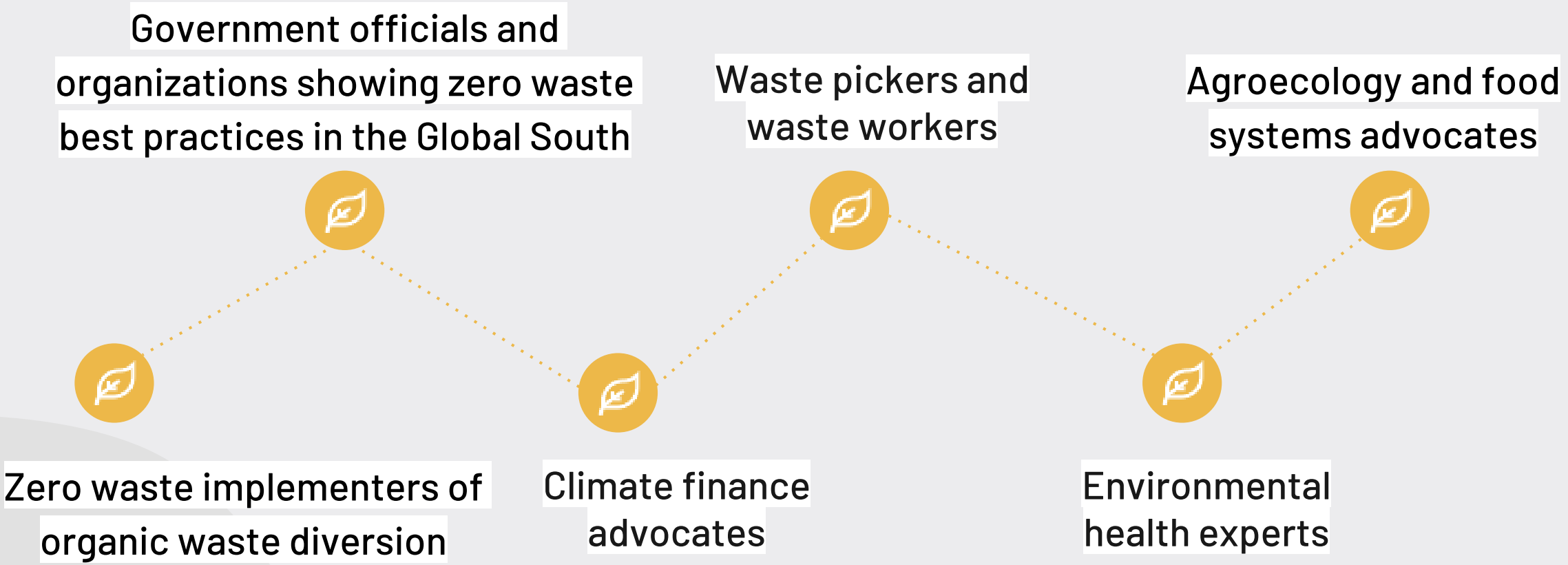
Five environmental justice principles for fast action the waste sector

5. Support holistic solutions through systems change

A systemic point of view must be used to find solutions for interrelated crises like climate, public health, poverty, gender, racial and class injustice, inequality, conflict and war, and to ensure solutions in the waste sector meet and exceed Sustainable Development Goals and climate targets.

Principle 5 - how does it apply to a dumpsite closure?

- Build multi stakeholder alliances and engage in dialogue to transform the linear system waste-to-disposal towards a circular and zero waste local and justice-centered economy.
- Assessment of waste composition, mapping of existing recycling, design holistic system.



Final conclusions for an EJ and Human Rights based approach to dumpsite closure

- Recognition of human right to a clean, healthy and sustainable environment, means **everyone has equal access to sound waste management, including regular collection and safe disposal sites that do not threaten human health or the environment.** (UNEP, 2022)

- **Affirmative action is needed to protect the rights of waste workers in the informal economy**, as they are the backbone of the global recycling system.
    - **Livelihood plans** should be an integral component of any dump closure process.

- Just transition from a mindset focused in making burying efficient towards a **system that prevents and/or diverts organic waste as the main strategy**, prioritising recovery, recycling and composting systems with a zero waste vision with environmental justice.

Join us in making change happen!

Methane Matters

Zero Waste for Zero Emissions

A Key to Rapid Methane Reductions: Keeping Organic Waste From Landfills

SCAN ME

www.no-burn.org

Understanding GHG Emissions from Dumpsites

Ali Abedini, Ph.D., P.Eng.
President, Landfill Gas Specialist
Methane Expert Engineering Ltd.

METHANEX
LANDFILL GAS ENGINEERING SERVICES

Workshop 2: Methane Mitigation Project Phases, Practical Solutions, and GHG Emission Quantification

March 05, 2024

Global Methane Initiative

Outline

- Methane Generation & Quantification 101
- Accuracy & Uncertainties (conventional methodologies)
- Alternative Methodologies
- Landfill Gas (LFG) Management Options
- Financial Aspects

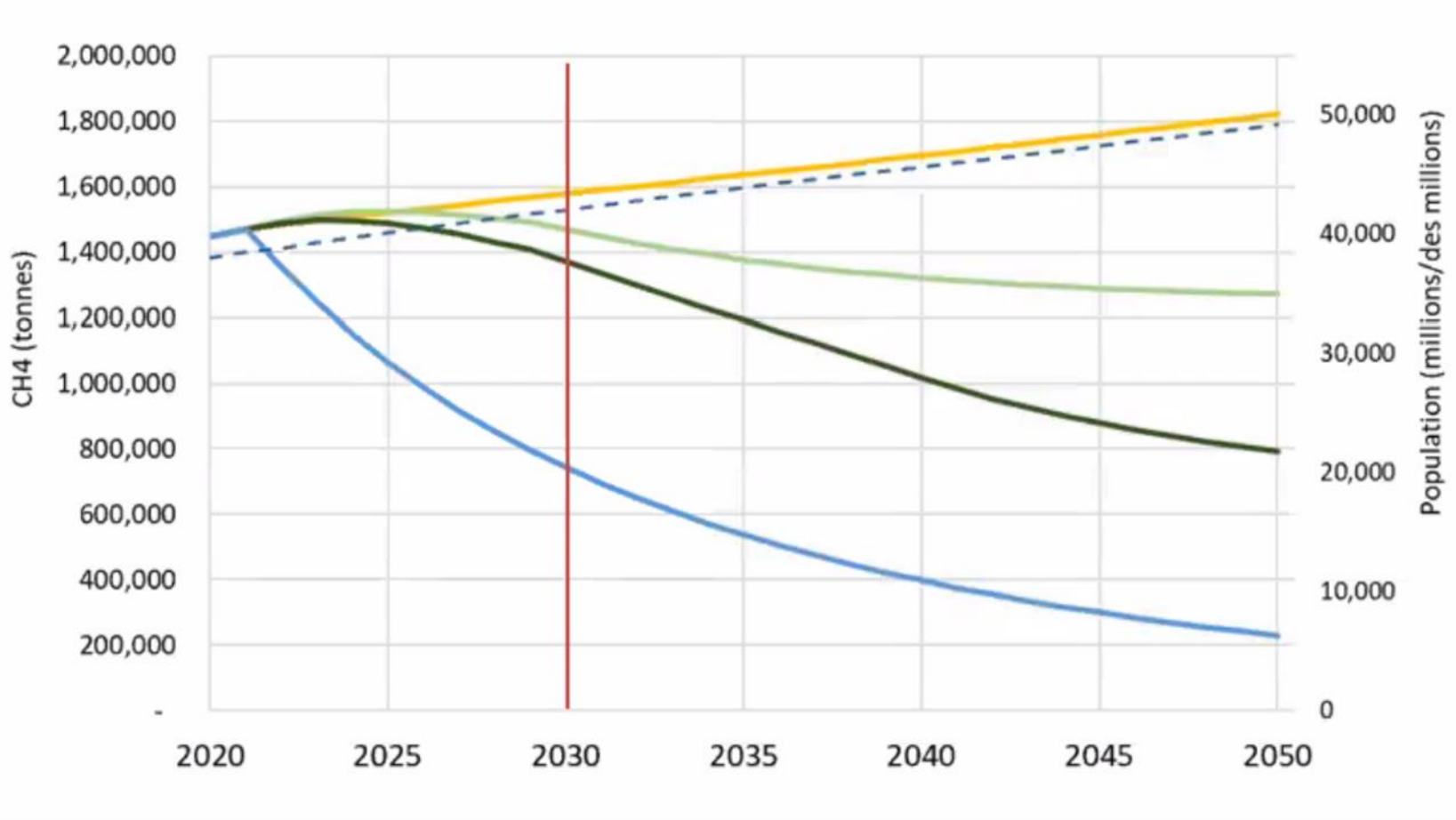
Reuters, August 10, 2022

"A landfill in Mumbai emits about 85,000 tonnes of methane per year….."

"A Buenos Aires landfill releases approximately 250,000 annual tonnes of methane….."

"In 2021, U.S. landfills emitted around 122.6 million tonnes of carbon dioxide (CO_2) equivalent of methane."

…..US EPA

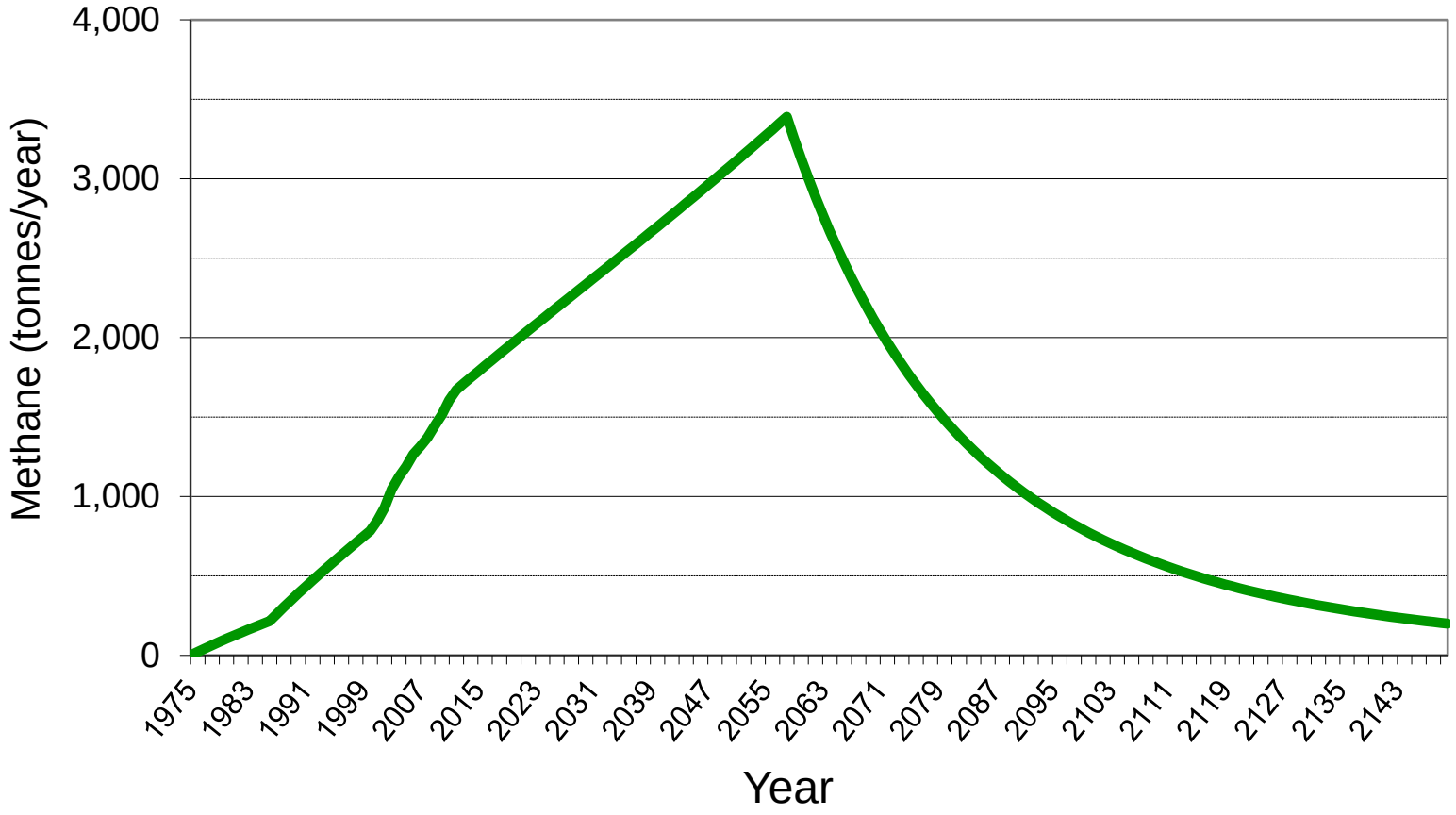


"Projected Methane Generation from Canadian Landfills….."

…..ECCC

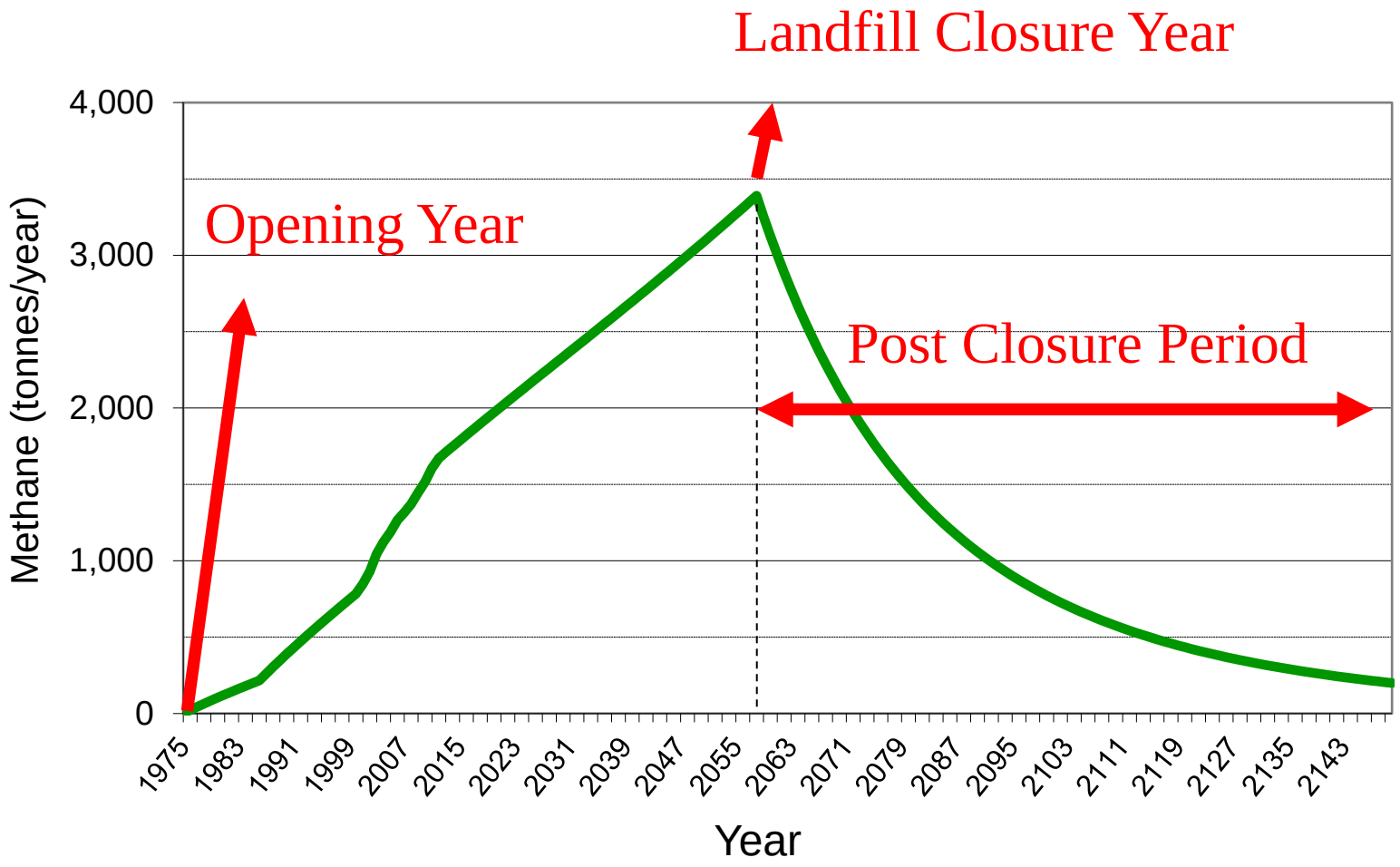
How do we know **how much methane** is generated from a landfill or dumpsite?

Methane Generation Modeling



Q1:
Q2:
Q3:

Methane Generation Modeling



Methane Generation Modeling

- **GHG Emission Inventories (National, Global)**
  - ✓ Impossible to measure emissions from every single landfill
  - ✓ Future emissions
- **Regulation Purposes (Screening Tool)**
- **Engineering (Design Tool)**

Methane Generation Modeling

First Order Decay Methodology

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

M_i = *Waste Mass Disposal in Year i (tonnes)*

k = *Organic Material Decay Rate (year^{-1})*

L_o = *Methane Generation Potential (m^3 tonne^{-1})*

Methane Generation Modeling

First Order Decay Methodology

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

M_i = *Waste Mass Disposal in Year i (tonnes)* — Annual Waste Tonnage

k = *Organic Material Decay Rate (year^{-1})* — Climate, Waste Composition, Landfill Operation, etc.

L_o = *Methane Generation Potential (m^3 tonne^{-1})* — Waste Composition, Landfill Operation, etc.

Landfill Gas Generation (Simplified Version)

Cellulose

Fats

Carbohydrate

Proteins

Paper
Food waste
Textile
Wood, …..

Landfill Gas Generation (Simplified Version)

LFG

Cellulose Fats Carbohydrate Proteins	hydrolyzed and fermented by acid former bacteria	Organic acids (Propionic and Acetic acids)	Methanogenic bacteria	Methane Carbon Dioxide Water

Paper
Food waste
Textile
Wood, …..

Can only occur in **Absence of Oxygen**

Landfill Gas Generation

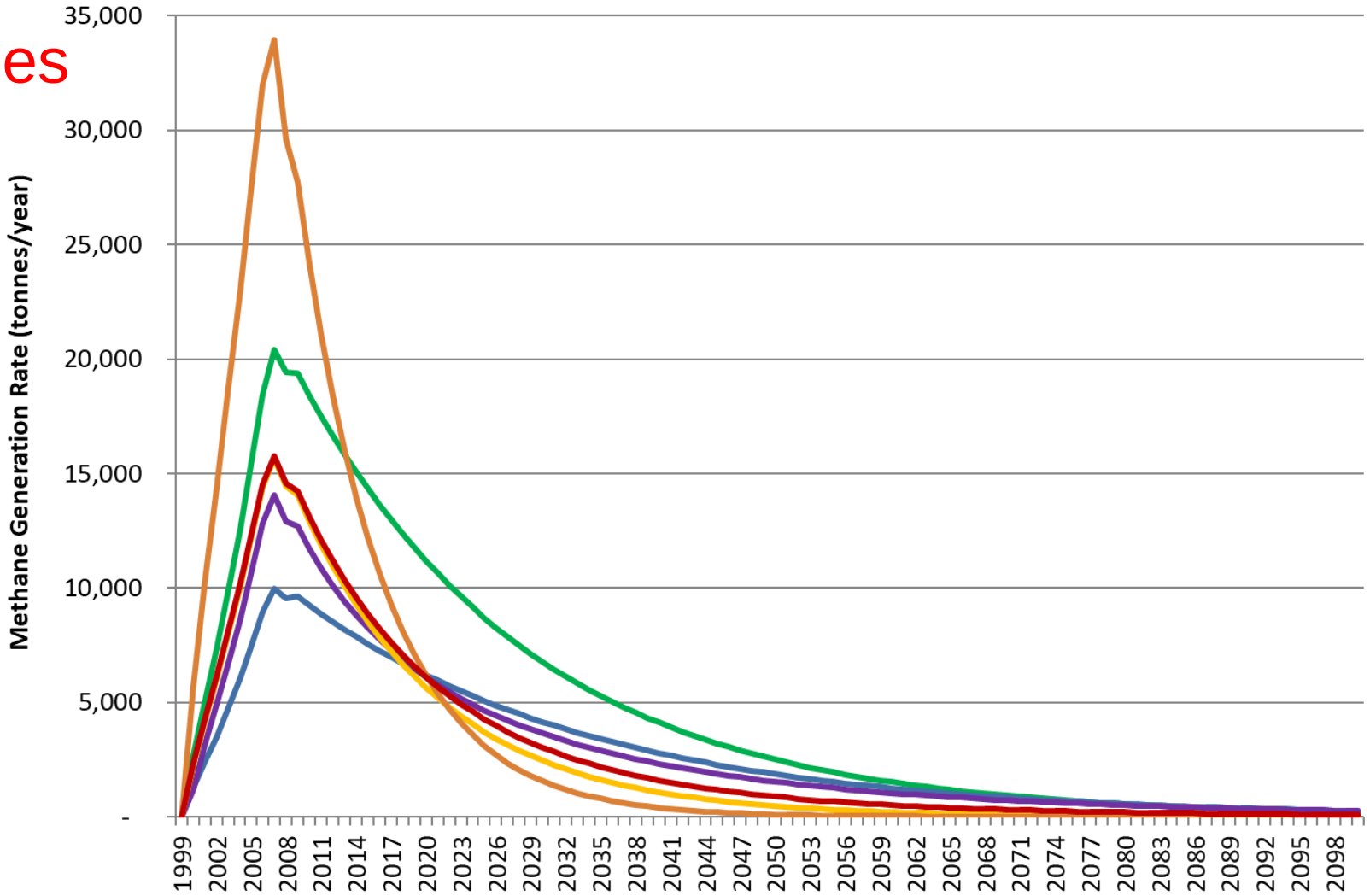
LFG Modeling Challenges

- Inaccuracy of Models (what model to use?)
- Data quality (waste tonnage & composition)
- Poor operation, resulting in aerobic decomposition of organics
- Landfill fires (loss of organics)

LFG Modeling Challenges

- Modeling inaccuracies

Choosing an appropriate model for methane generation prediction is crucial, as the wrong model can yield incorrect results



LFG Modeling Challenges

- Poor Operation & Data Collection

Poor landfill operations that result in the aerobic decomposition of organics can skew expected methane output

LFG Modeling Challenges

- Landfill Fires

The loss of organics due to fires can significantly reduce actual methane generation compared to model predictions

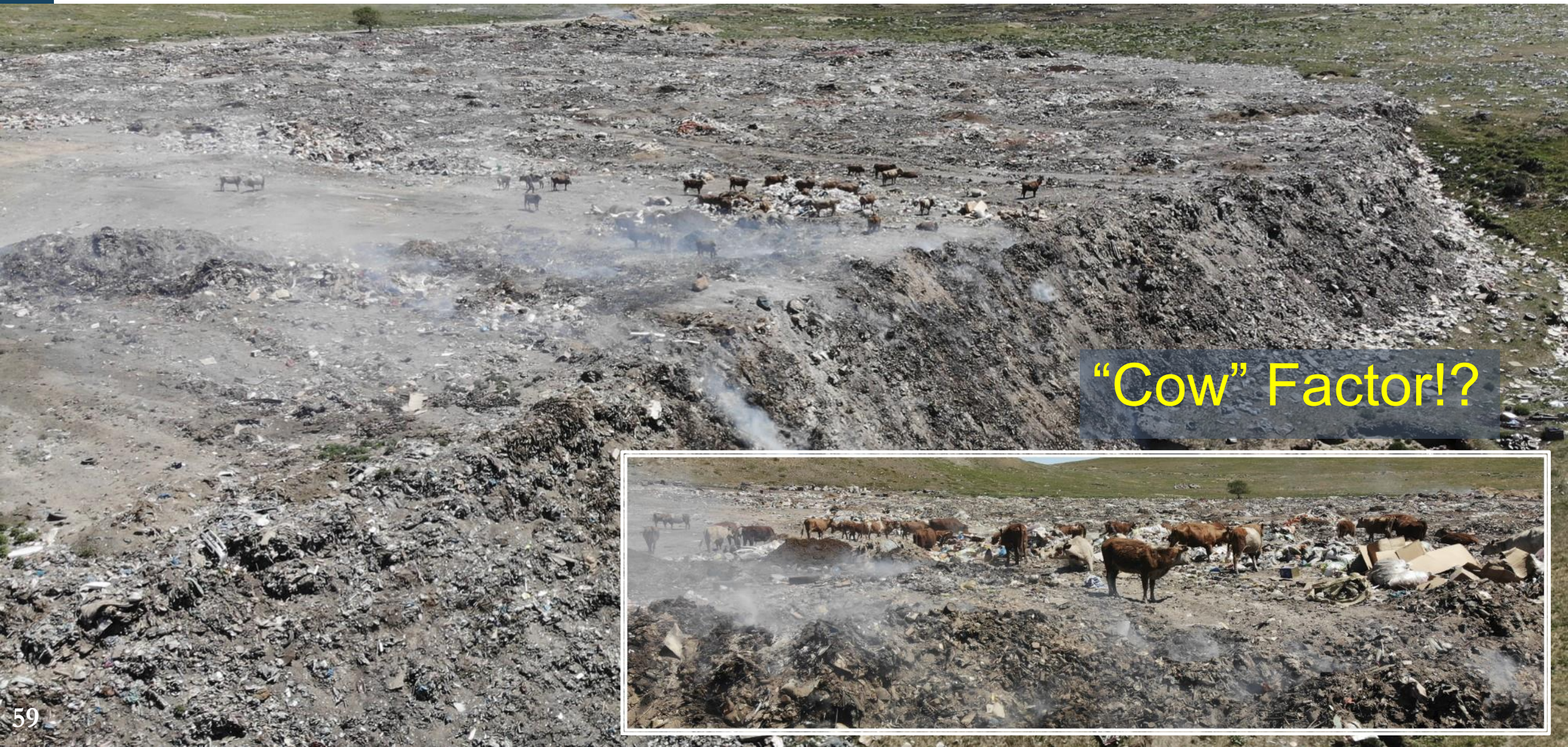
Example Dumpsite Situations

Example Dumpsite Situations

Methane Correction Factor

Example Dumpsite Situations

Example Dumpsite Situations



Alternative Quantification Approaches

Q4:

Q5:

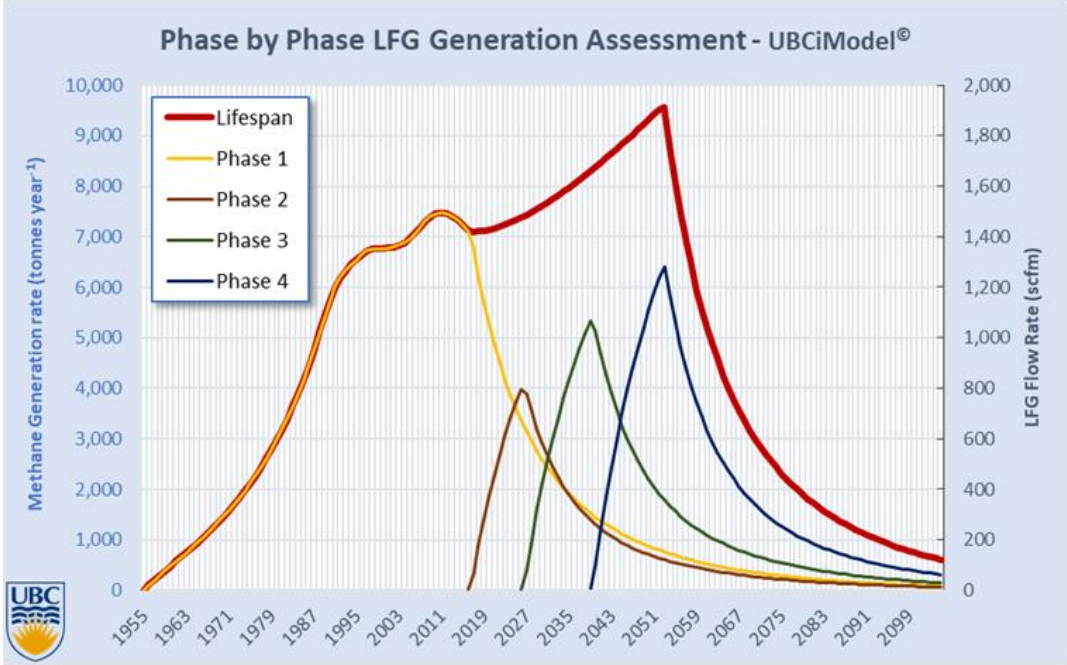
Alternative Quantification Approaches

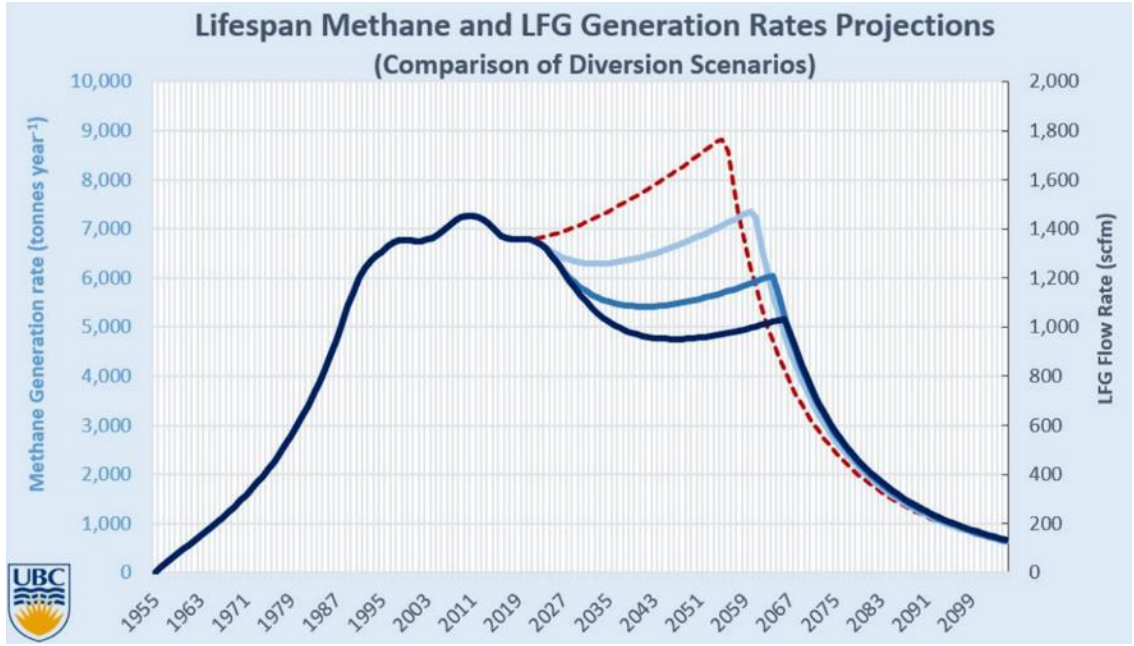
- Advanced (site specific) Modeling
- Field testing (example: LFG Pump Test (Method 2E USEPA)
- Methane Emission Measurement

Alternative Quantification Approaches

- Advanced (site specific) Modeling

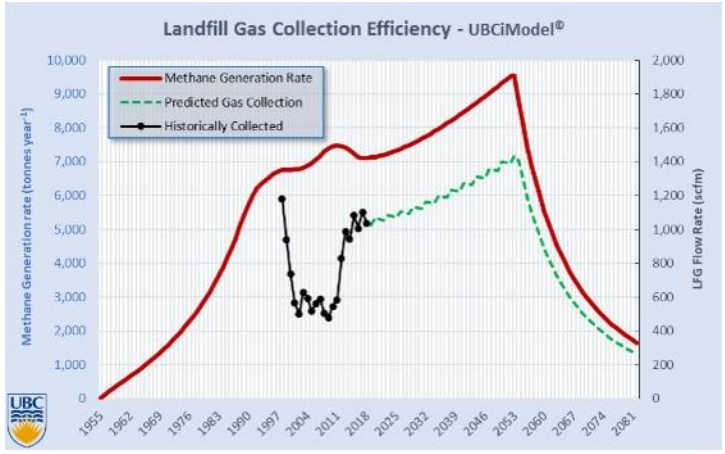
  - Requires very detailed understanding of landfill history (waste tonnage & composition, LF operation, etc.)
  - Takes 5 – 10 days
  - $5k to $20k





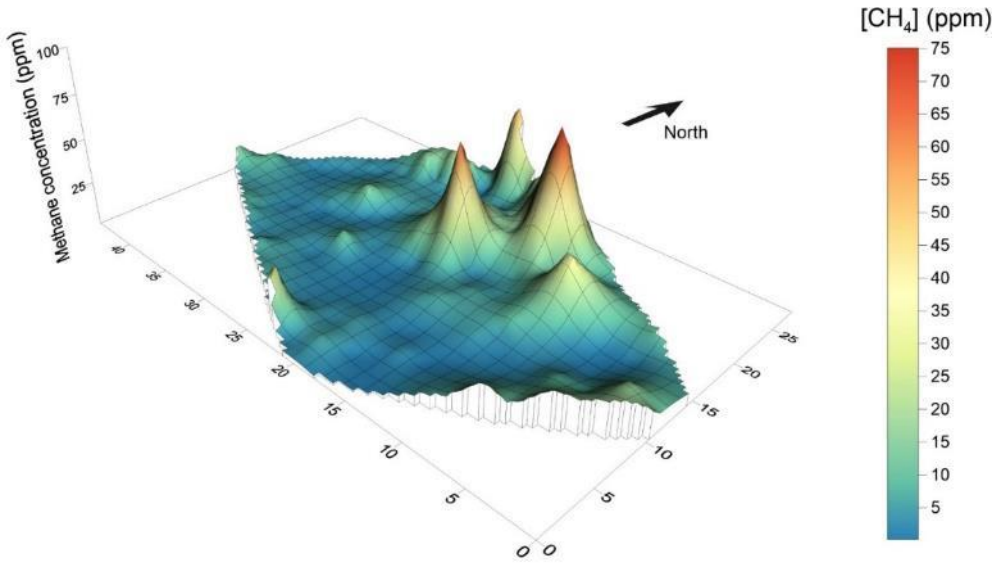
Alternative Quantification Approaches

- Field testing (i.e. LFG Pump Test (U.S. EPA Method 2E))
  - Test LFG well(s) installed, gas is pumped for a period of time and site-specific modelling parameters are developed → repeat modeling with new parameters
  - Takes 2 – 3 months (design, install, test)
  - $50k to $150k



Alternative Quantification Approaches

- Methane Emission Measurement
  - Several techniques
  - Total methane emitted from the site is measured
  - Takes a few days to couple weeks
  - $10k to $100k



Landfill Gas Management Options

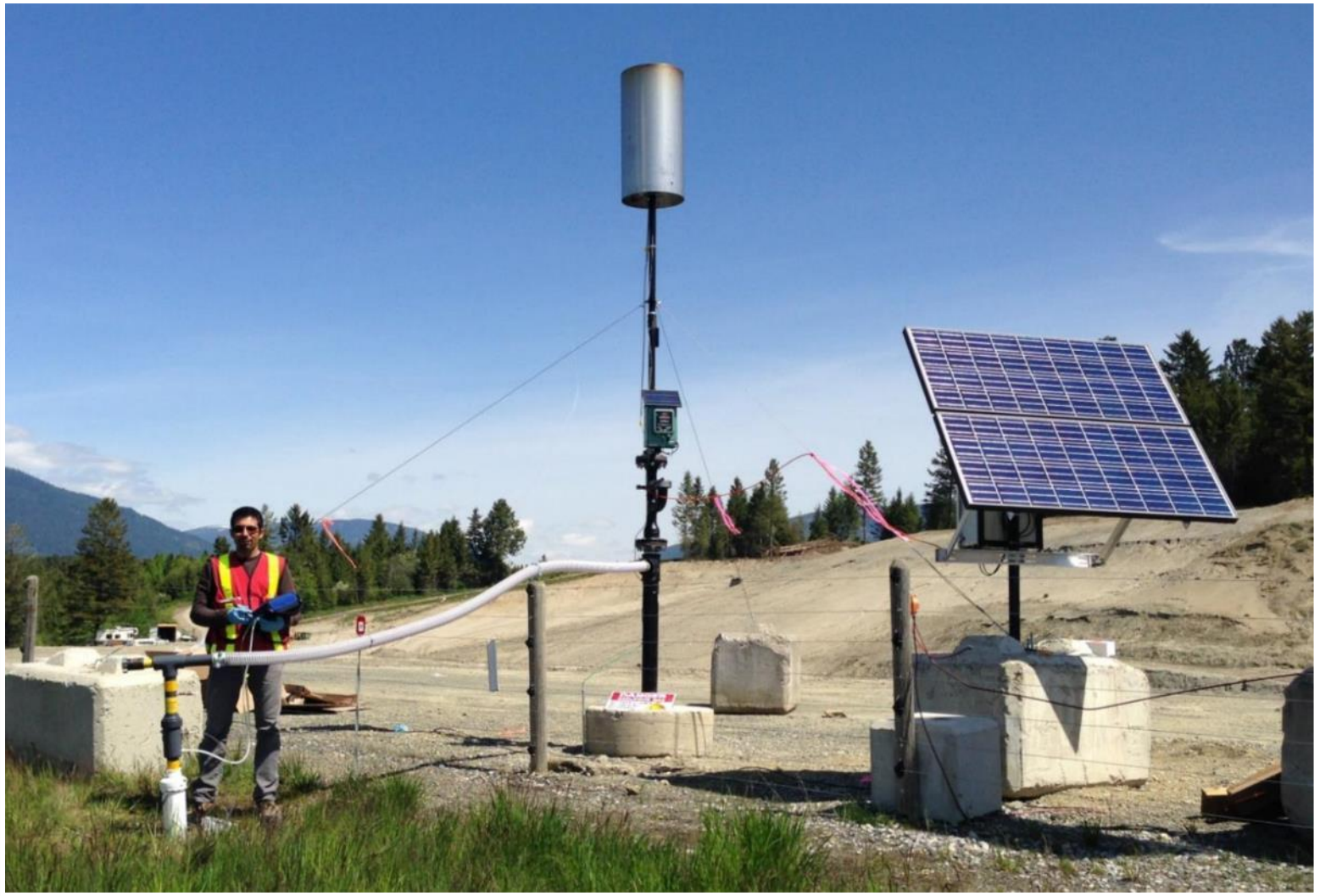
- Passive Systems (may or may not result in GHG reduction)
- Active Systems (always result in GHG reduction)
- Alternative Solutions for GHG reduction (e.g. Bio-cover Systems)
- Perimeter LFG Control Systems (mainly for safety)
- Structure Protection Systems (mainly for safety)
- No control (technically not feasible and not required)

Passive LFG Management Systems

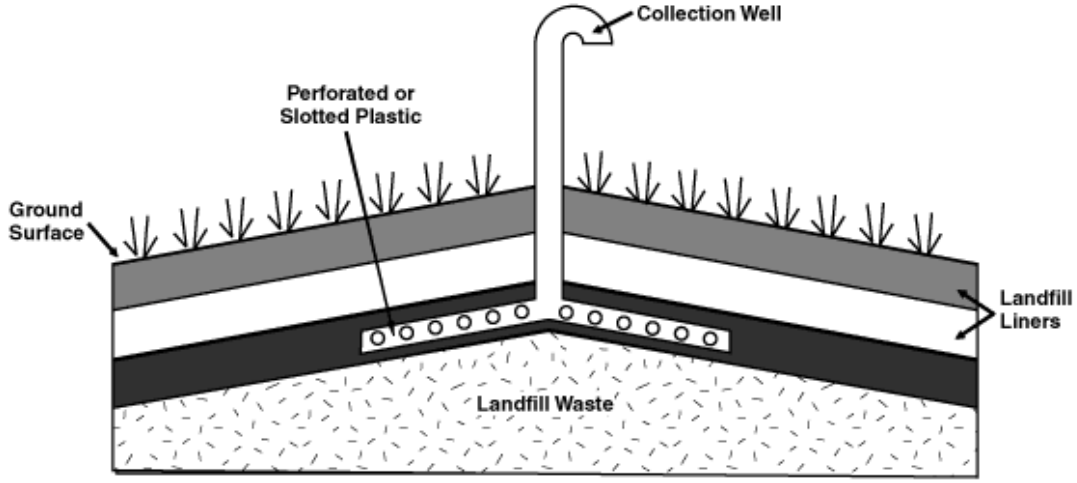
- No mechanical driving force is used
- System relies on **Pressure or Concentration Gradients** to function
- Necessary for **Geomembrane Cap** Systems

Passive LFG Management Systems

Passive LFG Management Systems

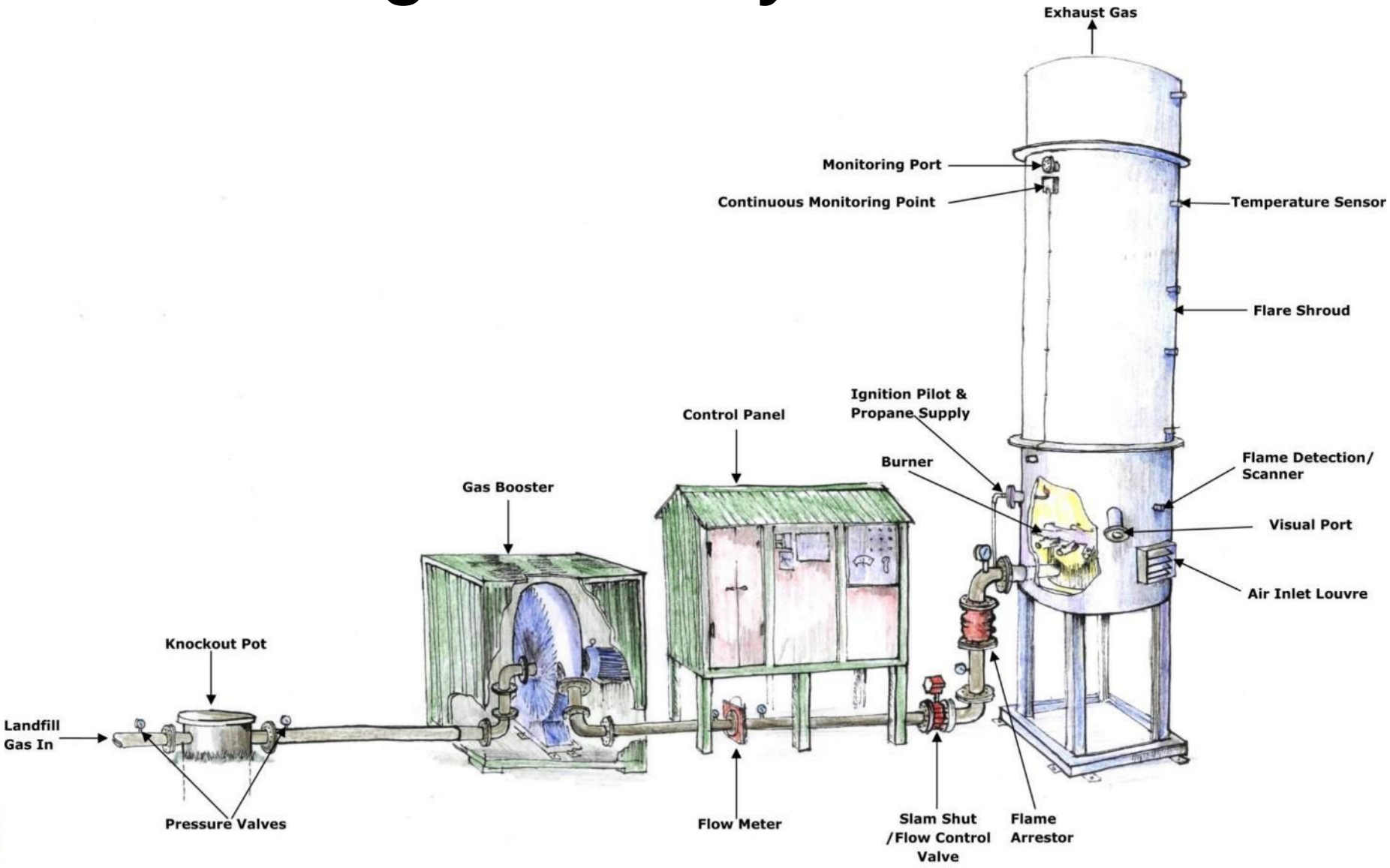


Passive LFG Management Systems



- Low capital cost (~ $20k per hectare (ha)) for collection and venting
- Low operation & Maintenance cost
- Positive pressures
- Gas collection inefficiencies
- Can include GHG reduction (Solar Flare or Bio-Filter) with ~50% efficiency @ an additional capital expenditure of $50k to $100k & operating expenses of $10k to $20k per year.

Active LFG Management Systems



Active LFG Management Systems

- System relies on **Mechanical Driving Force,**
- Blowers to create a **Vacuum** drawing LFG from LFG extraction wells through pipes,
- Aims to control LFG flow and odors and to collect LFG for **Utilization** or **GHG Reduction**.

Active LFG Management Systems

<u>For mid-size Landfills (15 to 30 ha)</u>

- Capital cost ~ $100k - $150k/ha (collection & flaring)
- Operation & maintenance cost ~ $10 - $15k/ha/yr
- GHG reduction approximately 75%

Thank you

Ali.abedini@ch4xe.com
www.CH4XE.com

Methane Expert Engineering Ltd.

Thank you!

Upcoming Webinar

Third virtual workshop in the Mobilizing Methane Action at Open Dumpsites and Landfills series

More details coming soon!

Final materials will be posted to:
www.globalmethane.org

Questions?
secretariat@globalmethane.org