EPA Biogas Tools Overview

EPA Lunch-and-Learn
4/8/2022

Tom Frankiewicz – Lead,
International Biogas Programs

Nick Elger – Program Manager,
AgSTAR & GMI

Global
Methane Initiative

Presentation Overview

- Introduction to EPA's Biogas Programs
- Overview of Biogas Tools
- Example Demonstration Using Multiple Tools
- Q & A ; Discussion

AgSTAR Program

PARTNERSHIP PROGRAM

Collaborative program sponsored by EPA and USDA.

Established in 1994

1 Mission

Advance adoption of livestock manure anaerobic digestion and alternative manure management practices to reduce, capture, and use methane.

2 Strong Ties

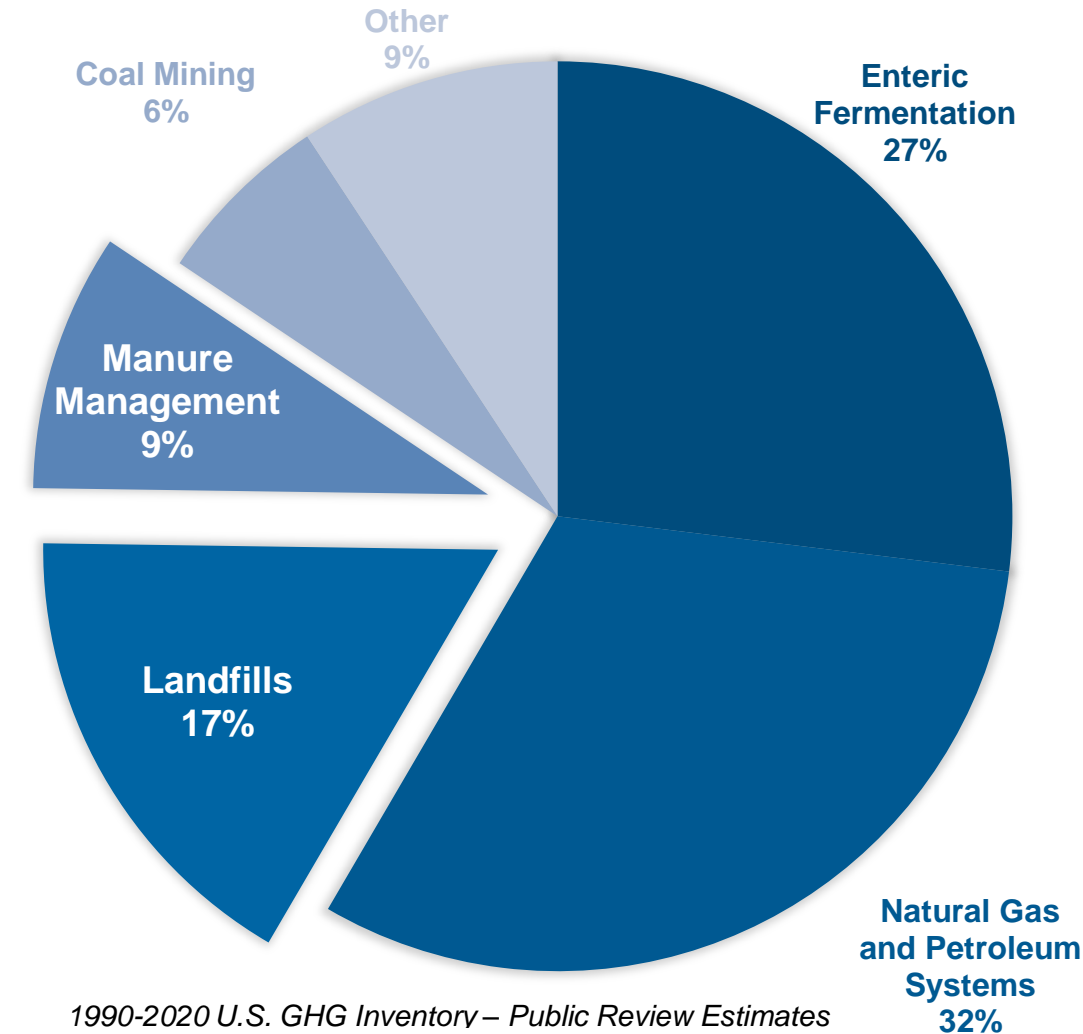Working with industry, government, NGOs and university stakeholders.

3 Helping Hand

Assisting those who enable, purchase, or implement farm anaerobic digestion projects.

Why EPA Is Concerned about Manure Management and Landfill Emissions

- Livestock (dairy, beef, swine, poultry) manure and landfills contribute 26% US methane emissions

- US methane emissions from livestock manure increased 71% between 1990 to 2020
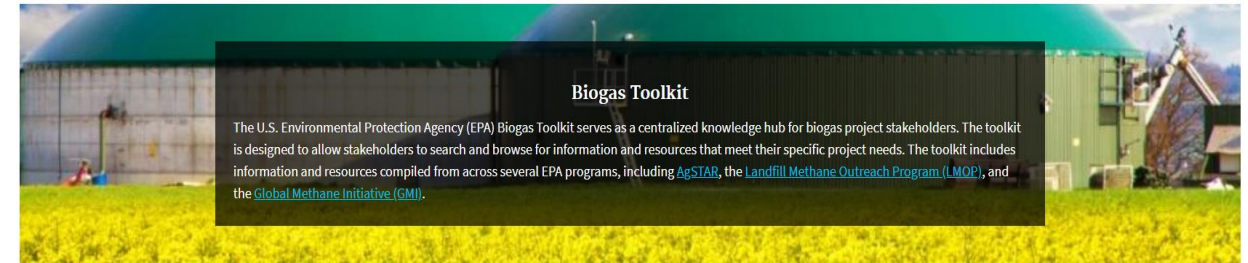
U.S. METHANE EMISSIONS 2020, BY SOURCE

Other 9%

Coal Mining 6%

Enteric Fermentation 27%

Manure Management 9%

Landfills 17%

Natural Gas and Petroleum Systems 32%

1990-2020 U.S. GHG Inventory – Public Review Estimates

Overview of EPA's Biogas Tools

EPA Biogas Toolkit

- A web-based toolkit with **38 tools and resources** to facilitate biogas project development.

- **Roadmap for planning and implementing biogas projects** and quantifying economic and environmental impacts

- **Audience:** Project implementers, developers, financiers, and policymakers.

Toolkit Highlights

- Usable by all knowledge levels

- Filter categories help users find exactly what they need

- Intended for U.S. and international audience

New GMI Biogas Tools

Anaerobic Digestion (AD) Screening Tool version 2.0
Estimates the quantity of biogas and digestate produced by AD systems and methane emissions reductions
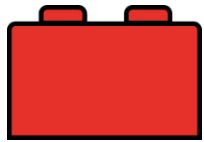
Organics Economics (OrganEcs) version 3.0
Estimates costs, revenues, and profitability with composting and AD projects

Solid Waste Emissions Estimation Tool (SWEET) version 4.0
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 Digester Screening Tool Overview

What is the Anaerobic Digestion Screening Tool?

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

- Primary audience:

  - Project proponents to understand the biogas potential of a proposed project

  - Lending institutions/banks to determine if a project application is feasible

Anaerobic Digestion Screening Tool

Version 2.0
October 2021

Developed by U.S. Environmental Protection Agency

Tool Support: biogastoolkit@epa.gov

Anaerobic Digestion Screening Tool Applications

- Project implementers can:

  - Estimate biogas and digestate production potential from a variety of feedstocks

  - Evaluate end uses like electricity, RNG, and cooking gas

  - Estimate emissions reductions

- Financial institutions can assess project viability and risks

- Project developers, analysts, local stakeholders can calculate emissions reductions to justify climate goals

AD Screening Tool Inputs and Outputs

Inputs*

Digester inputs (e.g., feedstock type & amount, AD system type)

Emissions inputs (e.g., baseline waste management practices, electricity consumption)

Outputs

Annual biogas production

Annual methane production

Annual digestate production

Estimated emissions reductions

Potential end uses for biogas
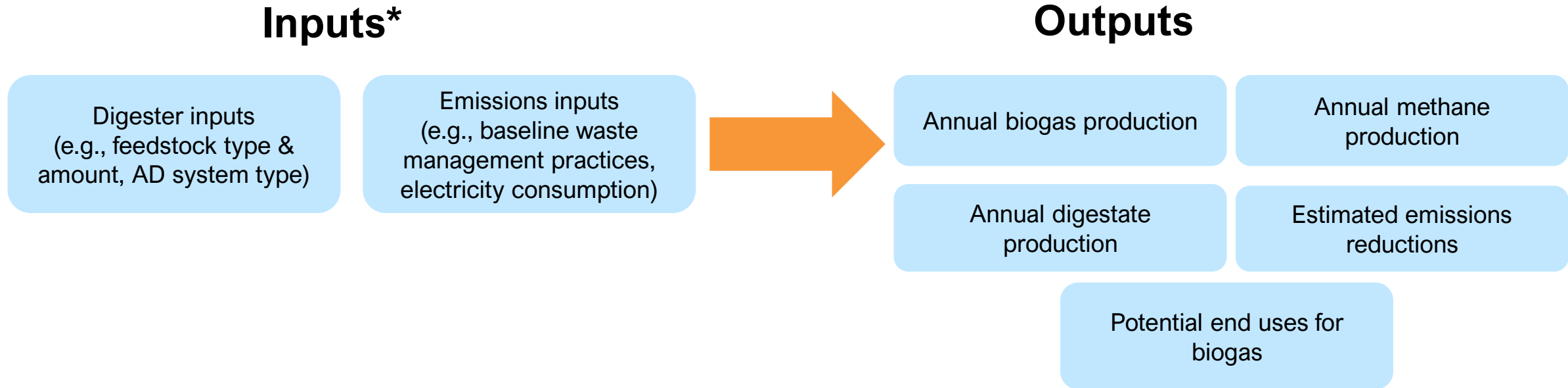
AD Screening Tool provides default values for various inputs, which can be updated by the user

OrganEcs Overview

What is the Organics Economics (OrganEcs) tool?

- Two Excel-based tools to estimate the financials of organic waste management projects:
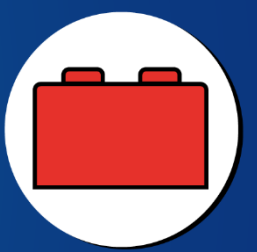 - Composting
  - Anaerobic digestion
- Primary audience:
  - Local governments
  - Waste professionals
  - Policymakers
  - Facility operators
  - Project developers

OrganEcs – Anaerobic Digestion

Version 3.0
December 2021

Developed by U.S. Environmental Protection Agency

Lead, International Biogas Programs: Tom Frankiewicz | Frankiewicz.Thomas@epa.gov
Tool Support: biogastoolkit@epa.gov

EPA United States Environmental Protection Agency

Global Methane Initiative

OrganEcs – Compost

Version 3.0
December 2021

Developed by U.S. Environmental Protection Agency

Lead, International Biogas Programs: Tom Frankiewicz | Frankiewicz.Thomas@epa.gov
Tool Support: biogastoolkit@epa.gov

EPA United States Environmental Protection Agency

Global Methane Initiative

OrganEcs Applications

- Evaluate economic feasibility of a proposed composting or anaerobic digestion project

- Evaluate effect of gate or tipping fees on project profitability

- Evaluate optimal financial management of an organics project

- Estimate project net present value or internal rate of return

- Evaluate financial sustainability of existing composting or AD projects

POLICY REPORT:
HIGH-LEVEL PRE-FEASIBILITY STUDY AND IMPLEMENTATION PLAN FOR AN ORGANIC WASTE TREATMENT PROJECT IN THE MUNICIPALITY OF QUITO

Technical Assistance Financed by the Municipal Solid Waste Initiative of the Climate and Clean Air Coalition

CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

CCAP
CENTER FOR CLEAN AIR POLICY

JUNE 2018   Dialogue. Insight.

Global Methane Initiative

PRE-FEASIBILITY STUDY
Scaling Up the Novi Sad, Serbia Composting Project to Treat Organic Waste from the South Bačka Waste Management Region

DRAFT
27 September 2021

OrganEcs Inputs and Outputs

Inputs*

Facility inputs

Waste inputs

Economic inputs

Outputs

Capital investment costs

Operations & maintenance costs

Total annual biogas and digestate, or compost production

Total revenues (e.g., compost sales, net electricity from AD system)

Profitability (internal rate of return)
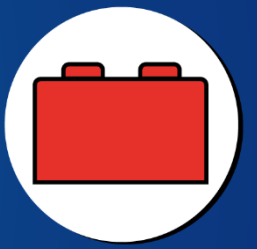
*OrganEcs provides default values for various inputs, which can be updated by the user
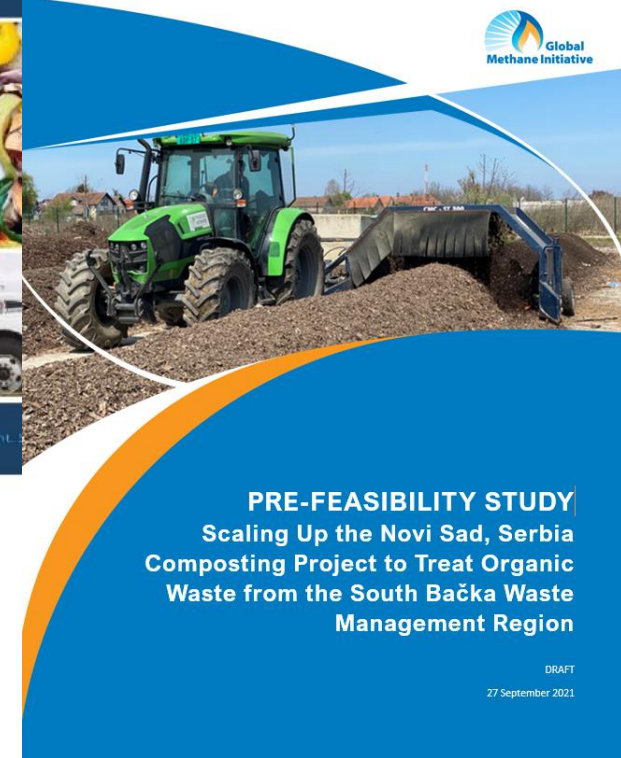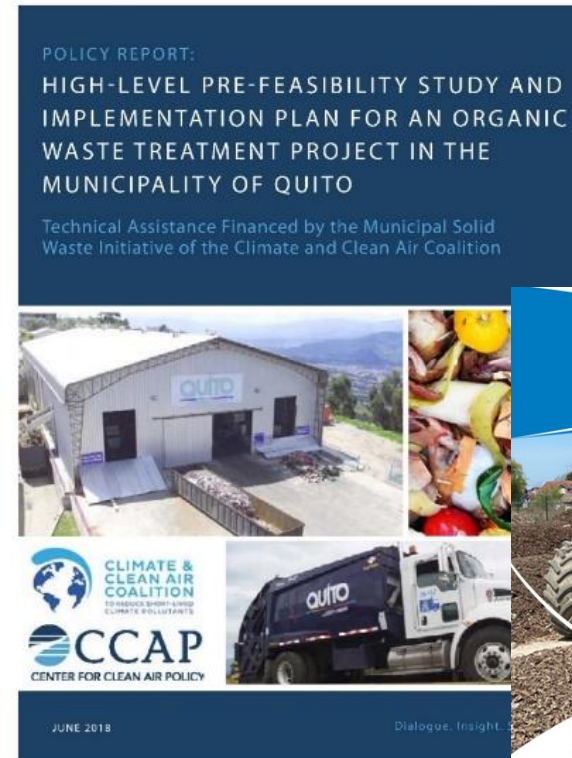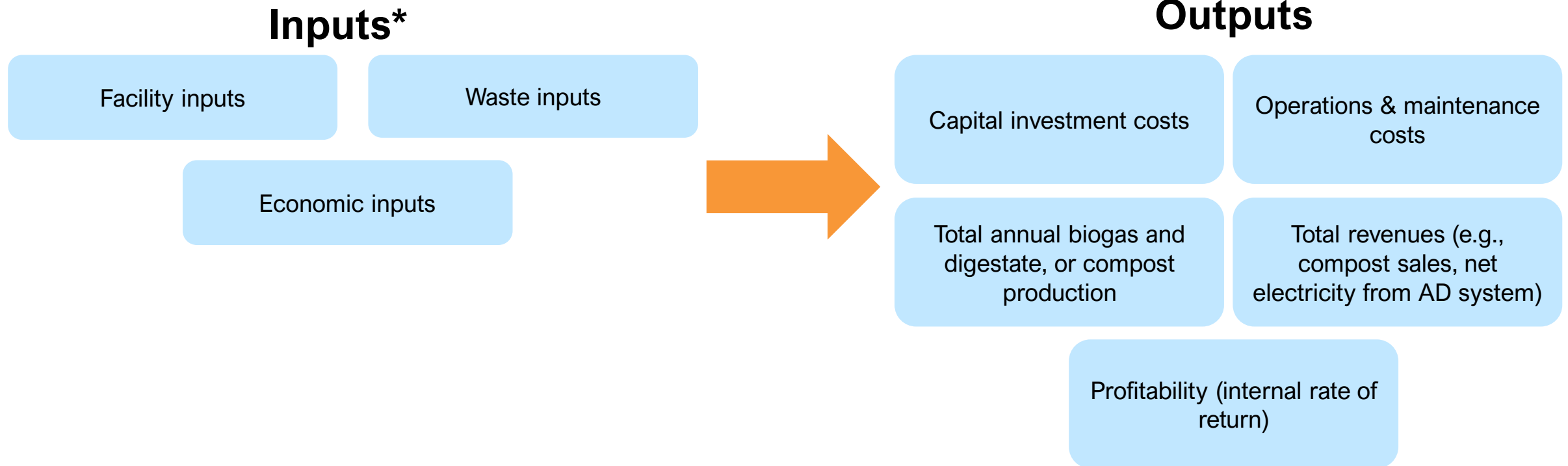
SWEET Overview

What is the Solid Waste Emissions Estimation Tool (SWEET)?

- Excel-based tool for quantifying pollutant emissions from sources across the waste sector

  - Project-, source-, or system-level emissions estimates

  - Methane, black carbon, PM, and other pollutants

- Increasing usage among audience

  - Used in 50+ cities to date

  - Adopted by the International Solid Waste Association's Closing Dumpsites campaign

  - Incorporated into the United Nation's Habitat's Waste Wise Cities Tool

  - Used by World Health Organization as part of Urban Health Initiative

Solid Waste Emissions Estimation Tool
Version 4.0
December 2021

Developed by U.S. Environmental Protection Agency

Lead, International Biogas Programs: Tom Frankiewicz | Frankiewicz.Thomas@epa.gov
Tool Support: biogastoolkit@epa.gov

EPA United States Environmental Protection Agency   SWEET SOLID WASTE EMISSIONS ESTIMATION TOOL   Global Methane Initiative

Example SWEET Applications

- Creating municipal GHG inventories
- Establishing emissions baselines
- Comparing policy and project choices for handling municipal waste
- Justifying waste management projects for grant funding or financing
- Supporting quantification of public health impacts of waste management choices
- Measuring, reporting, and verification of emissions reductions

Solid waste management and health in Accra, Ghana

Pierpaolo Mudu
Betty Akua Nartey
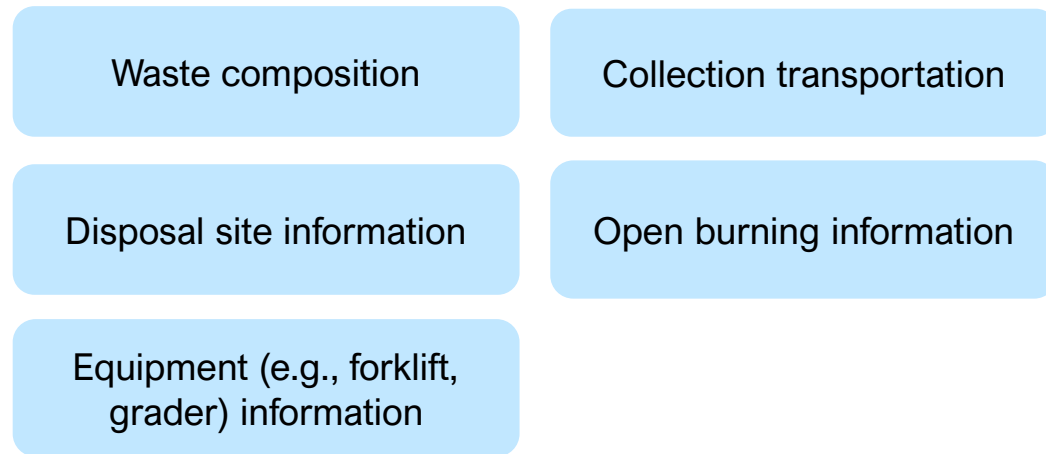Gina Kanhai
Joseph V. Spadaro
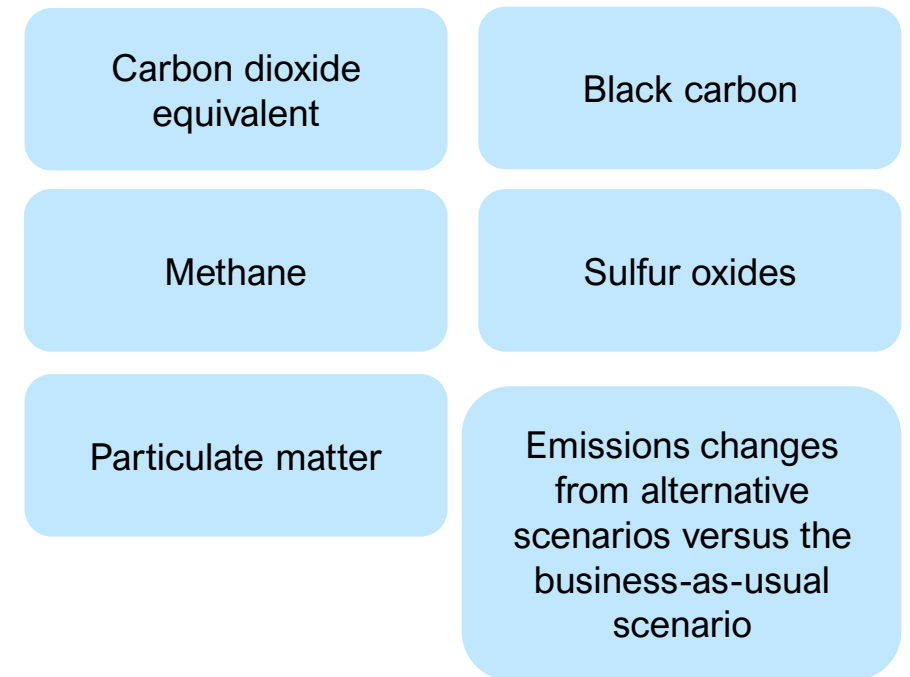Julius Fobil

WHO URBAN HEALTH INITIATIVE

SWEET Inputs and Outputs

Inputs*

Waste composition

Collection transportation

Disposal site information

Open burning information

Equipment (e.g., forklift, grader) information

Outputs

Carbon dioxide equivalent

Black carbon

Methane

Sulfur oxides

Particulate matter

Emissions changes from alternative scenarios versus the business-as-usual scenario

*SWEET provides default values for various inputs, which can be updated by the user

Landfill Gas Screening Tool Overview

What is the Landfill Gas Screening Tool?

- Excel based screening tool to assess potential feasibility of landfill gas (LFG) to energy projects
  - Estimates LFG recovery rate
  - Provides potential project type and size
- Primary audience:
  - Landfill/dumpsite operators
  - Project developers

Landfill Gas Screening Tool

December 2021

Developed by U.S. Environmental Protection Agency

Lead, International Biogas Programs: Tom Frankiewicz | Frankiewicz.Thomas@epa.gov
Tool Support: biogastoolkit@epa.gov

EPA United States Environmental Protection Agency

Global Methane Initiative

LFG Screening Tool Applications

- Generate preliminary estimate of how much landfill gas (LFG) a site could collect

- Determine whether biogas production is likely sufficient to support a modest-sized landfill gas to energy project

- Determine what type of landfill gas to energy project would be most

Source: Waste Management

LFG Screening Tool Inputs and Outputs

Inputs

Opening Year of Disposal Site

Annual Disposal Rate (Metric Tons/Year)

Landfill Category (I.e., dump site, controlled dump site/landfill, sanitary landfill)

Closing Year of Site (Actual or Projected)

Climate

Outputs

Estimated LFG Recovery Rate (m^3/h)

Feasible Project Types, based on LFG Recovery Rate

Feasible Project Sizes, Based on LFG Recovery Rate

BioWATT (Biogas Wastewater Assessment Tool)

- Provides a quick and preliminary assessment of wastewater-to-energy projects.
  - Biogas production estimate for various wastewater-to-energy technologies
  - Electricity generation potential from the produced biogas
  - GHG savings associated with biogas-generated electricity
  - Preliminary assessment of the WWTP's electricity demand that can be met through biogas-generated electricity
  - Preliminary design parameters of major components of a wastewater-to-energy project, such as required digester volume, required gas holder volume, and total combined heat and power (CHP) electric power output

  https://www.globalmethane.org/tools-resources/resource_details.aspx?r=1913

Multi-Tool Project Examples

Ex. 1: Anaerobic digestion project pre-feasibility study

- **Challenge**: A farmer in a rural community would like to build an AD system to manage cow manure and potentially food waste to produce energy.

- **Proposed solution**: Available livestock manure and food waste from a local producer could be used for AD system. Biogas from the AD system will be used to heat barns and produce electricity.

- Analysis:

  - AD Screening Tool: plug in available feedstocks to identify biogas and digestate generation potential

  - OrganEcs: plug in outputs from AD Screening Tool into OrganEcs to determine financial feasibility of AD project

AD Screening Tool

Copy outputs from AD Screening Tool into **OrganEcs - AD**
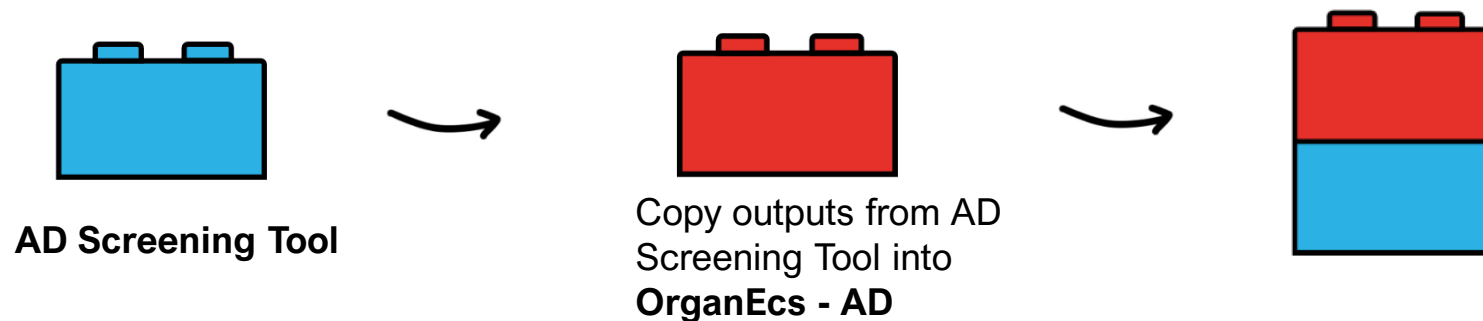
# Ex. 1: Anaerobic digestion project pre-feasibility study

- **AD Screening Tool inputs:**
  - Feedstock type (cow manure, food waste)
  - Feedstock amount (kg/day)

- **AD Screening Tool outputs:**
  - Biogas production: 75 m^3/day
  - Digestate production: 2,446 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	10,940	19,934	27,292	m3/year
Annual Methane Production	5,459	9,947	13,618	m3/year
Digestate Production		**Value**		**Unit**
Total Non- Biodegradable Solids		23,004		kg/year
Remaining Volatile Solids		75,947		kg/year
Digester Solids		892,826		kg/year
Dry Sludge		803,544		kg/year
Liquid Effluent		89,283		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 m3/year natural gas, but is capable of producing either X kWh of electricity hours or Y m3/year of natural gas).		**Value**		**Unit**
Electricity Production (cleaned biogas to natural gas quality)		52		MWh
Electricity Production (biogas only)		35		MWh
Renewable Natural Gas (RNG) Production		5,459		m3/year
Cooking Gas Potential		100		homes/year
Home Heating Potential		75		homes/year

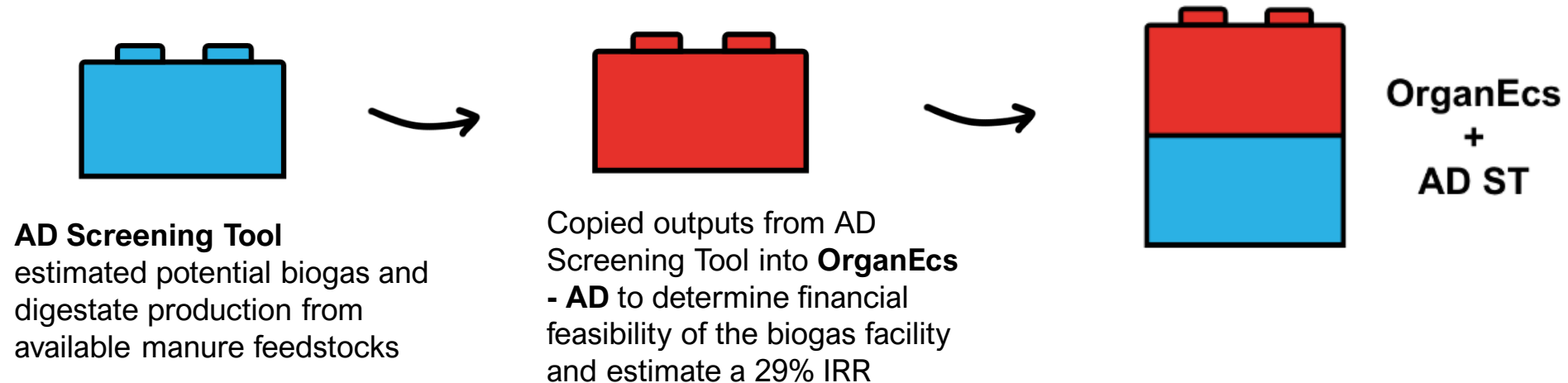# Ex. 1: Anaerobic digestion project pre-feasibility study
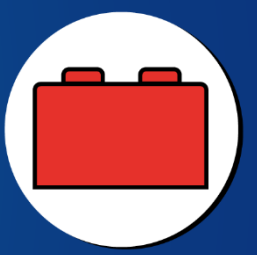
- **OrganEcs inputs:**
  - Facility specifications
  - Outputs from AD Screening Tool
  - Capital costs
  - O&M costs
  - Tipping fees, electricity sale price, digestate sale price
- **OrganEcs outputs:**
  - Total revenues
  - Total expenses
  - IRR

IRR: 29%

Legend: Total Revenues (USD/year), Total Expenses (USD/year)
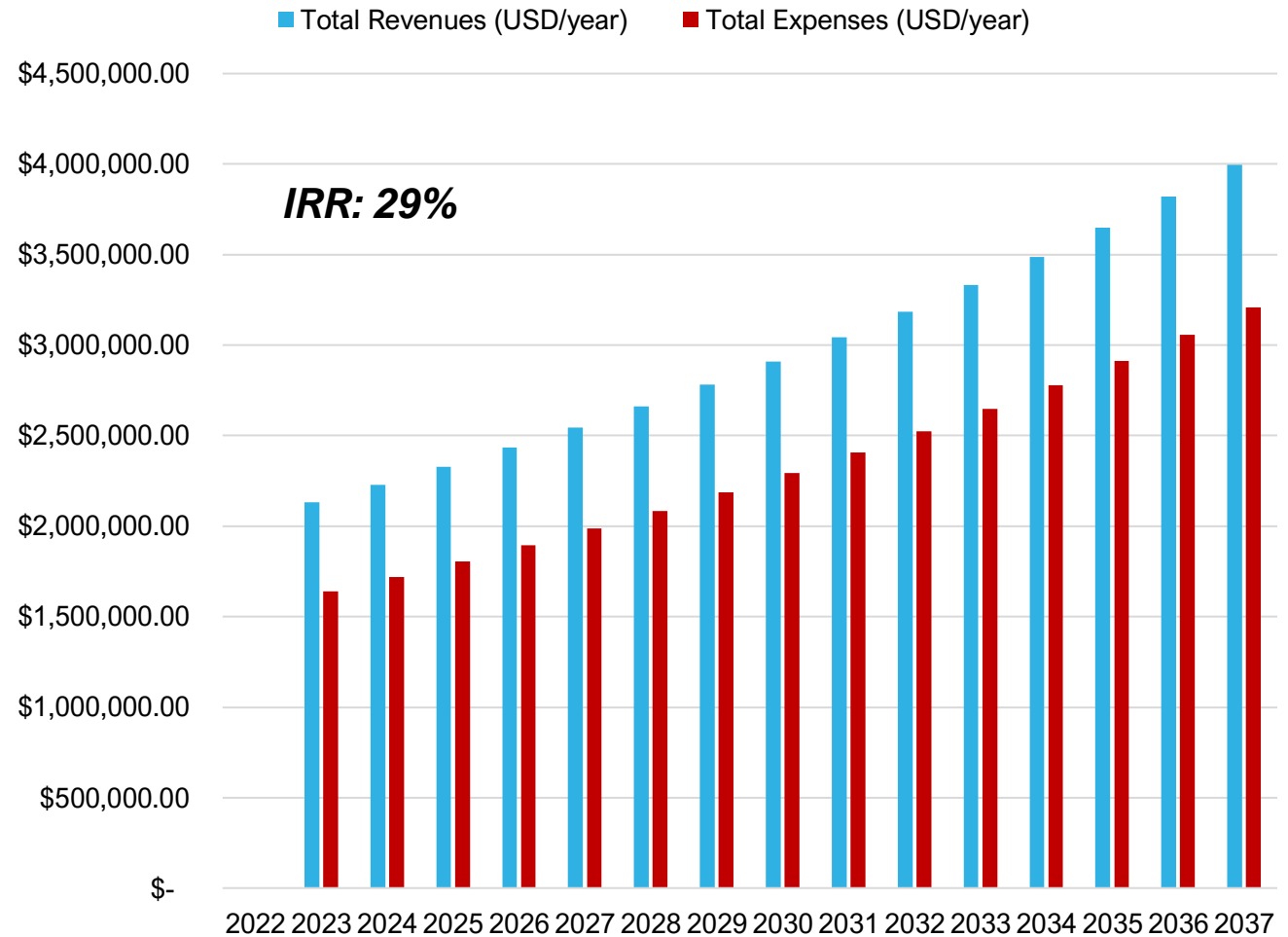
Ex. 1: Summary

- **Result:** Demonstrated a scenario that showed preliminary financial feasibility of AD system which will use manure and food waste to produce heat and electricity.

AD Screening Tool estimated potential biogas and digestate production from available manure feedstocks

Copied outputs from AD Screening Tool into **OrganEcs - AD** to determine financial feasibility of the biogas facility and estimate a 29% IRR

OrganEcs + AD ST

Various Ways Biogas Tools Can Work In Tandem

EXAMPLE 1

SWEET estimates baseline emissions from landfill gas to energy modification and anaerobic digestion projects → AD ST or LFG ST offers project pre-feasibility information → **AD ST or LFG ST + SWEET**

EXAMPLE 2

AD ST estimates biogas potential → Use AD ST results in OrganEcs to estimate financial feasibility → **OrganEcs + AD ST**

EXAMPLE 3

OrganEcs assess financial feasibility of various anaerobic digestion projects → SWEET estimate potential emissions reductions of the preferred project → **SWEET + OrganEcs**

EXAMPLE 4

SWEET estimates potential emissions of alternate scenarios → AD ST estimates biogas potential from a chosen anerobic digestion scenario → Use AD ST results in OrganEcs to estimate financial feasibility → **OrganEcs + AD ST + SWEET**

Additional Resources

- User Manuals
- Presentations
- Case Studies
- Webinars
- Fact Sheet
- Training Videos
  (in progress)

Examples of ways to use tools

- AgSTAR plans to train dairy cooperatives on tools and support farmers to run tools to analyze potential for AD systems

- LMOP plans to encourage partners to use them to see the benefits of diverting organics from landfills.

- GMI Biogas Team will conduct trainings on tools to international partners

  - We will also use these tools in practice for technical assistance to communities and organizations interested in analyzing environmental impacts and costs of various waste management options.

Q&A
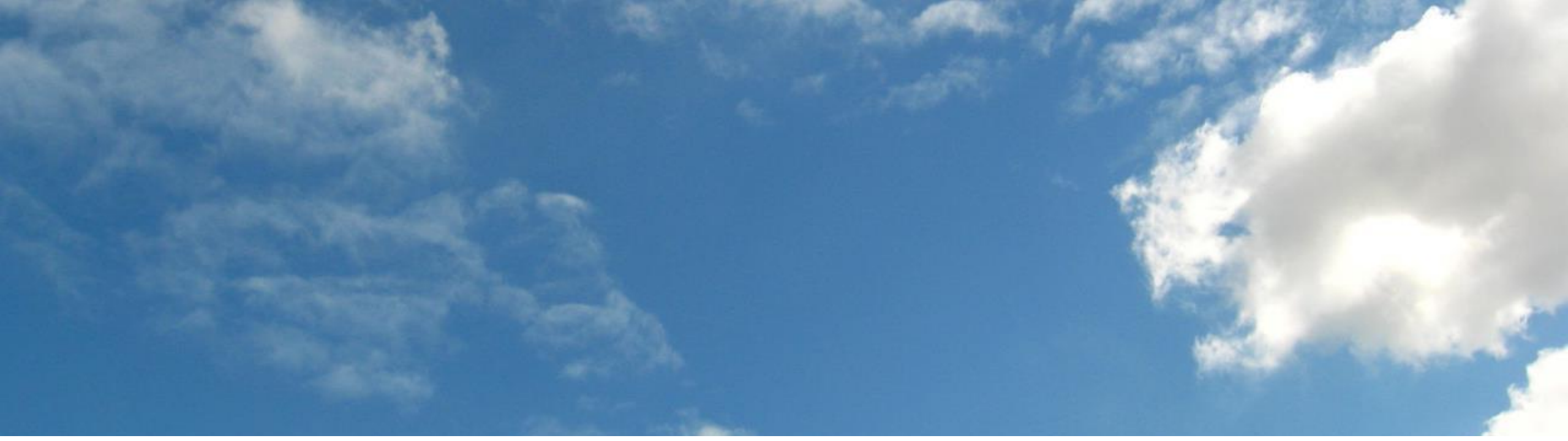
Thank you!

Additional Resources

- SWEET v4.0

  - Excel Tool and User Manual: www.globalmethane.org/sweet

  - Webinar: https://www.waste.ccacoalition.org/seminar/introduction-solid-waste-emissions-estimation-tool-sweet

  - Fact Sheet: https://drive.google.com/file/d/1A_3CNgL1mPjZnZYEuorTtxfsdJfkQV1r/view

- Anaerobic Digestion Screening Tool v2.0

  - Excel Tool: https://www.globalmethane.org/resources/details.aspx?resourceid=5170

  - User Manual: https://www.globalmethane.org/resources/details.aspx?resourceid=5174

- OrganEcs v3.0

  - Excel Tools and User Manual: www.globalmethane.org/organecs

- Landfill Gas Screening Tool v3.0

  - *Pending re-release*

- EPA Biogas Toolkit: https://www.epa.gov/agstar/biogas-toolkit