

EPA Biogas Tools Overview



EPA Lunch-and-Learn
4/8/2022

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AgSTAR & GMI



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.

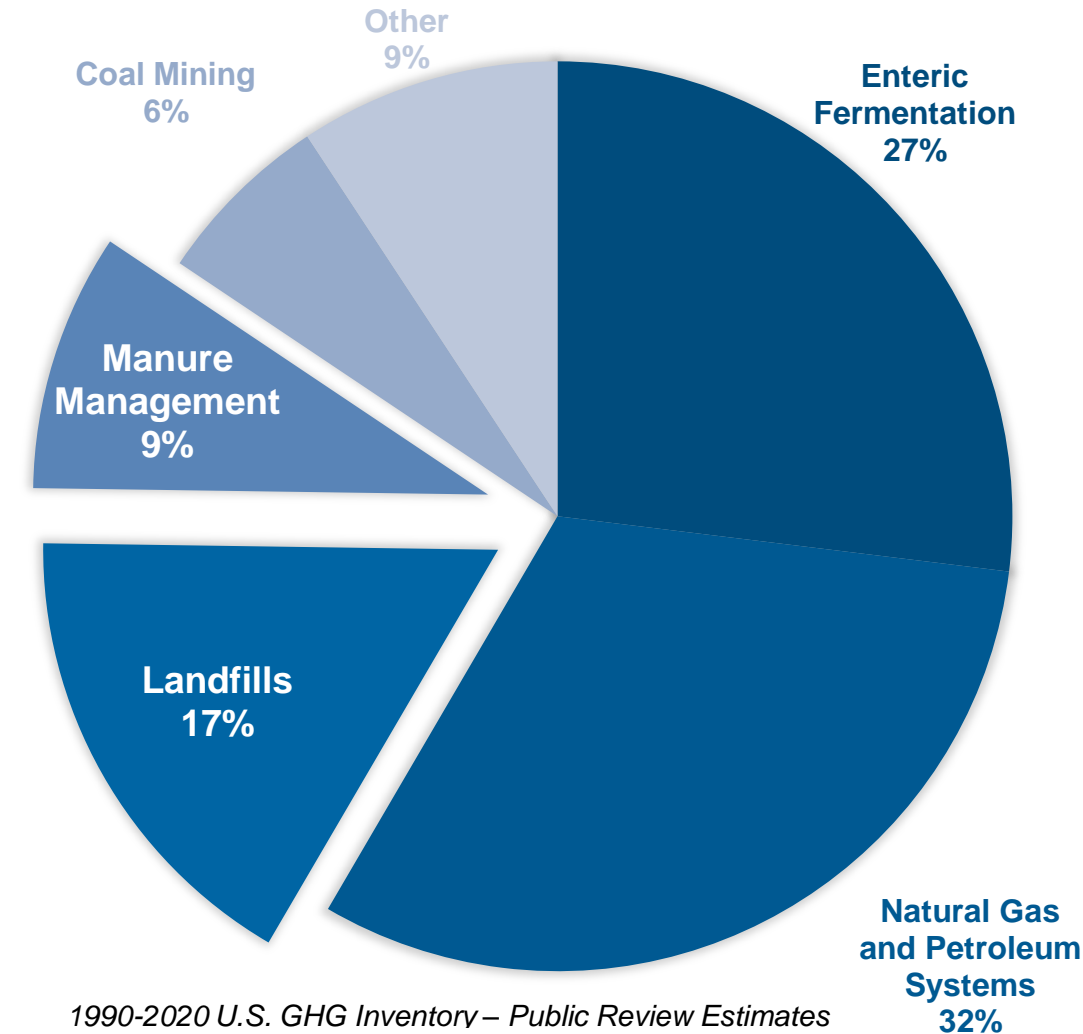
3 Helping Hand

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

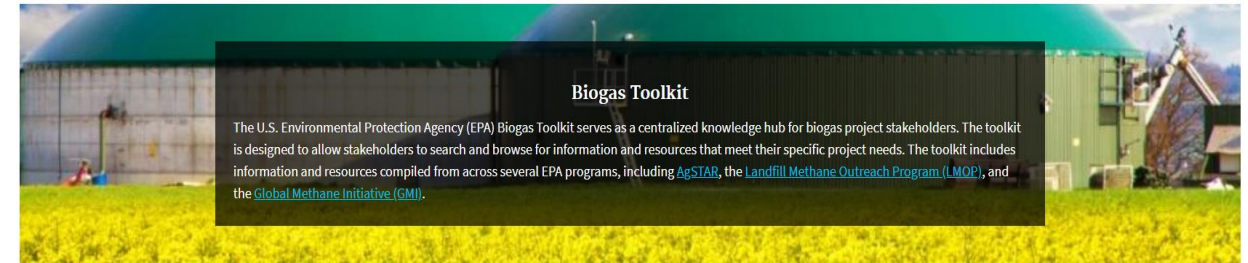


An aerial view of Earth from space, showing a coastline and a large body of water. The image is a composite of satellite imagery, showing a dark blue ocean, a lighter blue coastal area, and a brownish-green landmass. The Earth's curvature is visible at the top of the frame.

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.



Filters

Project Phase

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


Biogas Sector


- Agriculture
- Solid Waste
- Wastewater


Topic

- Engineering and Technology
- Finance

Displaying 38 of 38 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
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.
DOCUMENT

EPA Biogas Toolkit Makes It Easier to Develop Successful Projects

Toolkit Highlights

- Usable by all knowledge levels
- Filter categories help users find exactly what they need
- Intended for U.S. and international audience

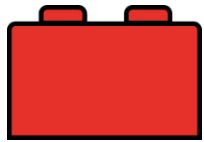
The screenshot displays the EPA Biogas Toolkit interface. On the left, a sidebar titled "Where do I start" contains a "Guided Search" button. Below it, a "Filters" section is visible, with a "Project Phase" category containing the following options: Getting Started, Pre-Feasibility, Feasibility Assessment, and Development and Construction. A modal window titled "Guided Search" is open, asking "Which of the following best describes your goals? (Check all that apply)". The options are: I am new to the topic of biogas and want basic information on biogas projects., I want to start a biogas project., and I am looking for technical resources for an existing biogas project. A "Next" button is located at the bottom of the modal. Below the modal, a "CHECKLIST" icon is shown next to a link titled "10 Keys to Digester Success". The text below the link reads: "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."

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

An aerial photograph of Earth from space, showing a coastline with a large bay and surrounding land. The ocean is a deep blue, and the land is a mix of green and brown. The curvature of the Earth is visible at the top of the frame.

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



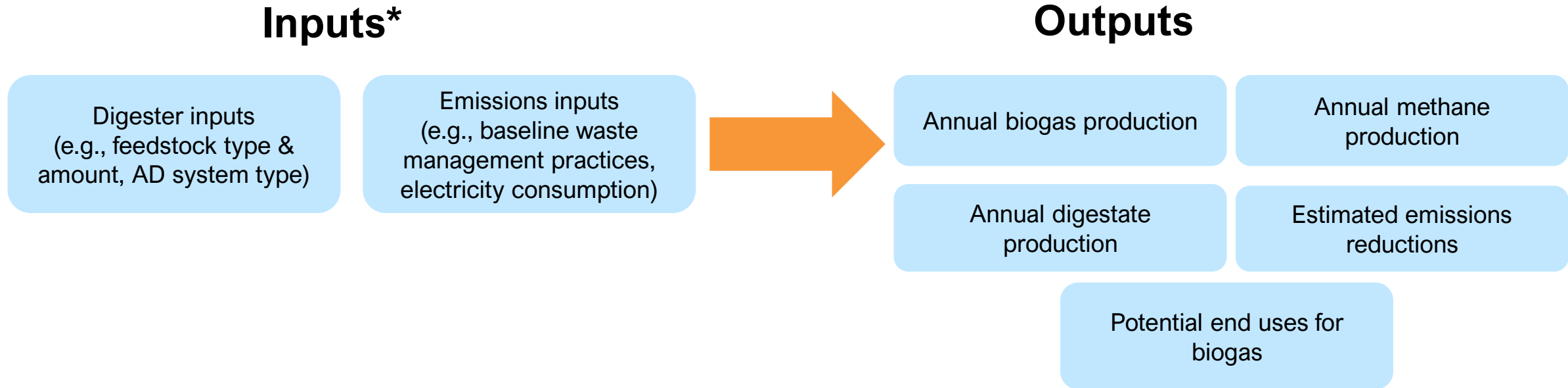
Anaerobic Digestion Screening Tool Applications



- 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

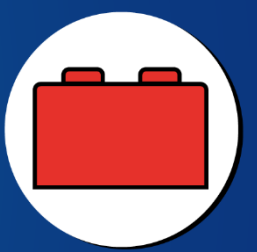


**AD Screening Tool provides default values for various inputs, which can be updated by the user*




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

 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

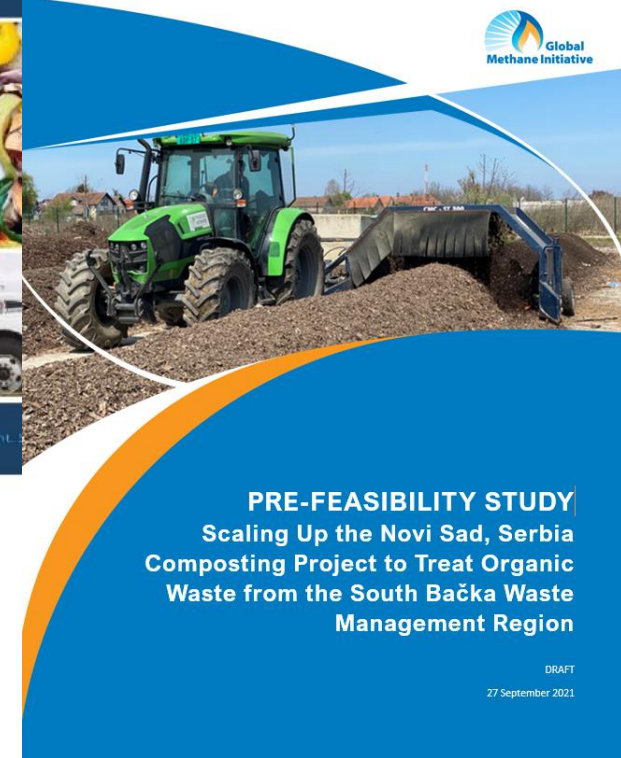
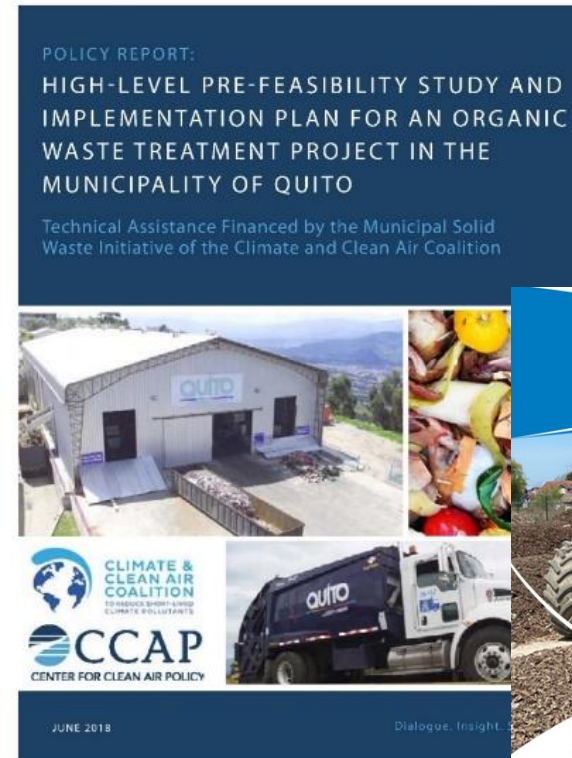
 United States Environmental Protection Agency

 Global Methane Initiative

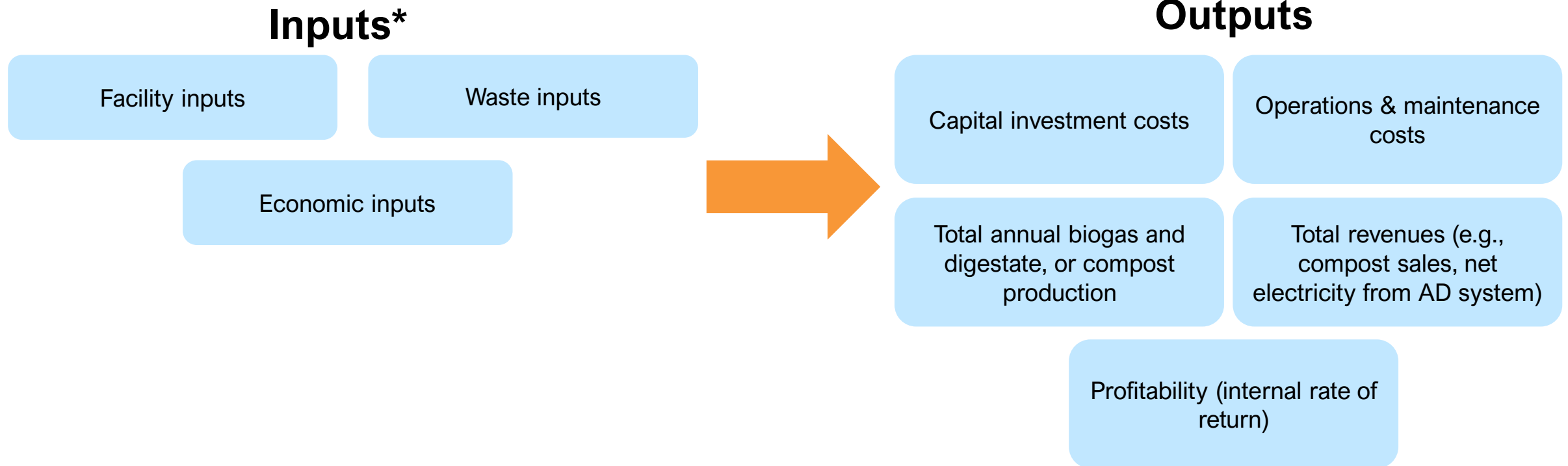
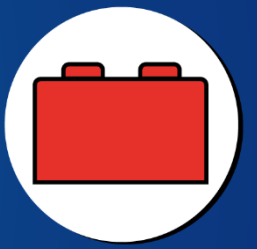
OrganEcs Applications




- 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



OrganEcs Inputs and Outputs



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

A satellite image of Earth's coastline, showing a large body of water and a complex network of rivers and estuaries. The image is framed by a dark blue border at the top and bottom. A white rectangular box is overlaid on the image, containing the text "SWEET Overview".

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
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 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

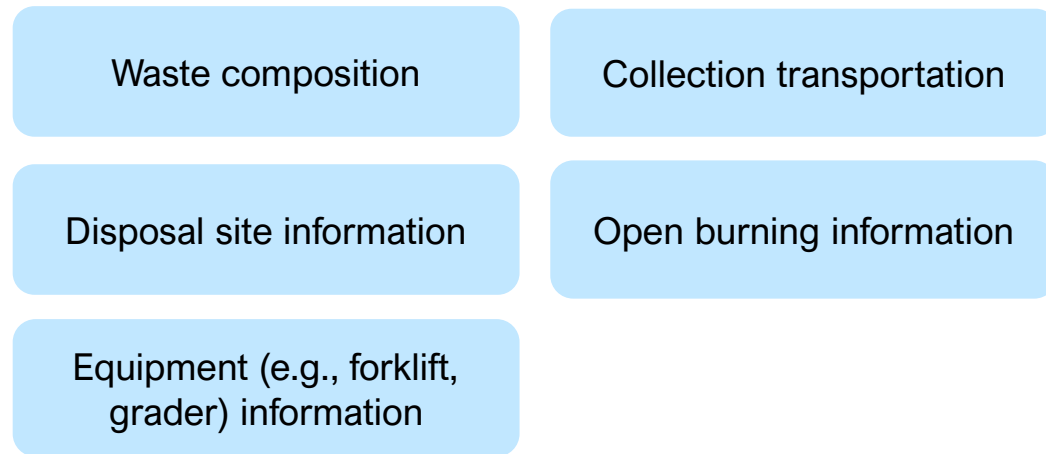
WHO URBAN HEALTH INITIATIVE



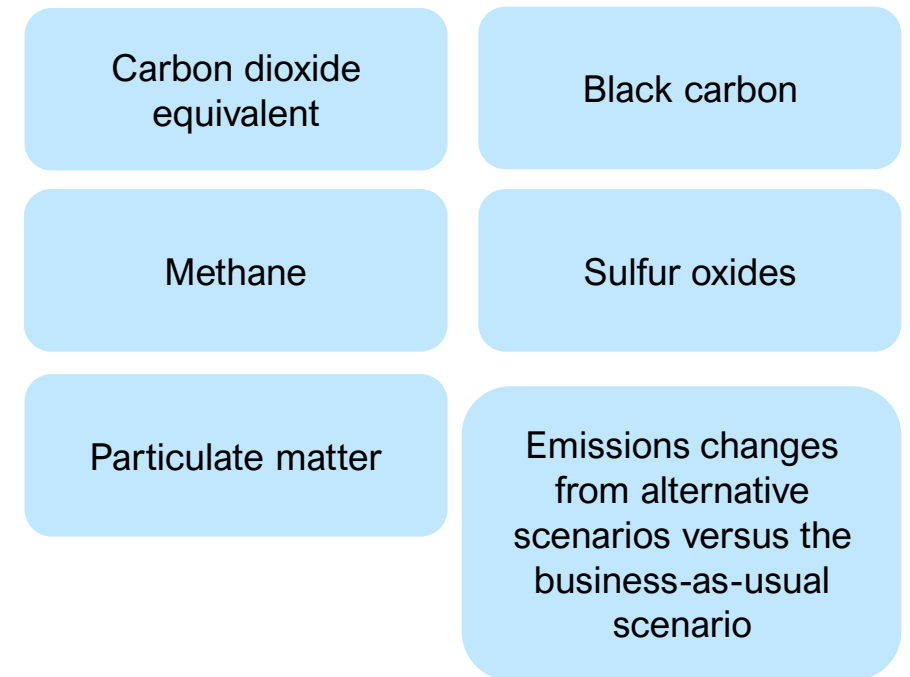
SWEET Inputs and Outputs



Inputs*



Outputs



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

An aerial photograph of a coastal region, likely a bay or estuary, showing a large body of water with a prominent inlet or channel. The surrounding land is a mix of green and brown, indicating a mix of vegetation and developed areas. The sky is blue with scattered white clouds. The image is framed by a dark blue border at the top and bottom.

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

Closing Year of Site (Actual or Projected)

Annual Disposal Rate (Metric Tons/Year)

Climate

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



Outputs

Estimated LFG Recovery Rate (m³/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

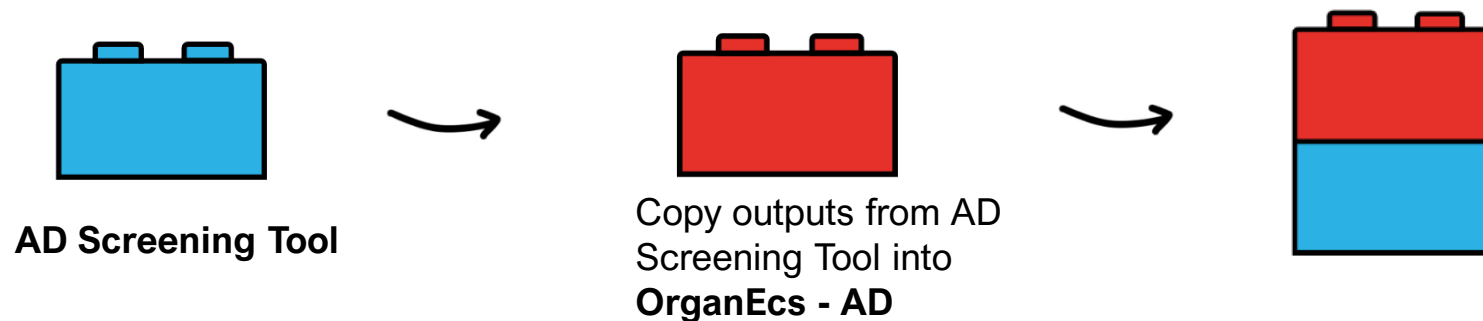
https://www.globalmethane.org/tools-resources/resource_details.aspx?r=1913

A satellite view of Earth from space, showing a curved horizon and a coastline. The ocean is a deep blue, and the land is a mix of green and brown. A white rectangular box is overlaid on the image, containing the text "Multi-Tool Project Examples".

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



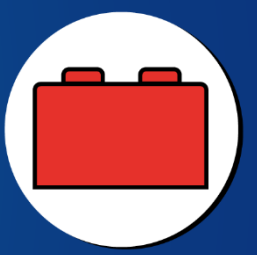
Ex. 1: Anaerobic digestion project pre-feasibility study



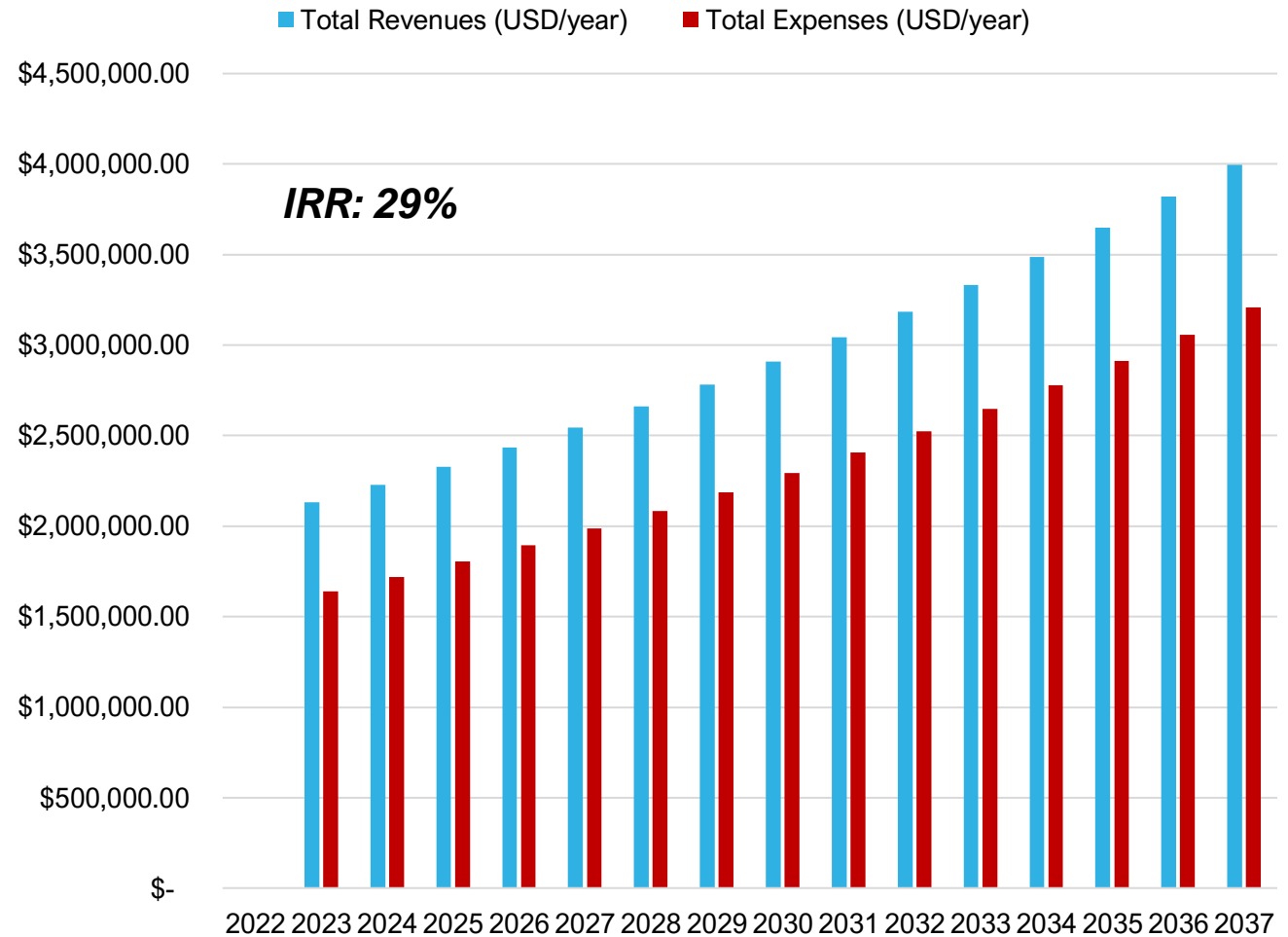
- AD Screening Tool inputs:
 - Feedstock type (cow manure, food waste)
 - Feedstock amount (kg/day)
- AD Screening Tool outputs:
 - Biogas production: 75 m³/day
 - Digestate production: 2,446 kg/day

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	m ³ /year
Annual Methane Production	5,459	9,947	13,618	m ³ /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 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)	52			MWh
Electricity Production (biogas only)	35			MWh
Renewable Natural Gas (RNG) Production	5,459			m ³ /year
Cooking Gas Potential	100			homes/year
Home Heating Potential	75			homes/year

Ex. 1: Anaerobic digestion project pre-feasibility study

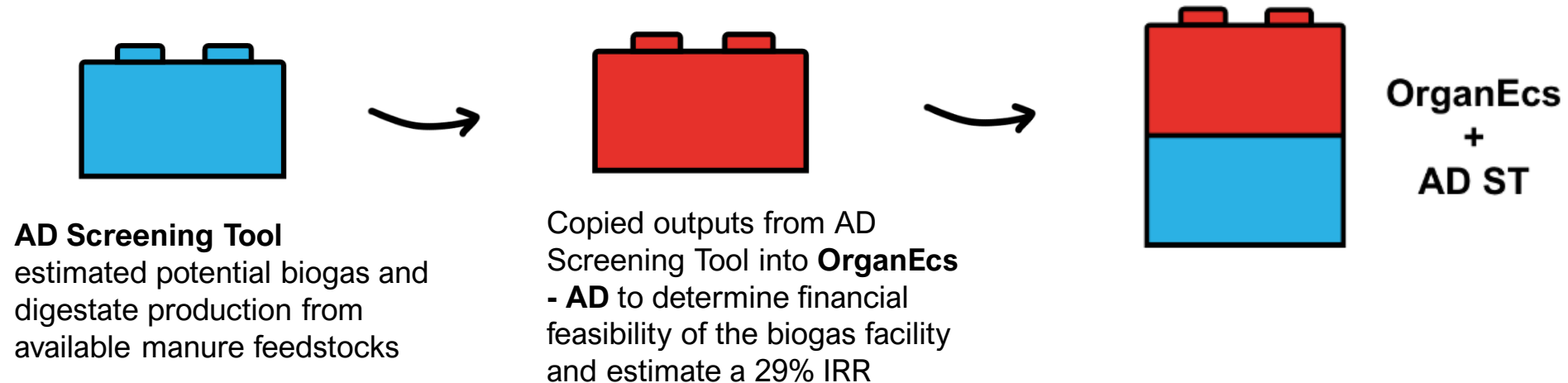


- OrganEcs inputs:
 - Facility specifications
 - Outputs from AD Screening Tool
 - Capital costs
 - O&M costs
 - Tipping fees, electricity sale price, digestate sale price
- OrganEcs outputs:
 - Total revenues
 - Total expenses
 - IRR



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.



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 anaerobic 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)



SWEET
SOLID WASTE EMISSIONS ESTIMATION TOOL

Estimating short-lived climate pollutants from municipal solid waste in Tyre Caza, Lebanon

Background
Tyre Caza is a coastal district of Lebanon that includes the historic city of Tyre and provides solid waste collection services for 400,000 people. In 2015, Lebanon had a waste management crisis with no waste pickup services after the closure of a large landfill for 8 months. Currently, the national government is operating under a temporary waste management plan since no new plan has officially been adopted. As of 2020, Lebanon has landfills, but the district of Tyre Caza does not. Tyre Caza uses dump sites and open burning as its core waste management strategy. About 80% of waste in the district was disposed in dump sites as of 2018.

The International Solid Waste Association (ISWA) used data from Lebanon's Ministry of Environment and Office of the Minister of State for Administrative Reform (OMSAR) surveys in 2005, 2011-2016, and 2018 to develop inputs for the Solid Waste Emissions Estimation Tool (SWEET). SWEET was developed by the U.S. Environmental Protection Agency under the auspices of the Global Methane Initiative. ISWA used SWEET to estimate short-lived climate pollutants from municipal solid waste in Tyre Caza for business-as-usual and four alternative policy options. The alternative scenarios are based on proposals from OMSAR.

Baseline
The ISWA study authors calculated current waste composition from a 2018 OMSAR report and historic waste volumes based on data about a large dumpsite from a 2017 OMSAR proposal on dumpsite closures. The business-as-usual (or baseline) scenario considers the disposal of 100 thousand metric tons of municipal solid waste separated into recycling, composting, burning, and disposing in dump sites. The baseline scenario also assumes the government will construct a landfill in the next decade.

Alternative Scenarios
The four alternative scenarios build upon the baseline with measures such as conversion of uncontrolled dumpsites to controlled dumpsites, covering and closing dumpsites, reducing and eliminating waste burning, and capturing and combusting landfill gas from the new sanitary landfill. The authors added each scenario into SWEET with the start year and percent changes to waste burning.

Modeled Results
In 2050, three of the alternative scenarios would produce less than half of the amount of CO₂e emissions projected for 2050 in the baseline scenario. Comparing the SWEET results, the authors find that the largest emissions reductions come from the combination of closing and remediating dumpsites, ending waste burning, and building a sanitary landfill to receive all waste disposal.

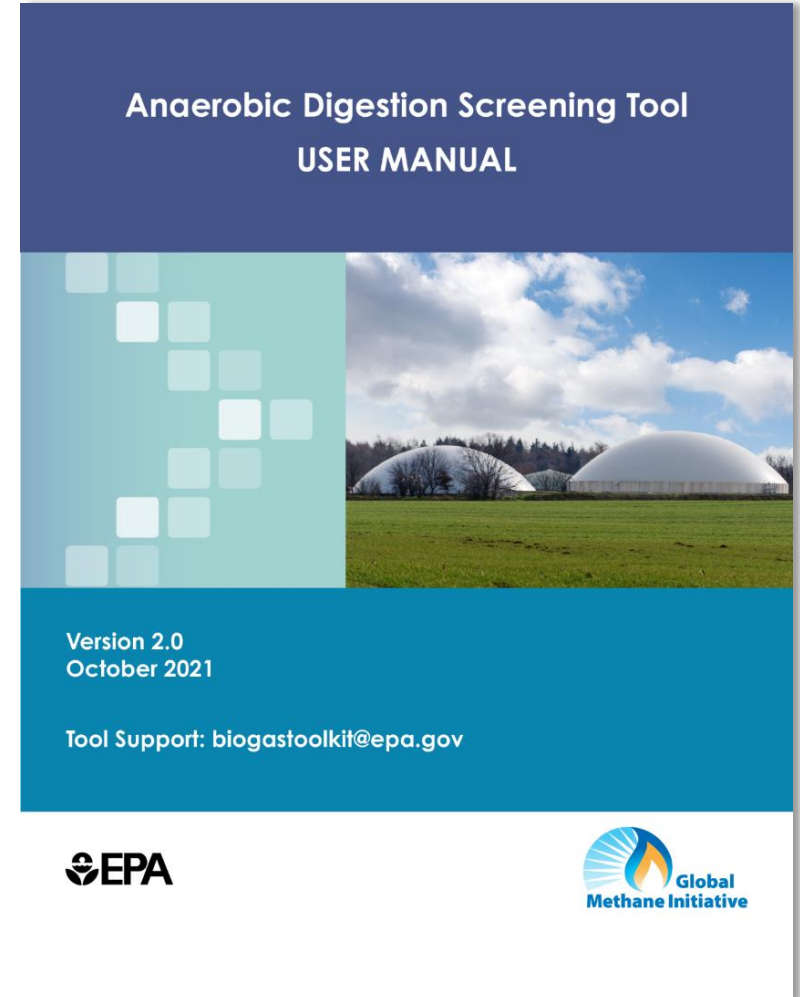
Using the Results
ISWA recommended that Tyre Caza conduct feasibility studies as a next step before choosing a solid waste management program. SWEET was used as a preliminary scoping strategy to focus on specific policy measures that could improve public health and reduce greenhouse gas emissions.

Source: ISWA and Karim Hashash of OMSAR.

For more information, see the report "Estimation of Waste Sector Greenhouse Gas Emissions in Tyre Caza, Lebanon, Using the Solid Waste Emissions Estimation Tool" (2020) from the International Solid Waste Association.

Global Methane Initiative

Launched in 2004, the Global Methane Initiative (GMI) is an international public-private initiative that advances cost-effective, near-term methane abatement and recovery and use of methane as a clean energy source.



Anaerobic Digestion Screening Tool USER MANUAL

Version 2.0
October 2021

Tool Support: biogastoolkit@epa.gov

EPA

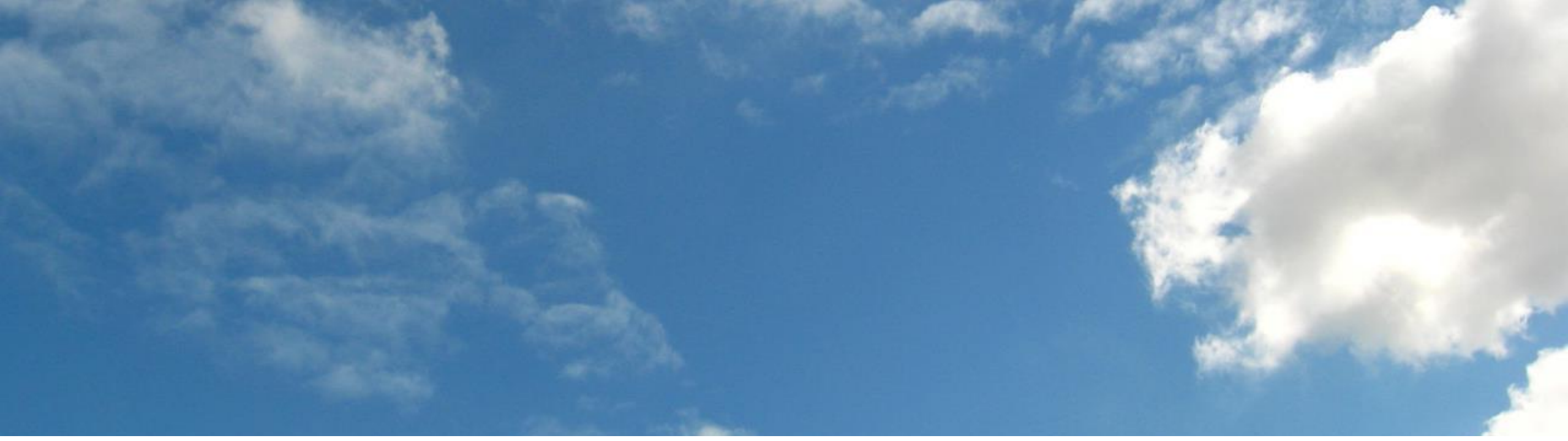
Global Methane Initiative

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.

A satellite view of Earth from space, showing the curvature of the planet and the blue oceans. A white rectangular box is centered on the image, containing the text "Q&A".

Q&A



Thank you!

Additional Resources

- SWEET v4.0
 - Excel Tool and User Manual: www.globalemethane.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>